ASSESSING THE ECOLOGICALLY SUSTAINABLE MANAGEMENT OF THE NORTHERN TERRITORY TREPANG FISHERY

A report prepared for the Department of the Environment and Heritage as required for assessment under Part 13A of the *Environment Protection and Biodiversity Conservation Act (1999)*

September 2003

APPLICATION TO THE DEPARTMENT OF THE ENVIRONMENT AND HERITAGE FOR THE NORTHERN TERRITORY TREPANG FISHERY

Against the Guidelines for the Ecologically Sustainable Management of Fisheries

For Listing on Section 303DB of the *Environmental Protection and Biodiversity Conservation Act 1999*

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Executive Summary

The Northern Territory (NT) Trepang Fishery is a hand harvest fishery that takes Holothurian species in coastal waters of the NT. The terms trepang, sea cucumber or Bêche-de-mer are often used interchangeably to refer to Holothurians, although "trepang" actually refers to the high valued dried body wall of the sea cucumber. This product is considered a delicacy in many Asian cuisines with nearly all NT product destined for export markets.

Management of the fishery is achieved under the *Northern Territory Fisheries Act 1988*[1] with harvest controlled through a range of input controls and minimum size limits. The fishery operates within waters from highwater to an imaginary line that extends three nautical miles from the baselines. The NT also has jurisdictional responsibility for trepang to the outer limit of the Australian Fishing Zone (AFZ).

The history of trepang fishing itself is possibly over 1000 years old with Macassan fishermen, from SE Asia, fishing in NT waters for at least 150 years and possibly since the 1600's. As such it was probably Australia's first export industry. Foreign catches from northern Australia, including NT waters, from the 1770's to the late 1800's, may have averaged 3000 tonnes/year wet weight with Government records from 1882 to 1904 showing that NT catches averaged at least 1000t wet weight per year during that period.

In the early 20th century the fishery went in to a significant decline in response to Government policy limiting resource access to foreign fishers and the impacts of conflicts in Asia.

Due to renewed interest, the NT fishery was re-established in 1992. The NT Fisheries Group has adopted a precautionary and conservative approach to managing the fishery since its reinception. The management arrangements aim to reduce the risk of uncertainties by limiting the total number of licences available, fishing capacity, permitted methods and protecting adequate numbers of breeding stock. The adoption of such a strategy aims to ensure there is a high probability of the fishery not exceeding sustainable harvest levels, acknowledging that historical limits were a significant magnitude higher than current catch.

Sandfish (*Holothuria scabra*) is the target species with catches over the last six years averaging around 140 tonnes wet weight. The fishery is in a developmental phase with catches well below the long term historical catch rates (principally of sandfish) from periods when the fishery was heavily fished around the turn of the 20th century.

The commercial fishery is monitored through daily logbooks which are building a valuable record of catch and effort data that can be used to assess the health of the fishery through a number of indicators. The data provided in these logbooks is considered accurate and provides a sound estimate of removal by this sector.

The recently completed National Recreational and Indigenous Fishing Survey recorded no harvest of trepang from the recreational and indigenous sectors. This implies that catches from these two sectors are most likely negligible.

The status of the fishery is assessed through completion of the Annual Status Report and at the annual Northern Australian Fisheries Management Workshop. As sustainable yield estimates are not available, key variables are monitored to ensure that conditions and trends, principally species composition, catch, effort, CPUE, areas fished, average size of trepang and licensee ownership are consistent with ensuring the sustainability of the NT trepang resources.

[1] [1] *For the purpose of consistency the *Northern Territory Fisheries Act 1988* will be referred to as the *Fisheries Act* for the remainder of this report.[1]

Impacts on bycatch, byproduct and threatened species of a highly selective hand harvest fishery are considered to be nil, whilst any impacts on the ecosystem is considered to be negligible.

The NT Trepang Fishery has low participation rates and is still developing within the large area available to the fishery. It has strict input controls, minimum size limits and utilises highly selective hand harvest methods to target live individuals specimens. Due to the characteristics of the fishery and the precautionary management arrangements in place, the impacts of the fishery are not considered a threat to ecosystem sustainability.

Consequently the management arrangements for the NT Trepang Fishery meet the *Guidelines for Ecologically Sustainable Management of Fisheries*. Justification for this conclusion is documented within this application.

Overview of application

This report has been produced so that the Department of Environment and Heritage (DEH) can assess the ecological sustainability of the management of the Northern Territory (NT) Trepang Fishery against the Commonwealth Guidelines for Ecologically Sustainable Management of Fisheries. The report is necessary to meet the requirements under Part 13A of the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), to ensure the listing of species harvested in the NT Trepang Fishery in section 303DB of the EPBC Act.

The report is prepared in three sections. The first provides a general overview of the trepang fishery focusing on the NT, next the general requirements of the DEH guidelines are covered and then the general principles of the assessment under the EPBC Act are addressed.

Description of the fishery

Introduction

The NT Trepang Fishery is a hand harvest fishery that takes Holothurian species in coastal waters of the NT. The terms trepang, sea cucumber or Bêche-de-mer are often used interchangeably, although "trepang" actually refers to the high valued dried body wall of the sea cucumber which is a delicacy in many Asian cuisines. Management of the fishery is achieved under the *Fisheries Act* with commercial harvest controlled through input controls and minimum size limits.

The history of trepang fishing itself is most likely over 1000 years old with Macassans fishing in NT waters for at least 150 years and possibly since the 1600's (Stutterd and Williams 2003). Historical catches in northern Australia, including NT waters, were high in the period from the 1770's to the late 1800's and catches may have been on average in the vicinity of 3000t/year wet weight (MacKnight 1976). Detailed South Australian (SA) Government records from 1882 to 1904 show that catches averaged at least 1000t wet weight in the NT during that period (Appendix I) before a significant decline in fishing activity occurred in response to Government policy limiting resource access to foreign fishers (MacKnight 1976).

In 1992, the NT fishery was re-established and is still considered to be in a developmental phase. Sandfish (*Holothuria scabra*) is the target species with catches over the last six years averaging around 140 tonnes (t) wet weight, peaking at 320t in 1999/2000.

The vast majority of trepang is exported and is considered a first grade product on the international market (Hamel et al 2001)

There are no reported catches from the recreational and indigenous sectors.

Area of the fishery

The area of NT Trepang Fishery extends seaward of the high water mark to an imaginary line three nautical miles (nm) from baselines (Figure 1). This is an extremely large area and includes all the offshore islands of the NT. Trepang may not be harvested in waters beyond this seaward boundary.

The fishery is divided into two fishing zones at Cape Grey, which is south east of Nhulunbuy. One zone extends west to the Western Australian (WA) border and the other extends east to the Queensland (Qld) border (Figure 1).

Within these two fishing zones, the functional commercial fishery currently only uses a small portion of the total available area, as fishers tend to operate in proven grounds and/or those

that meet the necessary requirements to minimise operational constraints for a hand harvest dive fishery. These matters are expanded on in the section describing the fishing methods employed in the NT Trepang Fishery.

Fishing occurs in areas extending from the south western Gulf of Carpentaria, westward across Arnhem Land to the Tiwi Islands. Fishing activity has been reported in statistical fishing grids 1032, 1131, 1132, 1133, 1134, 1135, 1136, 1234, 1235, 1236, 1336 and 1436 (Appendix II). Archaeological evidence, based on discoveries of processing sites from the era of the Macassan fishery, showed that fishing also historically took place in these areas (MacKnight 1976)

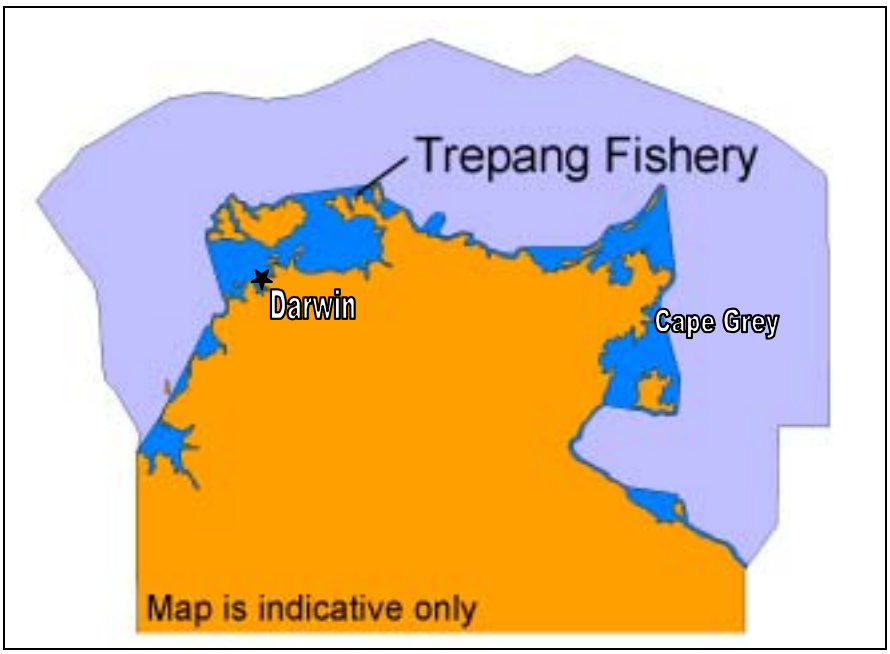

Figure 1. NT Trepang Fishery Locality Map.

History of the fishery

Trepang fisheries throughout northern Australia, including the NT, date back to at least 1720, but maybe as early as 1650, when Macassans from Celebes (Sulawasi island group, Indonesia) fished for trepang. Reports indicated that there might have been over 60 sail powered prau type vessels, each with six or so canoes and with over 1000 fishers in total operating in waters adjacent to the NT. Fishing methods included hand harvest, spearing, free diving and dredging (MacKnight 1976). Historical catches in the period from the 1770's to 1880's in northern Australia are believed to have averaged in the vicinity of 3000t/year wet weight (MacKnight 1976).

Activity in the fishery declined around 1880, not due to a decrease in resource availability, but as a result of economic pressures arising when the SA government (then administering the "NT") imposed taxes and charges on Macassan fishermen (MacKnight 1976).

SA Government reports from the period 1880 to 1904 suggest that catches by these foreign fishers were many magnitudes higher than current levels (Appendix I). These fishers reportedly harvested the equivalent of between 300 to 2500t wet weight annually over this extended period, averaging around 1000t (MacKnight 1976). The records were reported in dried weight. The conversion from dried weight to wet weight is based on dried specimens being in the vicinity of 10% of wet weight (MacKnight 1976, Stutterd and Williams 2003).

By 1907, the SA Government had ceased issuing licences to Macassans, due to the possible emergence of a local industry and as a result of government policy limiting access to aquatic resources by foreigners.

A low level of exploitation by commercial fishers, who were European Australians generally assisted by Aboriginals from the remote Arnhem Land coast, continued from 1907 until the 1930-40's. Activity then ceased, due to a demand decrease most likely arising from the invasion of China by Japan and the Second World War with the subsequent loss of major Chinese markets. There is no suggestion that the decrease in fishing was due to a decline in abundance.

Little or no fishing activity took place in the NT until the early 1980's when some licensees, under general fishing licences, may have taken some trepang. Increasing interest in Australia in the late 1980's led to investigations of the potential for developing the NT Trepang Fishery (Knight and Hollingsworth 1987, Vail 1988, Breen 2001). In 1992, six licences were issued in the NT for the hand harvesting of trepang. These licences were made transferable in 1993 and at the time of this report are owned by a single company.

The area available to the fishery is restricted to an area between the high water mark and a line three nm seaward of baselines (Figure 1). Such an approach mirrored the jurisdictional arrangements on marine resource use in Australia, in that the NT historically managed the fisheries resources in that region. With the passage of revised jurisdictional arrangements contained in the Offshore Constitutional Settlement (OCS) of 1988, management responsibility for trepang resource in all waters adjacent to the NT to the outer boundary of the Australian Fishing Zone (AFZ), not just territorial waters, were vested to the NT Government.

In 1992, the fishery was divided into three fishery management areas, with two licences permitted in each area. However, once the fishery became operational, licensees in the far western area indicated that there was insufficient product for their operations to be economically viable in this restricted area, particularly given the more extreme tidal fluctuation in the region (in excess of 8m tidal height variation). This would tend to correspond with the low level of recorded historical fishing activity in the western areas of the NT during the time of the Macassans. In response to licensee's requests, the central and western zones were merged. Currently, there are two fishery management zones, one to the east and one to the west of Cape Grey (Figure 1). Waters outside these zones are currently protected from trepang fishing.

At the time of licence issue, controls were introduced, on the number of crew and permitted divers/collectors. Underwater collecting was initially restricted to free diving and hand collection. Responding to concerns about the threat of crocodile and shark attack, scuba and hookah gear were introduced to the fishery thereby permitting the use of diver safety cages.

Participants in the fishery

The commercial sector is the major sector in this fishery. Entry is limited to the six licences (3 in each zone) initially issued in 1992 and these have a range of input and output controls attached. Licences have been fully transferable since 1993 and currently are all owned by a single company. This company also has trepang access rights in other jurisdictions (WA, Qld and the Coral Sea) and spreads its fishing resources throughout these areas.

In 2002, four of the six licences were active. The fishery is still developing and has the capacity for expansion by the take up of the latent effort of underutilised licences. Notwithstanding overall fishing capacity in the fishery it is still restricted within the licence limitations, effort controls and operational constraints in place in the NT.

As non-commercial fishers are not licensed in the NT, exact numbers in respect to participation rates for these groups are not available. However, the National Survey of Recreational and Indigenous Fishers (NSRIF) conducted during 2001, estimated the recreational and indigenous participation rates to be negligible, with nil reports of activity from either sector (Coleman pers com 2003). Non commercial fishers are not permitted to sell or trade in trepang. There are no bag limits or other restrictions for non-commercial fishers. However, this may be reviewed if this sector becomes active.

Fishing Tour Operators (FTO) have been licensed in the NT since 1995 and are permitted to allow their clients to take trepang as part of their operations. Around 180 annual licences have been issued over recent years, but none reported fishing for trepang.

Fishing methods and processing in the Trepang Fishery

Snorkel, scuba, hookah gear or low tide walking may be used when collecting trepang. Diving generally takes place in shallow coastal embayments and foreshores in waters up to 15 metres in depth. Not all areas are suitable for collecting trepang. Specific areas where the target species of trepang in the NT are generally prevalent are in areas of mud, silt and sand flats with high organic input and good water quality.

Non-commercial collectors may use the same techniques and fish in the same way, or collect specimens at low tide by walking.

Diving is generally limited to day time neap tides (lowest tidal variation) and during the dry season when water visibility improves and cyclone and monsoonal activity is minimal. The extreme tidal range experienced throughout many areas of the fishery, compounded by the distinct wet and dry season, reduces diver visibility and the potential to collect trepang all year round.

With restricted land access to the majority of the NT coastline, all fishing operations are vessel based. Generally, the mother boat anchors in deeper offshore waters and divers move in to the harvest area by way of dinghies (termed dories). These dories don't anchor, but stay "live" and move with the divers as they collect live individual specimens by hand. Dive sessions last up to three hours at which time all the product is returned to the mother boat. Operational constraints such as poor visibility, strong winds, currents and presence of predators or threats (e.g. crocodiles, sharks, jellyfish) can limit or cause all diving to cease.

Another phenomenon that has been observed that restricts harvest at certain times is that all the trepang bury in the sand and are not visible for harvesting. They may remain this way for several days then reappear. Divers believe that this phenomenon may be a response by the animals to variations in water conditions, such as decreased water temperature or salinity. Similar behavior was documented by trepang fishers in the 1930's when it was noted that trepang would be thick on the bottom and then suddenly disappear for a week or so during cooler weather. They would then reappear and smother the bottom on a bright sunny day (Sunter 1937). Carter (2001) noted similar behavior in Arnhem Land when trepang had covered a lagoon one evening, but had all disappeared by morning.

Initial processing includes removing the stomach, washing, grading, boiling and freezing the harvested product. Water used in processing is diluted and expelled in deeper water away from bays and inlets. The processed catch is generally unloaded in Darwin (the only NT port with all season access and road connections) and transported to domestic facilities in southern Australia for further processing, typically mechanical drying.

Fishing trips are generally of one to two weeks duration, with the length determined by the distance to the fishing grounds, weather, overall catch rates and the well being of crew.

Catch composition

Sandfish (*H. scabra*) is the most important species for the NT Trepang Fishery being taken in preference to any lower valued species. As a condition of the licence it has a minimum size limit of 16cm. Other Holothurians have been identified as possible harvest species and although none have been recorded as being harvested, the species have minimum size limits set as a condition of the licence. These species are:

Holothuria atra	lolly fish	15 cm
Holothuria nobilis	black teat fish	26 cm
	white teat fish	32 cm
Actinopyga echinites	deep water red fish	12 cm
Thelenota ananas	prickly red fish	30 cm

Provisions exist for other trepang species to be taken for biological and marketing purposes. If proven commercially viable, these species will have minimum size limits set based on size at sexual maturity.

A review of trepang fisheries elsewhere indicates that in the event of a population decline in the higher valued species, fishers seek to maintain profitability by targeting lower valued Holothurian species (Stutterd and Williams 2003). Such a situation was observed in the East Coast Bêche-de-mer fishery, in which commercial fishers shifted focus from sandfish to white teatfish (*H. fuscogilvia*) and prickly redfish (*Thelenato ananas*). A similar trend was reported for the Torres Strait fishery, with fishers shifting focus to teatfishes (*H. fuscogilvia, H. nobilis),* prickly redfish and surf redfish (*Actinopyga mauritiana*).

Anecdotal information from licensees in the NT indicates that to date few species, other than sandfish, have been observed in commercial numbers. However, licensees will seek to develop markets for these other species if sufficient quantities become available and they can be harvested sustainably in economic quantities.

Macassans were also believed to have been targeting sandfish and possibly to a lesser extent lolly fish when they operated in NT waters.

Catch and effort

Historical catches across northern Australia, including the NT, were believed to be very high in the period from the 1770's to the late 1800's with reports that catches may have been as high as 6000t, but on average in the vicinity of 3000t/year wet weight (MacKnight 1976). SA Government records from 1882 to 1904 show that catches ranged from 300t to 2500t and averaged 1000t wet weight during that period (Appendix I). The catch declined after 1904, not in response to stock abundance issues, but as a result of SA Government policy restricting foreign access to NT waters and aquatic resources (MacKnight 1976).

Since the reactivation of the NT fishery in 1992, commercial fishers in the NT Trepang Fishery have been required to complete daily reports on fishing effort, the level of harvest (both weight and numbers of individuals), fishing locality and statistical grid (Appendix II – grid sheet, Appendix III - logbook). This information allows a detailed desktop assessment of the status of the NT Trepang Fishery, including an estimation of the average weight of individual trepang harvested and CPUE. Both these indices can be used as indicators of the status of the fishery. As the fishery is still in a developmental stage, this data will become more valuable over time as the spatial and temporal scope of the data set increases.

During 2003, the logbook data entry and retrieval process was reviewed by NT Fisheries Group to confirm accuracy of data input and subsequent reporting. This involved reentering all logbook data from 1996 to 2001 and verifying it against the data previously entered into the reporting system. From a total of 8808 entries nine inaccuracies were identified which is an entry accuracy rate of 99.9%. These errors were corrected and data for this period

provided in this report supercedes all other catch and effort data previously reported for the NT Trepang Fishery (Table 1).

Data received from 1992 to 1995 is still to be validated and may have some reporting errors and as such will not be provided until validation can be completed and the data standardised with post 1996 data.

A complete overview of validated catch and effort in the fishery is provided in Table 1 and shown in Figure 2. All landings are reported in kilogram wet weight of trepang. Fishing effort is reported in diver hours which correlates to the number of divers harvesting, multiplied by the number of hours dived. Catch per unit effort (CPUE) is determined by dividing the reported landings by the effort and is reported in kg/diver hour. This effort estimation is considered a sound representation of fishing activity.

Table 1 Validated Commercial Landings and Fishing Effort for the Northern Territory Trepang Fishery - 1996/97 to 2001/02 (source DBIRD 2003)

Year	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02
Landings (kg wet weight)	77,286	88,778	76,542	320,696	187,166	103,917
Effort (diver hours)	3,879	6,279	3,567.5	6,547.5	3,828	2,615.5
CPUE (kg/diver hour)	19.92	14.14	21.46	48.98	48.89	39.73

With the reissue of licences in 1992, landings in the NT Trepang Fishery generally remained low with catch and effort peaking in 1999/2000 at 320t and 6547 dive/hours (Table 1, Figure 2). The average catch over the last six years has been 142t.

CPUE is often used as a tool for determining the relative health of fishery resources. A decrease in CPUE possibly indicates that the resource may be overfished. This is a common technique used in many fisheries where reliable stock assessments are not available and is also the basis of most stock assessment models (King 1995).

The NT Fisheries Group considers that the CPUE estimates for the fishery are consistent with a fishery in its developmental stage, that is not under threat of overfishing and that the current catch levels are sustainable. By way of comparison, CPUE trends for the East Coast and Torres Strait Bêche-de-mer fisheries demonstrated an industry wide extreme decline in CPUE over a few years prior to the collapse of sandfish populations (Stutterd and Williams 2003).

Since the peak NT catch and effort in 1999/2000, the amount of effort and associated catch has decreased. Overall however, CPUE has increased from around 15-20 kg/diver hour in 1996/97 to an average of 43.8 kg/diver hour over the last three reporting periods (Table 1, Figure 2).

Assessment of catch and effort throughout the reporting period (1996 to 2002) for individual regions was undertaken by the NT Fisheries Group and analysis of CPUE for individual localities was considered consistent with the overall fishery trends (DBIRD 2003).

Fluctuations are expected in a developing fishery and can occur for a number of reasons, such as new or inexperienced divers/skipper and experimental fishing in untried grounds. Additionally in this instance in the NT, there has been a lack of consistent fishing effort

focussed on the NT fishery as current industry resources are dispersed around WA, NT, Qld and the Coral Sea.

To compliment the analysis of CPUE, analysis of the estimated average individual weight of trepang harvested over the period 1996/97 to 2001/02 was undertaken. Initial interrogation of the data revealed that one operator had reported numbers and weight incorrectly and those entries (n=11 in 1996) were excluded from the analysis. To ensure this does not occur again, fishers must now report catch by both number and weight as well as provide sales data in kg. This allows for the detection of any such errors at the time of data entry. The compulsory reporting system now does not accept any logbook return that is not fully completed and the fisher must provide all information requested.

Analysis of the trend in average weight throughout the reporting period (1996 to 2002) shows that the average weight of trepang has remained stable and catch levels are not leading to a reduction in average body weight (Figure 3). If there was a decline in the average weight, it could be considered an indication that the resource may be being fished down.

Based on logbook data provided by all FTO licensees, there were no reports of any trepang catch or harvest.

The actual level of recreational harvest of trepang is not known. However, the comprehensive NRIFS survey showed that trepang is not widely harvested by recreational fishers for personal consumption, although certain community groups may take small amounts. The overall level of harvest is considered to be negligible with no activity reported during the survey (Coleman pers com 2003).

NT legislation provides for indigenous persons to utilise fisheries resources in a traditional manner. Based on the NRIFS the overall level of harvest is considered to be negligible with no activity reported during the survey (Coleman pers com 2003).

Based on compliance information, illegal fishing methods, illegal catch or black market sales are not considered an issue at this time.

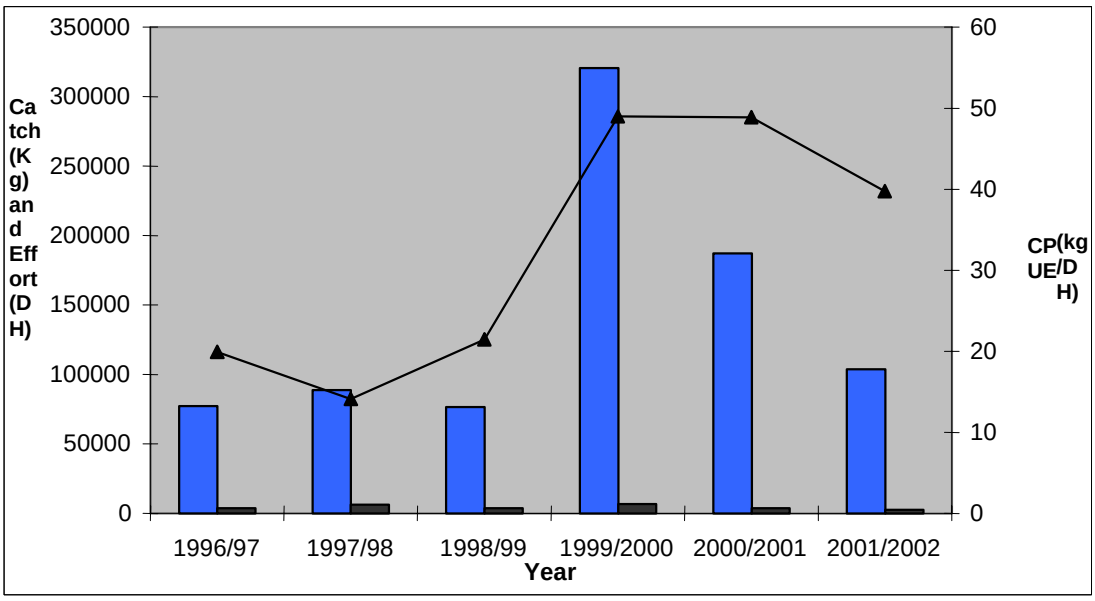

Figure 2: Commercial Trepang Catch, Effort and Catch Per Unit Effort for the NT Fishery - 1996/97 to 2001/02

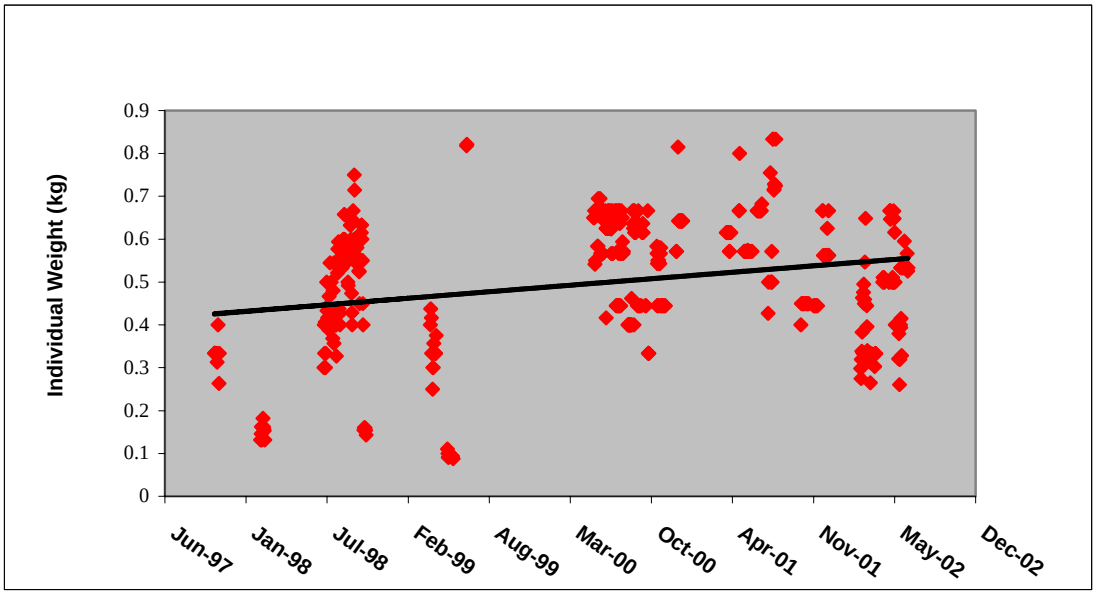

Figure 3: Estimated Average Weight of Individual Trepang in the Northern Territory Trepang Fishery - 1997/98 to 2001/02.

Marketing and value

The vast majority of trepang is prepared for export markets and shipment to the distribution hubs in Asia such as Singapore and Hong Kong. Sandfish is considered a first class product in international markets (Hamel et al 2001). The product is often repackaged and re-exported to Chinese based communities around the world (Stutterd and Williams 2003).

Trepang has historically been processed into dried product and then reconstituted prior to cooking. Recently NT product has successfully been sold in cooked and frozen form with canning also being trialed.

The price paid for trepang is dependant on a number of factors such as species, size (bigger generally better), thickness of wall (thicker generally better), color, taste and texture, but this may vary from market to market.

The quality of processing affects value, with prices generally decreasing for product that has:

- been insufficiently dried (over 20% moisture content)
- a scarred body
- unattractive incisions made to remove the gut
- an unpleasant odour
- poor body bands
- chalky epidermis (Hamel et al 2001).

Examples based on market prices in Singapore for dried product ranged from under $20 US/kg for small or lower quality pieces up to in excess of $100 US/kg for larger or good quality specimens (Hamel et al 2001).

The current NT fishery does not take small pieces as they are valued at less than ½ the prices of adult sized animals. With the additional work involved it is not considered economically viable to take smaller animals, hence the focus on larger specimens. Operators as a rule invoke voluntary “move on” provisions if and when catch rates or size decreases.

The value of the NT commercial catch over the gunwale in 1999 and 2000 was estimated to be in the vicinity of $2.4M (DPIF 2001A, DPIF 2001B).

Markets exist for other Holothurian parts such as the visceral organs and gonads in dried, fermented or salted forms in markets such as Korea, Taiwan and China (Stutterd and Williams 2003). These body parts only represent a very small percentage of total body weight and may not be an economically viable option for processing in Australia at this stage.

Management of the Trepang Fishery

The NT Trepang Fishery management arrangements are documented and publicly available in the *NT Fisheries Regulations 1995* (Fisheries Regulations) under the legislative framework of the *NT Fisheries Act* (Fisheries Act). The management arrangements for the fishery were developed as a result of an analysis of the potential to rejuvenate the fishery in the 1980's. This was after nearly a 50 year hiatus brought about by the Second World War and a subsequent decrease in market opportunities in Chinese markets.

The overarching management objectives for all NT fisheries, including the NT Trepang Fishery, is specified in the Fisheries Act and are to "conserve, enhance, protect, utilise, and manage the fish and aquatic life resources of the Territory to:

(a) promote, develop and maintain commercial and amateur fishing;
(b) provide for optimum yields from a fishery and maintain the quality of the yield;
(c) ensure that the fisheries of the Territory are not endangered or overexploited;
(d) encourage tourist and scientific interest in fish and aquatic life; and/or
(e) ensure that the habitats of fish or aquatic life and the general environment is not detrimentally affected".

These key objectives, for the NT Trepang Fishery, seek to limit the catch to a sustainable limit, maintain a viable reproductive population, minimize environmental impact and maintain long term economic returns. These are achieved through a combination of input and output controls which include; limited entry licensing, catch, area, size and gear restrictions and reporting requirements.

The low numbers of licensees in the fishery allows all commercial stakeholders to be directly involved in discussions on any proposed management arrangements. Currently all licences are held by one company which further simplifies these discussions.

Management controls for the NT Trepang Fishery are specified in Division 13 of the Fisheries Regulations and by licence condition (Appendix IV). These controls provide for a range of measures to assist in meeting the key fishery specific objectives, which are:

- limiting the number of commercial licensees to a maximum of six transferable licences
- having two separate fishery management zones, with not more than three licences authorised to operate in each
- limiting the fishery to the area between high water mark and an imaginary line three nautical miles seaward of baselines, thereby providing an extensive zone fully protected from trepang fishing
- only allowing the harvesting of trepang by hand
- utilising minimum size limits
- limiting the number of collectors/divers
- compulsory provision of catch and effort data.

Analysis and monitoring of catch and effort trends, average weight of trepang caught, the continuation of fishing on the same grounds, operational and logistic constraints together with the continued focus on the premier species, sandfish, indicates that the current

arrangements are appropriate to achieve the management objectives of the NT Trepang Fishery. These matters are strategically addressed in the preparation and publication of the Annual Fishery Status Reports, reports to DEH as well as at the annual Northern Australian Fisheries Management Workshop (NAFMW).

The NT is aware that relying solely on these factors may not provide protection to the resource, so the management arrangements have further controls inbuilt to provide additional protection.

These include a prohibition on the harvesting of trepang in waters beyond 3nm. Although the interrelationship between the inshore and offshore stocks is not fully understood research suggests that juvenile *H. scabra* may settle in shallow seagrass beds and later migrate offshore to deeper waters to spawn (Uthicke and Benzie 1996). It is for this reason, harvesting from waters outside the current fishing area has not been permitted as the offshore closure may provide protection to larger sexually mature animals. This is considered a precautionary response at this stage for the protection of the resource.

Fishing the tropical inshore waters of the NT with its large tidal range (exceeding 8m in some areas) and distinct wet/dry monsoon season also places operational limitations on the fishery and the collection of trepang by hand. Highly turbid water impedes the effectiveness of hand gathering, with commercial operators reporting the inability to harvest trepang during time of spring (larger) tides and the heavy flooding often associated with the monsoon. As a result of these factors, actual fishing time is limited.

Trigger points and management actions for the fishery are listed in Table 2. An appropriate management response if a trigger point were reached would be made in consultation with stakeholder groups with legitimate interests in ensuring ecological sustainability of the fishery. Should indicators show a decline in the abundance of trepang, management arrangements that can be implemented and which are expanded on in section 1.1.7 of this report include, but are not limited to:

- adjusting minimum size limits
- setting a Total Allowable Catch (TAC) or nil catch of some species
- adjusting the zoning scheme
- restricted or altering the harvesting season
- restricted or altering gear controls
- utilising the General Powers of the Director of Fisheries (the Director) to impose additional management controls or revoke conditions.
- invoking the Ministers emergency power if the fish stocks or the environment are threatened to restrict or halt activity in the fishery.

Collapses of trepang fisheries are well reported from around the world. These fisheries may take decades to recover if harvesting continues on depleted stocks. This has generally been exacerbated due to poor management and compliance within poorly regulated regimes that allow excess and/or uncontrolled access (Hamel et al 2001).

A recent example of this occurred in the Warrior Reef areas of the Torres Strait. This fishery saw extreme over-exploitation on the Papua New Guinea side of the region through unregulated access, which forced a closure of the fishery in 1994. This lead to a shift of effort to the Australian side of the region with a subsequent increase in catches from 150t to 1400t in one year (Damschke 1999). This was followed by a series of management measures including the use of quota, which eventually lead in a short period of time to a full closure.

None of these characteristics have been identified in the NT fishery

Compliance

Compliance with the management controls for the NT Trepang Fishery are undertaken by the Police, Marine and Fisheries Enforcement Unit of the NT Police and Fire and Emergency Services (PMFEU), under the Fisheries Act.

The PMFEU monitors and enforces the management controls of the NT Trepang Fishery through the inspection at arrival and departure of vessels from port. In addition, inspections may also be undertaken during normal surveillance operations, or in response to intelligence. This includes verification of catch returns against trader/processor returns (i.e. requirement for all operators to specify where they are selling their product). The PMFEU has the power to investigate the records of any seafood wholesalers or licensees and undertakes liaison with enforcement agencies in other jurisdictions if there are cross-border issues.

No "at sea" inspections were undertaken throughout 2001/02 or 2002/03, although intelligence on the locality of commercial trepang vessels is provided from a number of sources on an ongoing basis. Vessels were periodically inspected during routine wharf-side inspections of all commercial vessels present in Darwin.

To date there have been no reports of any illegal activity by any sector in respect to this fishery and the level of risk is considered extremely low.

Species Biology

H. scabra (sandfish) can vary in color from white/grey to black and are found throughout the Indo–Pacific in regions generally ranging from 30^{o} N to 30^{o} S (Hamel et al 2001). Sandfish are one of the few tropical Holothurian species that prefers muddy sandy bottomed coastal areas to coral reef, coarse sand or crushed coral (Hamel et al 2001). Sandfish appear to favor low energy environments such as bays and protected shorelines and are often found in areas with terrigenous inputs such as near estuaries, mangrove areas and swamps. They also appear to have a high tolerance to areas of low salinity.

They are detritus feeders ingesting sand and mud, consuming bacteria and nitrogenous compounds and also feed on deposited bacteria and algae (Hamel et al 2001).

Sexual reproduction by broadcast spawning occurs generally in the warmer months (December to February) and may be linked to increased water temperature, lower salinity, lunar cycles or some combination of these factors. A small proportion of the population may also spawn all year round. Up to 9 million buoyant eggs can be produced per female (Hamel et al 2001). The planktotrophic larvae of this species spend 10 to 14 days in the water column before settlement (Battaglene 1999) so there is potential for limited larval dispersal between populations (Uthicke and Benzie 1998)

In its juvenile form, trepang are generally found in seagrass beds, which are believed to play an important function in triggering larval settlement. Most individual larvae appear to prefer to settle on seagrass leaves (Hamel et al 2001). More mature specimens tend to be found in deeper waters, often in areas near major estuary systems. Individual specimens may reach sizes over 400mm in length and weights in excess of 1.5kg (Uthicke and Klummp 1996).

Outcomes of a genetic study of sandfish populations along the north-east coast of Australia and the Solomon Islands indicated limited genetic variability between shallow and deep water populations of sandfish (Uthicke and Benzie 2001). This is consistent with the view that juveniles settle in shallow seagrass beds and then migrate to deeper areas during their life span and therefore there is a mixing of genetic material between shallow and deeper areas (Uthicke and Benzie 1998).

Due to the current lack of a clear understanding of this issue, the existing management arrangements that protect the offshore breeding component of the NT fishery is considered appropriate and precautionary.

Reported growth rates in the wild vary greatly from 14mm/month to 100-150mm/month (Hamel et al 2001). Skewes (1997) estimated that at two years of age, a sandfish would be around 18cm in length. Average size at sexual maturity is 16.8cm (Kithankaeni 2001).

Sandfish are found in waters ranging from 0-20m and work undertaken in New Caledonia, show that densities vary, based on a number of unknown factors, from 0 to over 60 individuals/100m^2 (Hamel et al 2001).

Sandfish move by the use of tubular feet and muscular action of the body wall. They are often observed buried and appear to spend roughly ½ of the time on the surface and ½ buried. This may be affected by a range of conditions, such as light intensity, cloud cover, temperature and salinity levels (Hamel et al 2001). It has also been noted that at different times large numbers of trepang will burrow whilst others will stay on top of the seabed with numbers and duration varying. This can have consequences for any stock assessments based solely on visual assessment of numbers of animals at a single or limited point in time (Carter 2001).

A range of Holothurian larvae may be eaten by a variety of fish (Hamel et al 2001) and as a group, adults may rarely be part of fish or larger gastropods diet (Canon and Silver 1986). There is no specific information in relation to sandfish. Sandfish contain a biotoxin that can cause death in fish and induce paralysis in mice in laboratory tests (Hamel et al 2001). Observations during experimental work in the Pacific failed to observe any predation on trepang (Mercer et al 2000).

A thorough overview of the systematics, biology and ecology of sandfish is provided in Hamel et al 2001.

Research

During the developmental phase of the NT Trepang Fishery, the majority of research information was based on work undertaken on similar species in other jurisdictions. Limited financial and human resources have not permitted the NT Fisheries Group to undertake specific studies on the dynamics, or life history of NT trepang populations. This lower priority was based on the perceived lack of threat to this resource in NT waters under the existing arrangements.

A PhD. thesis completed in 2001 sought, amongst other things, to develop a simple biomass model suitable for assessing the status of the NT Trepang Fishery. This lead to an estimated MSY of 169t with a 122t TAC suggested for the fishery. The author however cautioned that the results were misleading and dangerous as substantially different values could generate the same likelihood. It was further noted that the results were considerably uncertain and not robust enough to apply 90% confidence levels (Carter 2001). This was mainly due to the short time series of data available, the broad spatial and pooled nature of the data and the lack of consistent fishing effort in discrete areas (Carter 2001). Catch and effort data used in the analysis ranged from 3.7t for the year taken with 17 days fishing effort to 87.3t taken with 423 days of fishing effort.

These findings underlie the uncertainty about biomass and productivity of the NT Trepang Fishery and highlight the danger in relying on models when there is considerable uncertainty about the data, biological parameters, fisher behavior and the stocks response to fishing. It is anticipated that as the temporal and spatial quality of the logbook data improves, with increased fishing activity, the data will most likely increase in value for stock assessment

purposes. Research in the NT noted that abundances were highly variable and there was also wide unexplained variation in densities (Carter 2001).

The logbook data will need to be complemented with an understanding about the complex interaction between stock availability and operator behavior in response to profitability, not necessarily just overall stock size. There is a need to standardize catch and effort data to obtain a better understanding of fisher response to stock density.

Problems also exist with attempting to use traditional size based research as there is to the difficulty in accurately measuring animals and determining a length/weight relationship. This is due to seasonal variations of condition, gut content and species response to handling. There are also significant difficulties with attempting to tag these animals, as they appear to lose traditional tags in a short period of time (Damschke 1998, Mercier et al 2000).

The fishery has now reached the stage where a fishery independent research program to assess the status of trepang stocks in the NT is being proposed as a joint industry, Fisheries Group initiative. The research will seek to estimate trepang biomass in the existing fishery and in waters outside the fishery to provide a total picture of trepang stocks. If supported, it is anticipated that this independent 3rd party audited research project will commence in 2004 with industry funding, as the Fishery Group does not have sufficient resources to undertake the project without industries backing. The final report will be peer reviewed and any relevant findings will be incorporated into future management arrangements.

The proposed research project expects to collect data on a range of variables including:

- species and numbers harvested
- length of specimens and a range or weight measurements
- gonad condition
- water temperature/salinity
- weather conditions
- depth fished
- moon and tide phase
- sediment/bottom samples.

It is hoped that this project will be able to help fill many of the current information gaps on life history parameters, abundance, densities and stock structure identified at the Trepang Workshop in Brisbane in 1997 (Damschke 1998).

An onboard observer program is also proposed to document vessel and gear details, location, depth fished, fishing practices, catch composition, ground type and to undertake biological assessment of species taken. As part of this program any data suitable for assessing the fishery activities with regard to adverse impacts on the wider marine ecosystem can be collected. This program is proposed for commencement in 2004 and will complement the proposed research program.

These proposed projects are a key component of the research strategy for the NT Trepang Fishery, but opportunities for collaborative work with other agencies will be sought, as will assessments of any relevant research undertaken in other jurisdictions.

General requirements of the DEH Guidelines

The management arrangements must be:

Documented, publicly available and transparent

The management regime for the NT Trepang Fishery is documented in Part 8, Division 13 of the Fisheries Regulations as a component of the *Fisheries Act*.

The *Fisheries Act* is publicly available on request from the Department of Business, Industry and Resource Development (DBIRD) or from the NT Government website at www.nt.gov.au/dpif/fisheries/index.shtml.

Any discussion papers or proposals for amendments to the fishery management arrangements are distributed widely to stakeholder groups and other interested individuals and advertised in major NT newspapers and NT Government websites through a public consultation process. All management arrangements are also discussed with key stakeholders and through the Aquatic Resource User Group (ARUG) forum and regional Aboriginal Consultative Committees (ACC) (see next section for details on forum/committee structures).

Prior to participating in the commercial fishery, all fishers are briefed on the management arrangements for the fishery when they undertake a compulsory pre-fishing interview with the Aquatic Resource Manager responsible for the fishery.

An annual status report is published and distributed to all stakeholder groups to ensure that management advice is transparent and that the community is fully informed about the current and predicted future status of the resource. Annual status reports are also available on line www.nt.gov.au/dpif/fisheries/index.shtml or as requested from the NT Fisheries Group.

As of the 2004 reporting year, the annual status report will also report on management objectives, performance indicators and triggers and how the fishery is performing against these criteria.

The NT Trepang Fishery has also produced annual reports to DEH to support the application for renewal of controlled specimens so as to continue export of product specified on the list of exempt native specimens in s303DB of *the Environment Protection and Conservation Biodiversity Act 1999*.

Developed through a consultative process providing opportunity to all interested and affected parties, including the general public that ensures a range of expertise and community interests is involved in individual fishery management and during the stock assessment process.

The management regime for the NT Trepang Fishery was developed through a consultation process involving broad stakeholder representation as part of the development of the Fisheries Regulations.

The low number of licences in the NT Trepang Fishery allows all commercial stakeholders to be directly involved in discussions on any proposed management arrangements.

The ARUG Forum provides a structured process for key user groups to discuss cross-sectorial fisheries resource issues. Members are at the Chief Executive or senior officer level of their respective organisations and include: two representatives from the NT Fisheries Group, three from the Northern Land Council (NLC), one from the Tiwi Land

Council, one from the Anindilyakwa Land Council, three from the Amateur Fisherman's Association of the NT (AFANT) and three from the NT Seafood Council (NTSC).

In recognising the specific cultural needs of indigenous stakeholders a separate consultative process has been established by the NT Fisheries Group for considering fishery related issues. These regional consultative committees provide formal advice in a culturally appropriate forum for discussions with the indigenous constituents of the regions on all aspects of fishing, including the NT Trepang Fishery.

Conservation groups and non-government organisations are advised and consulted on topical fisheries issues, including the NT Trepang Fishery, through monthly advisory meetings with senior fisheries officers and the Director. Conservation groups support the current consultation process, particularly given their limited level of resources.

Members of the public, including community and conservation groups are also invited to provide their views to the NT Fisheries Group through the release of public discussion papers and other consultative processes.

The current consultative processes are considered appropriate and effective given the size and scope of the NT Trepang Fishery and the human and financial resources available in the NT.

Ensure that a range of expertise and community interests is involved in individual fishery management committees and during the stock assessment process.

There is no Fishery Management Advisory Committee (FMAC) and no formal stock assessment undertaken for this fishery. However, as discussed in the previous section there are provisions for stakeholder involvement (including commercial, recreational, indigenous, Government, community and conservation representatives and the general public) in any assessment or management decision making process for the NT Trepang Fishery.

The status of the fishery is discussed each year at the Northern Australian Fisheries Management Workshop (NAFMW) and in the development of the annual status report. Membership of NAFMW includes state, Territory and Commonwealth fisheries managers, researchers and compliance staff. As a result of the 1997 NAFMW, a specific workshop was held in Brisbane late 1997 to consider management of the fishery on a national basis.

The workshop identified general management principals that should be considered so that trepang fisheries can be conducted in a sustainable way, and harvested in a precautionary manner that provide maximum economic and social benefits (Damschke 1999). Research priorities were also discussed and highlighted that there are significant gaps on many of the key life history parameters, abundance, densities and stock structures of Australia's trepang fisheries.

The proposed NT trepang research project will be 3rd party audited prior to commencement by respected scientific institutes as well as all results being peer reviewed. The proposed project will seek to address many of the research deficiencies identified at the Brisbane workshop (see section 1.1.1)

Be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements are measured

The overarching management objectives for all NT fisheries, including the NT Trepang Fishery, are specified in the Fisheries Act. These are to "conserve, enhance, protect, utilise, and manage the fish and aquatic life resources of the Territory to:

(a) promote, develop and maintain commercial and amateur fishing;

(b) provide for optimum yields from a fishery and maintain the quality of the yield;
(c) ensure that the fisheries of the Territory are not endangered or overexploited;
(d) encourage tourist and scientific interest in fish and aquatic life; and/or
(e) ensure that the habitats of fish or aquatic life and the general environment is not detrimentally affected".

For the NT Trepang Fishery these management objectives are achieved through a combination of input and output controls that include; limited entry licensing, catch, species, area, size and gear restrictions and compulsory reporting requirements.

Sustainability of target, byproduct, bycatch, protection of threatened species and the environment are achieved through the management objectives and relevant performance indicators listed in Table 2.

The objectives and performance criteria provide the framework to assess the effectiveness of the NT Trepang Fishery management. The strategic management directions of the NT Trepang Fishery are reviewed and assessed at the NAFMW, any relevant local, national or international workshops or stakeholder meetings and in compiling the annual status report or any reports to DEH.

Be capable of controlling the level of harvest in the fishery using input and/or output controls

The level of harvest in the NT Trepang Fishery is managed primarily through input controls, namely limiting the total number of trepang licences available, diver numbers, fishing method allowed (hand harvest) and area restrictions. Minimum size limits also apply. These controls are contained in Division 13 of the Fisheries Regulations and in licence conditions applied to each licence (Appendix IV). These arrangements are considered appropriate to control the level of harvest in the NT Trepang Fishery and enable the NT Fisheries Group to meet this guideline.

If there was a need to adjust the removals from the fishery a number of techniques are available to further regulate catch levels. These are expanded on in 1.1.7, but include:

- adjusting minimum size limits
- setting a Total Allowable Catch (TAC) or nil catch limits to species
- adjusting the Zoning scheme
- restricted or altering the harvesting season
- restricted or altering Gear Controls
- utilising the General Powers of the Director to impose additional management controls or revoke conditions.
- invoking the Ministers emergency power if the fish stocks or the environment are threatened to restrict or halt activity in the fishery.

The management strategy of using input controls and minimum size limits is to control the level of fishing effort within the fishery and therefore the level of take. Although sustainable yields are not yet determined for the fishery, longterm historical data from the 1880's to the early 20th century indicates that average catches in the NT were in the range of 1000t/year during a time of operational difficulty (due to government taxes) for the fishery (Appendix I) (MacKnight 1976). This was well below the reported annual catch levels for prior to 1880 that averaged around 3000t per annum (MacKnight 1976).

Since its reintroduction in 1992, the NT Trepang Fishery catches have been significantly lower than those levels. The highest reported catch of 320t was taken in 1999/2000 with 142t being the average catch in the last six years (Table 1).

As sustainable yield estimates are not available, precautionary management arrangements have been put in place to monitor other indirect indices such as species composition, catch, effort, CPUE, areas fished, average size of trepang and the licensee ownership. As sustainable yield estimates become available, further specific indicators and triggers can be developed to monitor the performance of management objectives.

There are no controls limiting the take in the non-commercial sectors, but provision exist in the Fisheries Act to implement management controls such as size and possession limits if required.

It is anticipated that additional information will become available over the next two to four years if an industry funded research program proceeds. This project will seek to collect a range of data and ascertain stock size through fishery independent methods. Details of this proposed project are expanded on in section 1.1.1.

Contain the means of enforcing critical aspects of the management arrangements

The management regime meets this guideline by enforcing the management arrangements as documented in the Fisheries Act, Fisheries Regulation and licence conditions.

Compliance with the management controls for the NT Trepang Fishery is undertaken by the PMFEU on behalf of the NT Fisheries Group, under relevant Fisheries legislation. The PMFEU has the power, if necessary, to investigate the premises, vessels or records of licensees and fish traders/processors and if necessary, collaborate with interstate agencies if there are cross-border issues.

The PMFEU monitors and enforces critical aspects of compliance through the inspection at arrival and departure of trepang fishing vessels through the port of Darwin (the only NT port with all season access and road connections). Principal management arrangements can be monitored in port, including verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product).

In addition, inspections can also be undertaken during normal surveillance operations or in response to intelligence. Monitoring of trepang vessels at sea is infrequent due to the vast distances away from shore, the low number of vessels active in the fishery and the perceived low level of risk in the fishery.

No “at sea” inspections were undertaken throughout 2001/02 or 2002/03, although intelligence on the locality of commercial trepang vessels is provided from a number of sources on an ongoing basis. Vessels were periodically inspected during routine wharf-side inspections of all commercial vessels present in Darwin.

To date there have been no reports of any illegal activity by any sector in respect to this fishery and the level of risk is considered extremely low. Powers exist to confiscate product, vessels and vehicles as well as impose financial penalties and prison sentences for those convicted of breaches under the Fisheries Act.

The enforcement and compliance operations for the NT Trepang Fishery are considered appropriate and a sufficient deterrent in light of current fishing practices and limited resources available in the NT. Nonetheless, the NT Fisheries Group and PMFEU will undertake a compliance risk assessment by December 2004.

Provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria

The strategic management directions of the NT Trepang Fishery are reviewed and assessed at the NAFMW, relevant local, national or international workshops, stakeholder meetings and in compiling the annual status report or any reports to DEH.

As a result of the 1997 NAFMW, a specific workshop was held in Brisbane in 1997 to consider management of trepang fisheries on a national basis. The workshop identified general management principals that should be considered so that trepang fisheries are conducted in a sustainable way, harvested in a precautionary manner and provide maximum economic and social benefits (Damschke 1999).

The paucity of information on the species targeted in the fishery was also discussed at the workshop and highlighted the need for focused research to fill the significant gaps on many of the key life history parameters, abundance, densities and stock structures for Australian trepang fisheries.

Capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates.

The characteristics of the NT Trepang Fishery such as only permitting hand harvest and the very low number of active operators reduces the potential risk for any adverse impacts on the marine ecosystem in which the fishery operates. An assessment of the fishery is undertaken yearly as part of the preparation of the annual status report.

It is proposed that an independent third party audited research project will commence in 2004 with industry funding. The final report will be peer reviewed and any relevant findings will be incorporated into any future management arrangements. It is anticipated that this project will be able to help fill many of the current information gaps on trepang life history parameters, abundance, densities and stock structure identified at the Trepang Workshop in Brisbane in 1997 (Damschke 1998).

An onboard observer program is also proposed to document vessel and gear details, location, depth fished, fishing practices, catch composition, ground type and to undertake biological assessment of species taken. As part of this program any data suitable for assessing fishery activities with regard to adverse impacts on the wider marine ecosystem will be collected. Subject to final approval, it is proposed that this program will commence in 2004.

Section 29 of the Fisheries Act provides powers for the Minister to impose emergency restrictions if the ecosystem is adversely affected by fishing operations.

With the existing management arrangements and fishing operations in place, it is considered that these are appropriate management responses given the characteristics of the Trepang Fishery in the NT to minimise impacts on the wider marine ecosystem.

Require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy.

Bycatch in the NT Trepang Fishery is non existent and there is no recorded or observed interaction with threatened or vulnerable species. A bycatch reduction plan is not considered necessary for this fishery, but the proposed observer program will be able to undertake monitoring to confirm the nil level of bycatch in the fishery.

There are no threat abatement plans or recovery plans implemented for species of relevance to the NT Trepang Fishery. If a threat abatement plan does become relevant, NT Fisheries Group will ensure that relevant recommendations are incorporated into management arrangements.

PRINCIPLE 1

A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover.

Objective 1. The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.

The small scale and precautionary management arrangements (Appendix IV) for the NT Trepang Fishery are in place so that catch levels of the target species are maintained at acceptable levels.

Assessment of the target species is currently not available, but the proposed research and observer programs and the subsequent increased availability of data will enhance the ability to undertake assessment of these species in the future. This will be complemented in the longer term by the ongoing data collected through the daily logbook program.

Based on historical data from the early stages of the NT fishery (1880's to 1904) collected by the SA Government, catch levels of trepang are being maintained well below what appeared to be long term sustainable levels of around 1000t/year wet weight (Appendix I). Average landings over the last six years in the NT fishery are 142t with the highest reported catch of 320t taken in 1999/2000 (Table 1).

Some level of localised depletion may possibly occur during normal fishing operations, but the existing fishing practices sees licensees invoke voluntary 'move on' provisions, if and when, catch rates or sizes decreases. It is also common practice for fishers to not return to recently fished areas for a period of time. However, this varies from place to place depending on the characteristics of the area being fished, environmental conditions, fisher skills and the behavior of trepang.

Byproduct and bycatch species in this fishery are considered to be non-existent, therefore are considered to be at nil risk from this fishery. This will be confirmed through data from the proposed observer program and ongoing logbook monitoring. This ensures minimal risk to the sustainability of non-target species in the NT Trepang Fishery.

Regular monitoring and review of the fishery, together with future research, will further enhance the precautionary management arrangements in place for maintaining ecological viable stock levels. Table 2 provides the triggers identified for this fishery to maintain viable stock levels.

1.1.1 There is a reliable information collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring.

Fishery dependent data is currently collected for the NT Trepang Fishery through a comprehensive daily logbook system. Although fishers are entitled to catch all species listed on the licence condition in Appendix XX, *H.scabra* is the only species landed. There are no records of species other than *H.scabra* landed for the fishery. For this reason and for the purpose of the DEH assessment, species other than *H.scabra* are considered byproduct species (until catches indicate otherwise).

Due to the small size of the fishery and nil byproduct and bycatch in the fishery, future research and assessments will be focused upon the key target species (*H.scabra*). Data from the proposed observer program will be useful to confirm the nil impact on any non-target species.

Fishery Dependent

Logbooks

Commercial trepang fishers are required by legislation to complete and return daily logbook data to the NT Fisheries Group (Appendix III). The logbook must be completed for each day that fishing takes place and includes; species, fishing method, catch (numbers, weight and species); effort (number of divers and fishing time); depth fished and fishing location. From this information amongst other things, catch, effort, area fished, the CPUE and average size of trepang can be ascertained.

Licensees are also required under the Fisheries Act to provide marketing details including point of sale, the level of processing undertaken and the weight of individual species sold (Appendix III). This information provides a validation mechanism for assessing the reported catch.

Compulsory logbook data must be returned together with monthly market summary sheets by the 28th day of the following month. Fisher logbooks are cross-referenced against market returns on entry into the database. Any discrepancies detected through data entry are investigated.

The logbook data provides catch and effort information which can be utilised in stock assessment modeling. Commercial logbook data has been collected from fishers operating in the NT Trepang Fishery since its reintroduction in the NT in 1992. Due to the relatively limited amount of fishing activity in the fishery since 1992, it will take a number of years to build a meaningful data set from which to establish fishery trends and encompass natural fluctuations. The value of the data set will improve, as will its utility, as spatial and temporal spread increases.

This lack of fishing data is exacerbated by the fact that those involved in the NT trepang fishing industry also undertake fishing activity in WA, Qld and the Coral Sea and move boats and crew between jurisdictions to fill the shortage of experienced divers and skippers (Torelli pers com 2003).

Specific data on catch and vessel numbers are available from fishing in the 1880's to 1904 via excise and tax information collected from Macassan fishermen by the SA Government (Appendix I). This will be available to be factored into any assessments that may take place. However, their value for specific stock assessments may be limited, but will still provide a broad understanding of the high level of removals over a prolonged period that appears possible from NT waters.

Logbooks have been revised over time to provide what is considered necessary data that will be useful in fishery dependent stock assessment models. The level and reliability of information is appropriate given the size and extent of the fishery. Nevertheless, NT Fisheries Group will continue to refine the logbook and data entry process together with the validation of market returns. This process has enabled all data from 1996 to present to be revalidated. Pre 1996 logbook information still requires reviewing and standardisation so that it is compatible with post 1996 data.

Based on logbook data and an understanding of the fishery practices, the level of bycatch and byproduct taken in the fishery is nil.

Monitoring

Onboard monitoring does not currently take place in the fishery, but an independent industry funded observer program is proposed for commencement in 2004, subject to final approval. The program will collect a range of data on fishing procedures, areas fished, target species, confirm bycatch and byproduct levels and monitor any environmental impacts of the fishery. Observers will also be able to validate catch returns and audit the manner in which logbooks are completed. Information collected will be prepared into observer reports.

The EPBC Act requires fishers to report any interaction with listed threatened species found in Commonwealth waters. None have been reported for this fishery. As of July 2003 all NT Fisheries Logbook cover sheets provide details of the legislative reporting requirements to the Commonwealth of any interaction with threatened species.

Fishery Independent data

Due to the limited financial and human resources available to the NT Fisheries Group, no fishery independent research on the dynamics or life history of trepang populations is currently available on the NT Trepang Fishery. This lower priority was based on the perceived lack of threat to this resource in NT waters under the existing arrangements. Research from other jurisdictions is utilised when available and if relevant.

With the ongoing development now in the fishery, it has been proposed by Industry and Government that an industry funded 3rd party audited research program be developed with a proposed commencement in 2004. The project should take between two to four years to complete. The program will be extensive and aim to evaluate the status of fished and unfished trepang grounds, identify preferred habitat, nursery or other significant areas, evaluate the efficiency of contemporary fishing methods and collect and analyse data for future use in managing NT stocks, including species composition and distribution.

The survey will have a high level of industry participation and provide a wealth of fishery independent data that can be used to assist in determining the spatial structure of Holothurian stocks and possibly make predictions regarding sustainable yields. It may also provide a fishery independent method of assessing abundance, spatial distributions, review appropriateness of size limits and population structure. Not only target species information will be collected, but also data on habitat, depth, sediment type, benthic communities and although improbable, any incidental catch.

The proposed research project expects to collect data on a range of variables including:

- species and numbers harvested
- length of specimens and range of weight measurements
- gonad condition
- water temperatures/salinity
- weather conditions
- depth fished
- moon and tide phase
- sediment/bottom samples.

The final report will be peer reviewed and any relevant findings will be incorporated into future management arrangements. It is hoped that this project will be able to help fill many of the current information gaps on life history parameters, abundance, densities and stock structure identified at the Trepang Workshop in Brisbane in 1997 (Damschke 1998).

An onboard observer program is also proposed to document vessel and gear details, location, depth fished, fishing practices, catch composition, ground type and to undertake biological assessment of species taken. As part of this program any data suitable for assessing the fishery activities with regard to adverse impacts on the wider marine ecosystem can be collected. Subject to final approval, the program is scheduled for commencement in 2004 and will complement the proposed research program.

Additional research projects

Further independent and/or collaborative research opportunities that arise will be undertaken to expand the level of knowledge about the biology, ecology and sustainability of Holothurian resources of the NT.

1.1.2 There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and/or reproductive capacity. Review should take place at regular intervals but at least every three years.

Annual Review

The performance of the NT Trepang Fishery is reviewed annually and reported through the publication of annual fishery status report, reports to DEH and at the NAFMW.

The fishery status report provides current information on catch, effort, stakeholder participation, research, compliance and management together with major issues that have occurred throughout the year. As of the 2004 reporting year, status reports will report on objectives, performance indicators and triggers and how the fishery is performing against those criteria. The status report is distributed to major stakeholders and representative groups and is readily available from the NT Fisheries Group, or online from NT Government websites, www.dbird.nt.gov.au.

The report to DEH provides information on the status of the fisheries and how it is meeting its performance against the criteria determined by DEH.

Stock assessment

There is currently no formal stock assessment available for the NT Trepang Fishery. The existing logbook data set is building a valuable record of catch and effort data which can be used for stock assessment purposes. However, due to the relatively limited fishing activity in the fishery, it will take a number of years to build a meaningful data set from which to establish fishery trends. This lack of fishing data is exacerbated by the fact that those involved in the NT trepang fishing industry also undertake fishing activity in WA, Qld and the Coral Sea and move boats between jurisdictions to fill the shortage of experienced divers and skippers (Torelli pers com 2003).

A PhD. thesis undertaken in 1995 sought amongst other things to develop a model suitable for assessing the status of the NT Trepang Fishery. The author estimated an MSY of 169t with a 122t TAC for the fishery, but cautioned that the results were misleading because substantially different values could generate the same likelihood. It was further noted that the results were uncertain and not robust enough to apply 90% confidence levels (Carter 2001). Consequently, the stock assessment is considered unreliable and therefore not applied.

These findings underlie the uncertainty about biomass and productivity of the NT fishery and highlight the danger in developing models when there is considerable uncertainty about the data, biological parameters and fisher behavior. It is anticipated that as the temporal and spatial quality of the logbook data improves and with increased fishing activity, the data will most likely increase in value for stock assessment purposes. This will be further enhanced

by the proposed observer and trepang research project data. It is anticipated that this research data will take at least two to four years before it becomes available in a form suitable for modeling.

Problems have been identified with attempting to use traditional size based research, due to the difficulty in accurately measuring animals and determining a length/weight relationship due to seasonal variations of condition, gut content and species response to handling. There are also significant difficulties with attempting to tag these animals by traditional methods, as they appear to lose tags in a short period of time (Damschke 1998).

A proposed research project (see 1.1.1) will seek to collect data on trepang, in the existing fishery, in deeper waters outside the fishery and also other relevant environmental data. The data should, in conjunction with the logbook and observer data, provide a sound basis for further analysis and development of stock assessment models.

Catch levels remain well below what appears to be historical longterm sustainable levels which averaged around 1000t/year over a 20 year period from the 1880's to 1904 (Appendix I). Average landings over the last six years in the NT fishery have been 142t with the highest reported catch of 320t taken in 1999/2000 (Table 1).

Considering the small scale of the fishery, current fishing practices, management arrangements and limited resources available to the NT Fisheries Group the existing process is considered adequate at this stage. As further data becomes available this will be factored into any assessments.

1.1.3 The distribution and spatial structure of the stock(s) has been established and factored into management responses.

Logbook data provides information to assist in determining the spatial distribution and stock densities in the NT Trepang Fishery. Data within this fishery is reported based on 35 statistical grids around the coast, with finer descriptions of areas within those grids. Appendix VI shows the frequency of areas fished during 1996 to 2002. This information has contributed to the process that determines the current management arrangements in the fishery.

The fishery is currently zoned into two inshore fishery management areas, plus an offshore area which is afforded complete protection to harvesting. This zoning is considered a safeguard for the fishery in this developmental stage as it provides permanent protection to the offshore portion of the fishery. This may assist in providing potential propagation areas and a source of larvae whilst acting as a buffer to fishing activity.

The interrelationship between the inshore and offshore stocks is not fully understood, but research has shown that there is genetic mixing of trepang from these areas. It is believed that juvenile *H. scabra* may settle in shallow seagrass beds and later migrate offshore to deeper waters to spawn (Uthicke and Benzie 1998). It is for this reason, harvesting from waters outside the current fishing area has not been permitted as the current offshore closure may provide protection to larger sexually mature animals. This is considered a precautionary response at this stage for the protection of the resource

The NT Trepang Fishery is managed as a single stock of the key target species, sandfish. Until such time as research findings differ, the current management arrangements and controls are considered adequate to ensure sustainability.

The new research project may assist in further clarifying the spatial structure of stocks in NT waters and such information can be factored into any management arrangements.

Adjustments to spatial zoning may be an option should indicators show significant variation between locations.

1.1.4 There are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

Reliable estimates of total removals by commercial operators in the trepang fishery are provided via compulsory daily logbook returns. This information allows for accurate estimations of stock removals by licensed operators that can be factored into stock assessment models and refining sustainable catch levels.

All NT commercial fish processor/traders are licensed by the NT Fisheries Group and are required to complete compulsory log sheets identifying the quantity, form and source of the product they purchase. This information can then be used to validate reported landings from commercial fishers. The NT Fisheries Group undertakes an annual review of logbooks and data to ensure the data collected provides an appropriate level of information for stock assessment. All logbook data since 1996 has been revalidated and is considered to be entered 100% accurate.

Fishing Tour Operators (FTO's) are also required to provide daily logbook returns on catch landed. There have been no reports of trepang being taken by this group.

Estimates of removals by the recreational sector are provided by recreational fishing surveys. The first of these surveys (Fishcount 95) was designed to collect information on recreational fisher participation, catch and effort and was conducted between November 1994 and February 1996 (Coleman 1998). There were no reports of trepang being taken by this group. The second Territory wide survey (NRIFS 2002) has an indigenous component and there were no reports of trepang being taken by this group or recreational fishers during the period of the survey (Coleman pers comm. 2003).

There are no obvious circumstances or incentives for fishers to discard target species in the NT Trepang Fishery and there is no byproduct. There are no quotas in place, holding and processing facilities are adequate, the market accepts all landings, the fishery is highly selective and unwanted product is not harvested.

There have been no reports of at sea discarding of these species, or reports of illegal activity in NT waters. As such, reported landings are considered reliable estimates of all removals.

Incorporation into stock assessments

Whilst there is reliable logbook data available on the NT Trepang Fishery, the spasmodic nature and subsequent irregular levels of effort between jurisdictions (fishers move and operate between jurisdictions), creates difficulty in the development of reliable stock assessments. Boats, skippers and crew move between jurisdictions as there is a shortage of experienced divers and skippers available to harvest resources in all these jurisdictions (Torelli pers com 2003).

As such, it would be unsafe to try and build dependable and reliable stock assessment models based solely on this data at this time. This is because fishing effort is spasmodic, there is not a clear understanding of what affects fisher behavior and if there is any correlation to abundance and fishing pressure. This was highlighted in Carter's thesis (Carter 2001). However, as more years of data is accumulated and is combined with data collected via the proposed observer and research programs, reliable modeling may well be

possible. With this in mind, the current conservative management arrangements are in place as a precaution in the absence of a reliable and current stock assessment.

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested.

Historical production data from foreign fishers provides an indication of the high level of removals that are possible from the fishery over an extended period. These were much higher than the existing catch (Appendix I). Catches in the period from the 1770's to the late 1800's in northern Australia, including the NT, may have been as high as 6000t, but on average in the vicinity of 3000t/year wet weight (MacKnight 1976).

SA Government records from 1882 to 1904 show that catches in NT waters ranged from 300t to 2500t and averaged 1000t wet weight during that period (Appendix I). The decline in catches after 1904 was not in response to stock abundance issues, but as a result of Government policy that saw restrictions on foreign fishing activity (MacKnight 1976).

As discussed in 1.1.2, a PhD. thesis sought amongst other things to develop a model suitable for assessing the status of the NT Trepang Fishery. The author estimated an MSY of 169t with a 122t TAC for the fishery, but cautioned that the results were possibly misleading because substantially different values could generate the same likelihood. It was further noted that the results were considered uncertain and not robust enough to apply 90% confidence levels (Carter 2001).

These findings underlie the uncertainty about biomass and productivity of the NT Trepang resources and highlight the danger in developing models when there is considerable uncertainty about the data, biological parameters and fisher behavior. It is anticipated that as the temporal and spatial quality of the logbook data improves and with increased fishing activity, the data will most likely increase in value for stock assessment purposes. This will be further enhanced by the data from the proposed observer and trepang research project. It is anticipated that this data will however take at least two to four years before it becomes available in a form suitable for modeling.

Problems exist with attempting to use traditional size based research due to the difficulty in accurately measuring animals and determining a length/weight relationship due to seasonal variations of condition, gut content and species response to handling. There are also significant difficulties with attempting to tag these animals, as they appear to lose traditional tags in a short period of time (Damschke 1998).

Current estimates can only be refined as more fishers become active, improved temporal and spatial associated logbook data becomes available and the results from the proposed research and observer programs come on line.

In the interim, the current conservative management arrangements are considered sufficiently precautionary to ensure productivity of the stock is sustainable.

1.1.6 There are reference points (target and/or limit), that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.

The NT Trepang Fishery is managed in accordance with the management objectives, performance indicators, trigger and management actions listed in Table 2. An appropriate management response if a trigger point were reached would be made by the Director in

consultation with stakeholder groups in the interests of ensuring the ecological sustainability of the fishery and the ecosystem that supports it.

Alternatively, the Minister can declare immediate emergency changes under the provisions of the Fisheries Act, (Division 1, subsection 29). The same emergency provisions apply for target species, byproduct and bycatch species.

The strategic management arrangements of the NT Trepang Fishery are continually reviewed and assessed at the NAFMW and in the compiling of the annual status report.

Due to the uncertainty about possible sustainable yields, but acknowledging the high historical catch levels taken in the fishery, the triggers points are designed to allow the NT Fisheries Group to interpret what is happening in the fishery by using a range of indices that allow the general health of the fishery to be assessed. This multi-faceted approach ensures that one factor may not cause an over reaction in this developing fishery, but if combined with a series of indicators will prompt a review of the fishery and ensure the implementation of appropriate remedial actions.

These triggers are not bottom lines or upper limits, but are considered what are reasonable and precautionary at this time with the data available. It is anticipated that by building on the logbook data, including observer information and incorporating findings from the proposed research program, these trigger points will be further developed and refined through a more robust and scientifically validated process.

In the face of only historical catch data being available and no valid sustainable yield determined, available through modeling, the draft FRDC - ESD Assessment Manual recommends that upper catch limits are set at 75% of the average annual catch that was taken during a period that catches were considered sustainable (Fletcher et al 2003).

The most valid long term time series relates to the data collected between 1882 and 1904 by the SA Government. That information showed catches over a 21 year period, when heavy fishing took place, averaged 100t of dried trepang. This equates to 1000t wet weight even though the fishery was facing severe limitations to operation due to the restrictive policies imposed by the south Australian Government at the time (Appendix I). This data provides coverage of a series of good and bad years with much higher levels of exploitation than the current data set from 1992 but well below the reported maximum harvest rate of 3000t per annum. As such an interim trigger point could be set at 750t wet weight, but this would be in excess of twice the highest reported catch (320t in 1999/2000) since the fishery recommenced in 1992 (Table 1).

It is considered prudent to not set the trigger at this maximum level, but to instead reduce it to 640t. This equates to twice the highest reported catches taken since 1992 and allows for continued growth in the fishery, within what is considered a sustainable harvest level. Current catches are well below this point (Table 1). This trigger level is justified based on the low number of participants in the fishery (6 with only 3 active), operating well below previously harvested levels with access to an enormous coastline. There is no trawling in the area and no other impact from other fisheries. There is also no recognised habitat degradation with the fishery operating in isolation from any other potential impacts.

Fluctuations in CPUE are expected in a developing fishery and can occur for a number of reasons as previously outlined. To even out these variations it is considered appropriate to smooth these perturbations by averaging CPUE over the last three reporting periods and basing any trigger on those figures. Again, during the developmental phase it is more appropriate to look for trends or downswings such as occurred in Torres Strait and Great Barrier Reef (GBR) trepang fisheries. As such the interim trigger point is set so that if there

is variation of 30% on the three year average CPUE, a review of management arrangements will occur and appropriate remedial action undertaken (Table 2).

Based on occurrences in other jurisdictions a change to targeting other, or lower grade species has often preceded a collapse, or could be considered as evidence of overfishing in the fishery. As such, it is considered prudent to put in place a trigger that will be activated if the catch of species other than *H. scabra* increases to more than 30% of the total catch (Table 2). *H. scabra* currently makes up 100% of the reported catch.

The average weight of trepang harvested since 1996 has remained relatively constant (Figure 3). A decline in the average weight is considered an appropriate trigger as this may indicate a reduction in the average size of individuals in the population. As such a trigger will be activated if the weighted average of *H. scabra* decreases by more than 20% (Table 2).

The report has a number of times commented on the stable licensing arrangements in the fishery and how as one company owns all licences, there would be little benefit in them overexploiting the resource for short term gain. However, if licences were traded the same level of resource stewardship may not necessarily be evident. As such it is considered prudent to put in place a trigger that will be activated if any licences are traded (Table 2).

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Table 2. Management Objectives, Performance Indicators, Interim Trigger Points and Management Actions Used in the NT Trepang Fishery

Species/Group	Management objectives	Performance indicators (valid for life of plan)	Interim Limit reference point (valid for life of plan)	Management response to be taken
Target species	Ensure intergenerational equity by maintaining ecologically sustainable annual catches in all sectors	1. Sustainable yield estimates developed 2. Change in total catch 3. Change in CPUE 4. Change in average weight 5. Change in catch composition 6. Change in licence ownership	1. Triggers to be refined when yield estimates developed 2. Total catch increases to over 640t/year. 3. The rolling three year CPUE average varies by a factor of 30%. 4. Weighted average decreases by more than 20%. 5. Catch of trepang species other than *H. scabra* increases to over 30% of total catch. 6. Any licences traded.	• Director to be notified within 60 days if trigger reached • An internal examination of cause and implication of reference point being triggered with report prepared within six months to Director • Consultation with industry and other stakeholders on need for alternate management strategy or action if necessary and agreement on line of action • If appropriate, any amended arrangements to be implemented within 12 months of trigger being reached
Byproduct species	Ensure sustainability of byproduct species taken in the NT Trepang Fishery	- Monitoring logbook - Onboard monitoring	NA - no byproduct in fishery	NA
Bycatch species	Ensure sustainability of bycatch species taken in the NT Trepang Fishery	- Onboard monitoring - Monitoring logbook	NA - no bycatch in fishery	NA

Endangered, threatened or protected species and/or communities	Ensure the continued protection of species and communities listed under the *EPBC Act 1999* and *Territory Parks and Wildlife Act*	- Endangered, threatened or protected species and or communities are identified in NT waters - Onboard monitoring - Monitoring logbook	- Identifiable impacts observed by commercial fishers, observers or other agencies regarding EPBC listed species or communities. - Any relevant new species or communities listed.	• Director to be notified within 60 days if trigger reached • Consultation with stakeholders and agreement on line of action regarding implementing a threat abatement plan, if required. • Amended arrangements to be implemented within 12 months of trigger being reached.
Ecosystem components	Minimise effects on ecosystem components	- Identification of any threatening processes - Onboard monitoring	- Identification of significant negative interaction with components of the natural ecosystem present on fishing grounds.	• Director to be notified within 60 days if trigger reached • Consultation with stakeholders and agreement on line of action regarding appropriate remedial action. • Amended arrangements to be implemented within 12 months of trigger being reached.

1.1.7 There are management strategies in place capable of controlling the level of take.

A limit on the total number of operators that may participate in the fishery and regulations on the type and amount of gear used can control the level of take within the NT Trepang Fishery and maintain it within appropriate limits.

The effort, gear and minimum size limit controls aim to ensure overall landings of target species do not exceed sustainable levels. The impacts on threatened species and the environment are negligible and therefore well within acceptable limits. There are also a number of natural factors that provide protection to the resource, such as the extensive area of the fishery, large tidal range, poor visibility affecting fishing, the monsoon season and the natural burrowing behavior of the animal.

Details from the fishery including catch and effort are gathered from statutory daily logbook data. This information is reviewed in compiling the annual status report and through regular assessments. The proposed observer programs records will provide information on all landed species and will confirm no take of any, byproduct, bycatch or interaction with threatened species.

The current management strategies are considered appropriate to detect changes in fishing effort, catch level and composition. Triggers and management responses provide the means to respond and control the level of take in the fishery if necessary.

In the event of a triggered response, the Director, through a consultative process, will initiate appropriate action if required, to ensure long term sustainability of the fishery.

The last two recreational surveys revealed a nil take from the recreational fishing sector. Therefore there are no controls in the form of possession or size limits on the non-commercial sector. Further recreational surveys will aim to be undertaken (every five years) to determine any developments in this sector.

There are provisions under section 29 of the Fisheries Act, which enable the Minister to take appropriate remedial actions, including closing the fishery if an emergency occurs that threatens the resources sustainability.

Compliance arrangements seek to maximise voluntary compliance, deter non-compliance and seek intelligence on any possible infringements though various sources including the general public via programs such as the FISHWATCH hotline. The annual Australian Fisheries Law Enforcement Conference (AFLEC) provides an opportunity for NT compliance officers to discuss and refine compliance strategies for this and other NT fisheries. The enforcement and compliance operations for the NT Trepang Fishery are considered appropriate and a sufficient deterrent in light of current fishing practices. However, the NT Fisheries Group and PMFEU will undertake a compliance risk assessment by December 2004.

If required, there are a number of management strategies that can be utilised in the fishery to adjust and control the level of take from the fishery. Some of these are already in place, but could be adjusted if there was a need. These are expanded as follows.

<u>Adjusting Minimum size limits</u>

Applying minimum size limits generally seeks to ensure that at least 50% of the harvested stock has reached sexual maturity prior to harvest. For trepang, it has been suggested that the limit be 20% greater than length/weight ratio of the size at first maturity given some

concerns about accurately determining the size of trepang. Growth parameters for NT trepang stock are not readily available.

Compliance with minimum length/weight restrictions is problematic as trepang lack rigid body parts and may alter length in response to actions such as harvesting and processing, but it provides a general guide for those harvesting (Breen 2001). Market demands are for larger specimens and this is what is targeted by the fishery. Data to date from logbooks has not indicated any decrease in average size of individuals taken in the fishery (Figure 2).

Independent onboard monitoring of commercial operators will seek to record a length/weight relationship in key commercial fishing areas. This will be undertaken over the next two years of a monitoring project, subject to final approval, and the existing limits can be reassessed if necessary.

Gear/Effort Controls

Existing gear controls have been implemented to restrict overall harvest levels and to afford protection to deeper water populations. Whilst initially there was a ban on the use of underwater breathing aids in the fishery, such restrictions were removed to afford an appropriate level of protection from crocodile and shark attack, so that divers can use safety cages to harvest trepang.

The use of trawls, dredges or similar devices for the harvesting of trepang is not permitted. Only hand harvesting is allowed.

A number of variables could be adjusted to reduce fishing effort, including further restricting the existing diver numbers from four at any one time, dive hours or fishing days. However, any such action would need to be cognizant of dangers to divers, operational and economic constraints involved in working in the vast distances prevalent in the NT fishery.

Zoning

The implementation of a zoning scheme provides a mechanism for spatial responses to changes in abundance or affords protection to areas of special interests. The fishery is currently zoned into two restricted inshore fishery management areas, plus an offshore zone which is afforded complete protection to harvesting. This zoning may be a significant safeguard for the fishery in this developmental stage as it provides permanent protection to the offshore portion of the fishery. This may assist in providing propagation areas and be a source of larvae whilst acting as a buffer to fishing activity (Uthicke and Benzie 1998).

Planktonic sandfish larvae spend 10 to 14 days in the water column before settlement (Battaglene 1999). There is therefore, potential for larval dispersal between populations. Recent research suggests population connectivity over relatively short distances (Uthicke and Benzie 1998).

There are some natural closures in the NT fishery as fishing does not generally take place near mangroves, areas with poor visibility, areas with uneconomical number of premium specimens and if there is risk from crocodiles or other predators. Formal closures are currently in place in the waters adjacent to Kakadu National Park to low water and two small aquatic life reserves in Darwin Harbour.

Additional spatial zoning and area controls, including closed areas may be an option should indicators show significant variation between locations or the needs for such measures.

General Powers of the Director

The Director has powers under the Fisheries Act to impose additional management controls via new regulations, Gazettal notice or by amending altering and/or, revoking licence conditions.

Emergency Powers of the Minister

In the event of an emergency that may endanger fisheries stocks or the environment, section 29 of the Fisheries Act allows the Minister to:

- halt all or any fishing in that fishery or any part of that fishery
- restrict the number of vessels used
- restrict the amount of fish that may be taken or
- restrict the amount or nature of the fishing gear used.

Each notice under this section shall be given for not more than 28 days but may be amended, revoked or renewed by the Minister by a subsequent notice. During this period other legislation can be enacted if required.

Alternative management controls

Restricted harvesting season

Restricted harvesting seasons are generally implemented to coincide with a specific biological consideration, such as a short spawning seasons, recruitment of juveniles to the fishery or allowing animals to reach an overall size (to maximise biomass and/or value). They are also used to reduce the duration of a fishing season and hence limit the overall level of removal.

Sexual reproduction of trepang is via broadcast spawning generally in the warmer months (December to February) in the southern hemisphere. It is during this time in the NT that water visibility is low due to impact from the wet monsoon period, and harvesting activities are generally low or not possible at all from November to April due to poor water visibility, strong currents and strong winds. Thereby as a result of a natural occurrence, the majority of the spawning season is already protected.

Unless there is a change in species behavior or increased catchability during spawning, there may be actually limited benefit only providing protection at that stage of the life cycle. A better strategy is to ensure that there are sufficient individuals available to breed (Damschke ed. 1998).

From an economic perspective the use of unnecessary or inappropriate closed seasons could place unnecessary economic hardship on some operators.

Due to the characteristics of the fishery and seasonal monsoon activity in the NT, it is not considered necessary to legislate to restrict harvesting seasons at this stage.

Total Allowable Catch (TAC)

The setting of a Total Allowable Catch (TAC) together with the allocation of individual catch shares or individual transferable quota (ITQ) has been promoted in some circles as a means of addressing specific concerns about excess capacity, overfishing and stock sustainability. The use of ITQ seeks in theory to remove competition between fishers and the subsequent race to take the greatest share of the catch.

However, if quota is set too low, the forgone catch could wipe out any future economic gain, especially if those loses have a cumulative effect (Walters & Pearse 1996, Walters 1998). If

set too high it could contribute to a collapse of the fishery, especially if the use of quota is the main management tool in place (Walters 1998).

Quota management is based on the setting of an annual TAC and being able to adjust it regularly to reach some level of long term sustainable catch. The process relies on determining the biomass, optimal harvest rate and having a sound understanding of recruitments, its variation and fisher behavior. Quota is best suited to fisheries that have:

1. relatively long lived species
2. stable stock or resource fluctuations are well understood
3. selective fishing methods
4. well understood stakeholder activities
5. known bycatch issues
6. reliable annual stock assessments.

Although the NT Trepang Fishery has some favorable characteristics for quota management it fails as an ideal candidate for quota on a number, namely points 2, 4 and 6 above.

Due to the current uncertainty about upper limits of stock size and the lack of a reliable annual stock assessment, there would be no scientific validity in putting in place quota to protect the resource. The only attempt to date at determining a sustainable yield for the fishery proved deficient in that the data did not allow for any confidence levels or standard deviations to be determined. This is an indication that the data was uninformative and would need to be further enhanced with a longer time series to be collected before such an assessment based on logbook data alone could provide scientifically valid estimates.

A number of compliance issues arise due to the remote nature of the fishery, the various forms the product is stored in (dry, wet, frozen, gutted, cooked) and limited compliance resources would lead to difficulties for the enforcement of TAC's in the NT.

At this stage, the fishery is still developing and one company controls all NT Trepang Fishery licences. Given the licensees considerable investment, it is in its interest to ensure the sustainability of the fishery, particularly given the current supply/demand relationship for trepang. If the licensing situation alters the NT Fisheries Group will need to asses the impacts of any such change on the sustainability of the resource.

The use of TAC's is not considered appropriate for this fishery in the NT. If there is greater understanding of the biomass, the fishery's responses to harvesting are determined and compliance issues can be resolved, quota management could be considered at some time in the future if it met the management goals for the fishery.

There are no recreational limits in place to control the potential catch of individuals in this sector.

1.1.8 Fishing is conducted in a manner that does not threaten stocks of byproduct species. (Guidelines 1.1.1 to 1.1.7 should be applied to byproduct species to an appropriate level)

The NT Trepang Fishery currently focuses on a single target species, sandfish, although other Holothurians may be targeted in the future. Due to the fishing method of hand harvesting individual live specimens there is no take of incidental or unintended byproduct species and fishing related mortality is considered to be nil.

Currently no non-target species or byproduct species are reported in the catch. The proposed observer program will monitor and report to confirm the validity of nil logbook reports.

1.1.9 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

The NT Fisheries Group has adopted a precautionary and conservative approach to managing the fishery since its reinception in 1992. The management arrangements aim to reduce the risk of uncertainties by limiting the total number of licences available, fishing capacity and protecting adequate numbers of breeding stock. The adoption of such a strategy ensures that potential fishing effort has a high probability of not exceeding a sustainable harvest level, acknowledging that historical limits were a significant magnitude higher than current fishing effort.

Management responses are considered appropriate to ensure overall landings remain within the interim limits (Table 2). Appropriate trigger mechanisms are in place to prompt a review should overall landings approach or reach these limits. As yield estimates are not known, changes in catch, effort, CPUE, average size, catch composition and industry structure will be monitored. Any significant variations will prompt a review of management arrangements for protection of any species concerned and remedial action will be implemented.

Byproduct and bycatch in the NT Trepang Fishery is considered to be nil and there is considered to be nil risk to these species in the fishery.

Provisions under the Fisheries Act allow the Director to take appropriate action for the protection of the fishery by ensuring total landings are considered within safe limits. In addition, the Minister has the capacity to close the fishery if there is a serious threat to the resource.

Objective 2. Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

1.2.1 A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock.

and

1.2.2 If the stock is estimated as being at or below the biological and/or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a 'whole of fishery' effort or quota reduction are implemented.

Not applicable, as no stock is currently considered over fished.

There is no evidence to suggest that the NT Trepang Fishery has been overfished in the past or has ever been below any biological bottom line during its long history. Current precautionary management arrangements aim to ensure that stocks are maintained at sustainable levels.

Sections 28 and 29 of the Fisheries Act provides for a management response, including emergency measures, if required.

PRINCIPLE 2

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

Objective 1. The fishery is conducted in a manner that does not threaten bycatch species.

There are currently no bycatch species, including endangered, threatened or protected species taken in the NT Trepang Fishery. Consequently, the NT Trepang Fishery is meeting Objectives 1 and 2 of Principle 2.

2.1.1 Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch.

Not applicable

Due to the very selective fishing method (i.e. hand collection of live individual specimens) the probability of bycatch is nil and all species taken would be sold as part of the catch. Compulsory logbook catch data and market logbooks have not reported any take of species other than target species in the fishery.

The proposed observer program will enable onboard monitoring of the NT Trepang Fishery and provide monitoring data, suitable for confirming the nil take of bycatch species.

2.1.2 There is a risk analysis of the bycatch with respect to its vulnerability to fishing.

Not applicable.

2.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

Not applicable.

2.1.4 An indicator group of bycatch species is monitored.

Not applicable.

2.1.5 There are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers.

Not applicable.

2.1.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Given the low level of fishing effort, the low impacting, highly selective and benign fishing methods used in the fishery it is extremely unlikely that there will be an increase in the level

of impact on bycatch species in the NT Trepang Fishery. This provides the means to ensure the management response achieves the objective of bycatch species sustainability.

If a significant threat is identified, Sections 28 and 29 of the Fisheries Act allow for a review in the management arrangements of the fishery or emergency powers.

Objective 2. The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.

2.2.1 Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

There has been no recorded negative interaction with endangered, threatened or protected species in the fishery although crocodiles, turtles and other macrofauna are sighted. Any interaction would be analogous to normal boating activity. Given the low level of fishing effort and the low impacting, highly selective and benign fishing method it is improbable that there will be an increase in the level of impact on endangered, threatened or protected species in the NT Trepang Fishery.

There are a number of species listed as protected in Commonwealth waters under the EPBC Act and in NT waters under the *Territory Parks and Wildlife Conservation Act*. Recently, the instructions on completing daily logbooks were amended to include information on reporting requirements for interaction with threatened species under the EPBC Act. A leaflet on "Interaction with protected species" and a threatened species list was also distributed with each updated logbook sheet. The logbook amendments and leaflet are to remind fishers of their legal obligation to report interactions with endangered, threatened or protected species to the relevant government agency.

There are no recognised threatened ecological communities in the area of NT Trepang Fishery.

The proposed observer program will enable onboard monitoring of the NT Trepang Fishery and provide monitoring data, suitable for confirming that there is nil impact by the fishery on endangered, threatened or protected species.

2.2.2 There is an assessment of the impact of the fishery on endangered, threatened or protected species.

Not applicable as fishing mortality and interaction of endangered, threatened or protected species is considered to be zero.

2.2.3 There is an assessment of the impact of the fishery on threatened ecological communities.

No threatened ecological communities have been identified within the boundary of the NT Trepang Fishery.

There is also negligible interaction with seagrass or coral as most effort is focussed on mud/sand and silt areas and divers drift over the sea bottom.

Management responses

2.2.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

There is no reported or observed interaction with endangered, threatened or protected species. Therefore there is no need for further measures to be in place to avoid the capture and or mortality of such species. The method of fishing precludes interaction with these species.

2.2.5 There are measures in place to avoid impact on threatened ecological communities.

Not applicable

No threatened ecological communities have been identified within the designated area of the NT Trepang Fishery, or within any likely impact range of the fishery.

Given the low level of fishing effort, the low impacting, highly selective and benign fishing method it is extremely unlikely that there would be an impact on any threatened ecological community.

If a threatened ecological community is identified in the future, provisions under the Fisheries Act allow appropriate action to be taken.

2.2.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

On the basis of no recorded or observed adverse interaction of NT Trepang Fishery with endangered threatened or protected species or threatened ecological communities there is currently no specific management response for the fishery.

However, as data from the proposed observer program become available, the suitability of the current measures will be reviewed and appropriate preventative measures undertaken, if required (see Section 28 and 29 of *Fisheries Act*).

Objective 3. The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.

The limited entry and low number of participants, passive, benign and highly selective fishing methods and nil bycatch or byproduct in the NT Trepang Fishery minimises the likelihood of impact on the ecosystem generally.

Precautionary management arrangements that focus on maintaining stocks of target species and regular review and assessment will ensure continued minimal impact on the ecosystem. In this respect the NT Trepang Fishery is meeting the performance requirements of Objective 3, Principle 2.

2.3.1 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the fisheries impact on the ecosystem and environment generally.

Due to the relatively small size, low number of participants in the fishery and limited resources available to the NT Fisheries Group, research information regarding impacts on the ecosystem generally is not available to the extent where all aspects of 2.3.2 could be analysed and evaluated. This situation is not unique, with the amount of information available on these aspects in nearly any of the world's fisheries being extremely limited.

Ecosystem wide research on the possible removal of a species, including trepang is complex, particularly in terms of separating causes and effects.

It is believed though that negative interactions are limited, with the main impact being the removal of a proportion of the trepang population from the environment. The likely effects of this is difficult to estimate, but as the fishery has operated for over two hundred years in waters adjacent to the NT, there has not appeared to be any discernable impact on the ecosystem or environment generally.

Any proposed research program will focus on target species and will remain so until greater certainty in their assessment has been achieved. The proposed observer and research programs may be available to collect certain information if required and resources permit.

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

Due to the relatively small size and number of participants in the fishery, research information regarding impacts on the ecosystem generally is not available to the extent where all aspects of 2.3.2 could be analysed and evaluated. Nonetheless, the impact of the NT Trepang Fishery on these ecosystem components is considered minimal.

1. Impacts on ecological communities

Benthic communities

The majority of the trepang fishing takes place in areas of mud, silt and sand. The effect of selective hand harvesting on benthic communities such as those present on trepang grounds has not been fully assessed. However, the extremely localised interactions on soft sediment with little or no structure are not considered to be a threatening process given the scale of the fishery. During collecting divers operate from live boats which are not anchored, but move with the diver. Mother boats generally anchor in deeper water one or more km offshore.

Ecologically related, associated or dependent species

Due to the relative small size of the fishery and limited number of participants, research specifically aimed at the ecologically related, associated or dependent species is yet to be performed. There are no impacts on any byproduct, bycatch or physical damage to the substrate with any impacts related to the actual removal of a number of trepang from the environment.

Water column communities

Water column communities have not been assessed, as harvesting is directly from the seabed and interaction is considered to be negligible.

2. Impacts on food chains

Structure and productivity flows

The effect of removing a portion of the animals in a trepang fish community is not well understood. Research specifically designed to address this question has not been undertaken, but impacts are considered to be low.

Holothurian larvae maybe eaten by a variety of fish (Hamel et al 2001) and as a group may very occasionally be part of fish or larger gastropods diet (Canon and Silver 1986). Sandfish however contain a biotoxin that can cause death in fish and induce paralysis in mice in laboratory tests (Hamel et al 2001). Observations during experimental work in the Pacific failed to observe any trepang being preyed upon (Mercer et al 2000).

The long history of activity, current low levels of effort and catch, large area available to fish, significant closed areas and selective harvesting practice are considered unlikely to have a significant impact on the food chain.

3. Impacts on the physical environment

Physical habitat

The fishing methods used in the NT Trepang Fishery are unlikely to affect the predominantly mud/sand structure of the sea floor where the fishery takes place. During collecting, divers move above the seabed and operate from live boats that are not anchored, but move with the diver. Mother boats generally anchor in deeper water offshore.

Water quality

The NT Trepang Fishery has a very small number of commercial vessels (currently 3 with a maximum of 6) that use no chemicals in their operation other than fuel. The vast area, tidal movement and wave action, in addition to the small number of vessels in the fleet, reduce the likelihood of any significant impact on water quality.

All rubbish is stowed on board vessels and unloaded at the end of trips.

Any water used in processing is held onboard the vessel, diluted and expelled in deeper water away from bays and inlets.

2.3.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

The existing controls, operational requirements and constraints evident in the fishery build in a level of ecosystem protection. The extremely low number of vessels operating in the trepang fleet, the method of fishing, minimum size limits, no bycatch/byproduct and the extent of actual fished area limit the potential of significant impact on the ecosystem.

Should a threat or significant impact be detected there are provisions under section 29 of the Fisheries Act which enable the Minister to take appropriate emergency remedial actions. The Director also has powers to change licence condition to cease or alter a particular activity that may be damaging the ecosystem.

2.3.4 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

There are no triggers or rules in place as it is believed that the benign nature of the fishery and limited ecosystem impact is not sufficient a risk to warrant specific actions.

2.3.5 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective

The current controls are structured so as that there is a lower risk of severe exploitation, size limits protect egg production, many unfished areas provide sufficient protection to ensure sufficient biomass to ensure sustainability and minimise impact on the environment generally.

Given the considered low risk of the NT Trepang Fishery to the broader ecosystem, it is highly probable that the management arrangements will continue to achieve the objectives of minimal impact.

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Appendices

APPENDIX I. MACASSAN PRAUS AND TREPANG CATCH FROM THE NT COAST 1884 – 1905 *[1]

Season	Number of praus	Dried trepang exported (ton)	Equivalent wet weight (tonne)*[2, 3]
1884/85	13	110	1,100
1885/86	16	200	2,000
1886/87	11	80	800
1887/88	11	250	2,500
1888/89	9	180	1,800
1889/90	10	130	1,300
1890/91	9	98	980
1891/92	8	125	1,250
1892/93	4	87	870
1893/94	8	82	820
1894/95	4	42	420
1895/96	3	48	480
1896/97	5	50	500
1897/98	6	69	690
1898/99	6	95	950
1899/00	5	103	1,030
1900/01	5	59	590
1901/02	6 est	89	890
1902/03	6	66	660
1903/04	4	44	440
1904/05	2	30	300
TOTALS	**151**	**2,037**	**20,370**
AVERAGE	**7**	**average/prau 135 t**	**970**

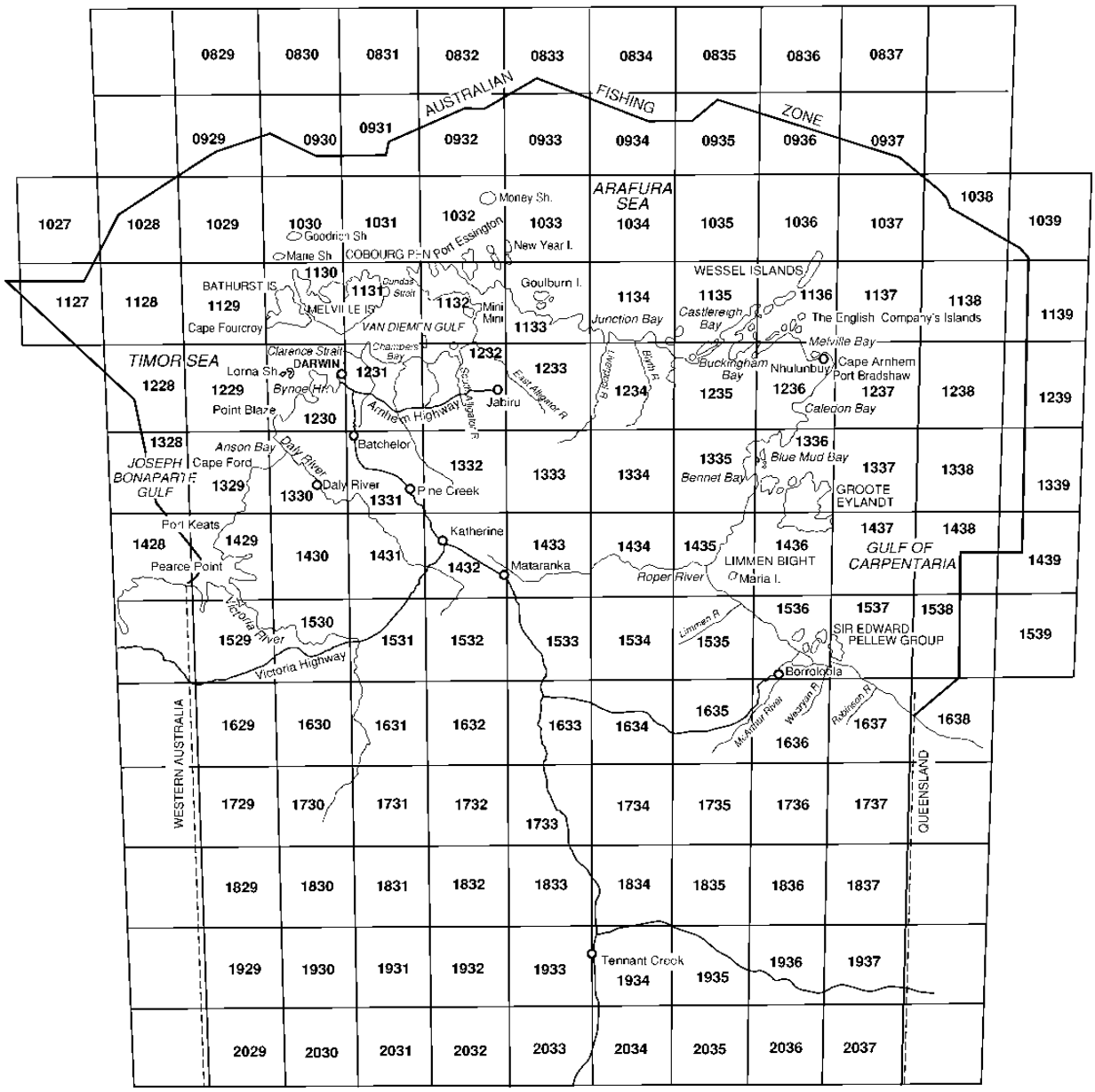
*1 from MacKnight 1976 - sourced from the annual statistical register of the Province of South Australia, compiled from official records in the Office of the Government Statistics printed as South Australian Parliamentary Paper No. 3.

*2 Dry weight to wet weight conversion based on 1 kg dried = 10 kg wet weight

*3 Conversion from ton to tonne is 1 ton – 1.02 tonnes. For report considered as 1:1 (MacKnight 1976)

APPENDIX II. STATISTICAL GRID MAP

NORTHERN TERRITORY OF AUSTRALIA – FISHING GRIDS REFERENCE



APPENDIX III. DAILY NT TREPANG FISHERY COMMERCIAL LOGBOOK – CATCH AND MARKETING

THE NORTHERN TERRITORY OF AUSTRALIA – FISHERIES ACT

TREPANG : DAILY LOG SHEET

LICENCE NUMBER : A13/_____ LICENCE HOLDERS NAME : _____

VESSEL REGO No : _____ PORT OF LANDING : _____

CATCH DETAILS

DATE	TIME SPENT COLLECTING		COLLECTION AREA		FISHING METHOD (tick column)			NUMBERS AND WEIGHT COLLECTED			DEGREE OF PROCESSING (single boil, dried, gutted etc)
	HOURS	NO. PEOPLE	GRID	AREA FISHED	FREE DIVE	HAND	HOOKAH	SPECIES	NUMBER COLLECTED	WHOLE GREEN WEIGHT (kg)	

This log must be completed on each day fishing takes place.

MARKET DETAILS

PRODUCT SOLD (list species)	WEIGHT (kg)	CUT (whole, gutted, etc)	STORAGE (dried, boiled, etc)	DESTINATION	
				NT (public or trader licence number)	INTERSTATE (state and traders name)

If 'NIL' fishing takes place during the month, tick the box. ☐ **Signature of licensee:**_____ **Date:**_____

Government Printer of the Northern Territory

APPENDIX IV. LICENCE CONDITIONS AND DIVISION 13 OF FISHERIES REGULATIONS RELATING TO NT TREPANG FISHERY

LICENCE CONDITIONS

Licence Number

Conditions relating to a licence held in the Trepang Fishery during 2002-2003

Species	Common Name	Min Length (cm)
Holothuria scabra	sandfish	16
Holthuria nobilis	black teat fish	26
	White teat fish	32
Thelenota ananas	prickly red fish	30
Actinopyga echinites	deep water red fish	12
Holothuria atra	lolly fish	15

Area

This licence is issued pursuant to regulation 135 (b) in that the licence shall only operate between Cape Grey, westward to the WA border (or eastward to the Qld border). NOTE: *This depends on which zone the licensee is authorised to fish in*

The trepang fishery is the area extending seaward from the high water mark of the coastline to an imaginary line 3 nautical miles seaward from the baseline.

Harvesting

Trepang shall only be taken in the above mentioned area. Harvesting method shall be by hand collection only. No more than four (4) divers may operate at any one time.

Assistants

A maximum of seven (7) assistants, including divers, may work with the licence during the fishing operation carried out under this licence.

Director

Date / /

Division 13 Fisheries Regulations– Trepang Fishery

134. Declaration of fishery

The industry of taking trepang is hereby declared to be the Trepang Fishery.

135. Number of licences

The Director shall not grant more than 6 Trepang Fishery licences of which –

(a) 3 shall be in relation to the coastline extending east from Cape Grey; and

(b) 3 shall be in relation to the coastline extending west from Cape Grey.

135A. Transfer of licences

A person who holds a Trepang Fishery licence may transfer the licence.

136. Area of fishery

The Trepang Fishery area is the area extending seaward from the high water mark of the coastline to an imaginary line 3 nautical miles seaward from the baseline.

137. Fishing gear

A Trepang Fishery licensee shall not, under the licence, use fishing gear other than hand-held implements, and, where directions in respect of such implements are given by the Director, shall use them only in accordance with those directions.

APPENDIX V. AREAS AND DAYS FISHED IN NT TREPANG FISHERY 1996-2002*

Area	Days Fished	Area	Days Fished
Anuru Bay	3	Mission Bay	2
Arnhem Bay	4	Naiwarung Island	3
Bartalumba Bay	3	Naiwarung Strait	3
Bickerton Island	8	North Bay	3
Blue Mud Bay	8	North Goulbourn	13
Bowen Strait	33	North Junction	3
Cape Arnhem	4	North P Island	8
Castlereigh Bay	3	N West Bay	9
Chasm Island	27	N W Island	8
Christies Bay	2	Popham Bay	3
Dalimbu Bay	4	Port Bradshaw	3
Elcho Island	7	Port Langdon	34
English Co Islands	2	Pt Bremer	13
Goulbourn Island	11	Raffles Bay	2
Grant Island	2	Rolling Bay	30
Guion Pt	3	Sommerville Bay	1
Hardy Island	1	South Goulbourn	13
Hempel Bay	1	Tasman Pt	1
Irgul Pt	25	Trial Bay	1
Junction Bay	3	Turner Pt	1
King River	10	Umbakumba	7
Liverpool River	9	Vanderlin Island	7
Malay Bay	9	Wessel Islands	2
Malay Strait	2	White Cliffs	2
Maningrida	38	Winchelsea Island	3
Mardy Island	3		

* DBIRD (2003)