Ecological assessment of Queensland's East Coast Trochus Fishery

A report to the Australian Government Department of Environment and Heritage on the ecologically sustainable management of a highly selective dive fishery

Brooke Young and Stephanie Challen

With contributions from
Phil Gaffney, Malcolm Dunning, Shannon Ryan and Jeff Bibby

July 2004

Queensland Government
Department of Primary Industries and Fisheries

INTRODUCTION

In 1992, Australian Commonwealth, State, Territory and local governments committed to an ecologically sustainable development (ESD) approach to the use of natural resources (COAG 1992). Fisheries resources were (see Green et al. 1991) and still are (see Fletcher et al. 2003) considered to be one of many specific natural resource foci that fall squarely under the ESD umbrella.

To prompt continued progress towards ESD, the Commonwealth Government introduced the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) and the *Environment Protection and Biodiversity Conservation Amendment (Wildlife Protection Act) Act 2001*. Following these legislative changes, in order for harvested fish species to remain exempt from export controls fisheries management agencies must demonstrate (through ecological assessment submissions) that their fishery management regimes comply with the objectives of ecologically sustainable development. The Australian Government Department of the Environment and Heritage (DEH) is currently auditing the fishery management agency submissions (unless a state has in place alternative audit processes accredited by DEH). All submissions must be based on and satisfy DEH's *'Guidelines for the Ecologically Sustainable Management of Fisheries'*. The Guidelines include a number of individual objectives broadly relating to impacts to target species; bycatch and byproduct species; endangered, threatened and protected (ETP) species; ecologically threatened communities; and the marine ecosystem generally.

This document represents the Queensland Government's ecological assessment submission to DEH for the Queensland East Coast Trochus Fishery (ECTF). The Queensland Department of Primary Industries and Fisheries (DPI&F), has prepared this ecological assessment with the assistance of stakeholders in the fishery. Broadly, the document comprises two parts:

- Fishery Description - providing a detailed description of the fishery; and
- Ecological Assessment - detailing the assessment of the fishery against DEH's Guidelines.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

ACRONYMS

AFMA	Australian Fisheries Management Authority
DEH	Department of the Environment and Heritage (Commonwealth)
CFISH	Commercial Fisheries Information System
DPI&F	Department of Primary Industries and Fisheries, Queensland
ECTF	East Coast Trochus Fishery
ECBDMF	East Coast Bêche-de-mer Fishery
EPBC Act	Environment Protection and Biodiversity Conservation Act (Commonwealth)
ETP	Endangered, threatened, protected (species)
GBR	Great Barrier Reef
GBRMP	Great Barrier Reef Marine Park
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area
OCS	Offshore Constitutional Settlement
PZJA	Protected Zone Joint Authority
QBFP	Queensland Boating and Fisheries Patrol (part of DPI&F)
QFMA	Queensland Fisheries Management Authority (now part of DPI&F)
RFISH	Recreational Fishing Information System

1. DESCRIPTION OF THE FISHERY

MANAGEMENT AGENCIES

The Department of Primary Industries and Fisheries (DPI&F) is responsible for the day to day management of Queensland's fisheries resources. The *Fisheries Act 1994* is the legislative document guiding DPI&F operations, the overarching objectives of which are:

"…to provide for the use, conservation and enhancement of the community's fisheries resources and fish habitats in a way that seeks to -

a) apply and balance the principles of ecologically sustainable development; and
b) promote ecologically sustainable development."

Under Offshore Constitutional Settlement (OCS) arrangements between the Commonwealth and Queensland governments, management of trochus throughout most of the Australian Fishing Zone adjacent to the east coast of Queensland falls under Queensland law. The trochus fishery area of Queenslands east coast comprises all tidal waters, south of latitude 10° 41' south, and east of longitude 142° 31' 39" east.

The Torres Strait trochus fishery operates within the jurisdiction of the Protected Zone Joint Authority (PZJA) for which management activities (licensing and enforcement) are jointly carried out by DPI&F and Australian Fisheries Management Authority (AFMA). Prior to April 1st 1999, the Torres Strait fishery was managed under Queensland jurisdiction by the then Queensland Fisheries Management Authority (QFMA), now incorporated into DPI&F.

SPECIES INFORMATION

Trochus niloticus, also known as topshells or topsnails, are gastropods belonging to the family Trochidae of the order Archeogastropoda. They are marine animals that inhabit intertidal and shallow subtidal areas of coral reefs, mainly in exposed aspects. In Australia, trochus are collected from remote reefs in Western Australia and Queensland either from reef tops at low tide or from the subtidal areas adjacent to the reefs.

Trochus can be distinguished from most other gastropods in having a conical shell. In Australia they can attain 16 cm in shell diameter, but are common around 8-12 cm. The trochus shell contains a layer of mother-of-pearl, which is used for the manufacture of jewellery, buttons, ornaments and cosmetics. Trochus meat is of secondary importance to the shell.

ECOLOGY AND BIOLOGY OF TROCHUS

The average life span for trochus is 15-20 years and most animals reach reproductive maturity by 2 years of age in the wild and 12 months in captivity. The size at which trochus first become sexually mature has been found to be between 5-6.5 cm in diameter. Larcombe (1993) found growth rates for animals in the range of 10-14 cm to vary between locations, with the general trend for smaller shell sizes to be found on southern reefs.

Trochus are dioecious (separate male and female) broadcast spawners and fertilization takes place in the water column. Spawning is initiated by the males, and females spawn in response to the presence of sperm in the water. Females generally spawn for 5-10

minutes, with individuals releasing more than one million eggs (Nash, 1985). Spawning often occurs in synchrony with lunar or tidal conditions, generally occurring at night and within one or two nights of either a full or new moon (Hyland, 1993). Spawning occurs throughout the year in low latitudes and only during the warmer months in high latitudes (Nash, 1985). In the central Great Barrier Reef region, spawning occurs throughout the year.

Subsequent to fertilisation, the eggs hatch into trochophore larvae (planktonic phase) after approximately 12 hours. The larval phase lasts approximately 3 to 5 days and the veligers then settle onto the reef substrate and begin grazing on fine filamentous algae and micro-organisms (Nash, 1985). Trochus adults are largely non-selective herbivores, grazing the epibenthos of a wide variety of biotic and abiotic materials including algae, foraminifera, mollusks and crustaceans (Asano, 1944 cited in Larcombe, 1993).

SHARED FISH STOCKS

The ECTF is adjacent to the Commonwealth managed Torres Strait Trochus Fishery.

The genetic distribution for *Trochus niloticus* within and beyond the boundaries of the ECTF are poorly known, although this species is distributed throughout the tropical and subtropical confines of the Indo-Pacific region between Sri Lanka, the Ryukyu Island, New Caledonia and northern Australia. Larcombe (1993) has however suggested that stocks are dependent on the degree of larval connection between separate reef habitats of *T. niloticus* as adult trochus only occur in their habitat on the reef front and are not capable of moving between reefs (unless transplanted). Considering the limited dispersal of *T. niloticus* (Gillet 1986; Nash 1985; Moorhouse 1933 as cited in Larcombe 1993), Larcombe (1993) suggested that individual reefs or neighbouring reefs along the east coast of Queensland might represent functional unit stocks of trochus. This is discussed further under Guideline 1.1.3. Stocks are therefore unlikely to be shared with the Torres Strait adjoining fishery.

Where stocks may overlap or are split between jurisdictions or are migratory, DPI&F seeks to ensure effective management strategies are applied across jurisdictions through participation in fora such as the Northern Australian Fisheries Management forum and through the development of Memoranda of Understanding where appropriate.

LOCATION AND EXTENT OF THE FISHERY

A full description of the area of the fishery (ie. the Queensland jurisdiction) is shown in Figure 1. The commercial and recreational fishery area for the east coast of Queensland comprises all tidal waters south of latitude 10º41' south, and east of longitude 142º31'49" east. The majority of the east coast commercial trochus fishery operates in the tidal waters between Cape York and Gladstone, within the range of the Great Barrier Reef (GBR). Mackay is the main port for the fishery.

Most indigenous traditional and customary fishing for trochus has been reported to occur north of Palm Island, near Townsville. Indigenous fishers taking trochus for ‘customary or traditional purposes’ are permitted to legally fish in all Marine Park Zones including Marine Park Preservation Zones, thereby effectively having access to stocks throughout the entire east coast of Queensland.

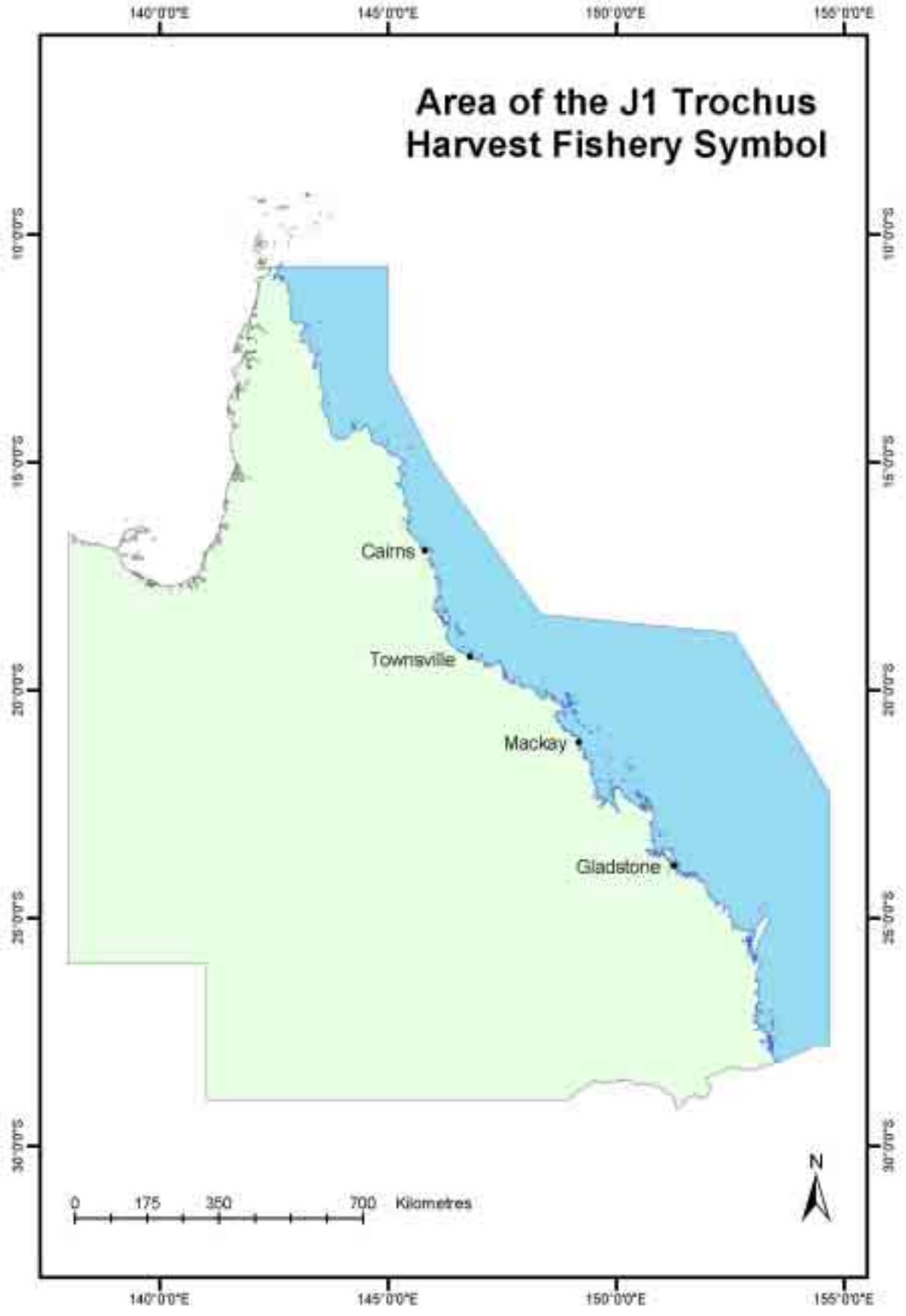

Figure 1. Map showing the area of Queensland's East Coast Trochus Fishery (ECTF).

FISHING METHODS AND APPARATUS

Commercial fishers

Harvesting of trochus is by hand held non-mechanical implements used intertidally or when free diving. Underwater breathing apparatus (SCUBA) or hookah apparatus provides extended underwater time and increased mobility for harvesting; these methods are also permitted.

The ECTF is currently managed on the basis of Total Allowable Catch (TAC) of 300 tonnes under the *Fisheries Regulations 1995*. Trochus collectors (authority holders) are licensed under the Fisheries Act. There are 6 authority holders, each with designated annual quotas. Regulations apply to the authority holders in that licences are transferable, a maximum of 10 crew members are allowed to collect trochus at any one time under an authority holder and that the boat identified in the authority and 4 other tenders not greater than 7 metres in length are allowed to take trochus in the same location.

Crew usually number 4 -10 and most collecting occurs by free-diving with a mask and snorkel in waters 2-10 metres deep, where most trochus stocks are found. Hookah gear is typically used in waters deeper than 10-15 metres. Collection of trochus at low tide may be possible from reef tops adjacent to the seaward reef crest. Trochus are often collected into mesh carry bags, which are filled and left on the reef, marked with buoys until the change of tide. The bags are then loaded into dinghies and transported on to the primary vessel (Nash, 1985). Commercial trochus fishers usually operate between the months of August to February when the prevailing north-westerly winds results in lower shells around the outer reefs producing more favourable diving conditions (P. Brayshaw, HarvestMAC Representative, pers. comm. 1998).

Recreational fishers

Trochus is collected by recreational fishers mostly for their shells, however, information regarding catch rates and fishing effort is very limited. Recreational fishers are not permitted to use scuba or hookah apparatus for collection, so harvesting is usually limited to shallow areas at a depth of around 10 metres. At present output controls are used to regulate recreational taking of trochus in the form of bag limits (50 trochus shells in possession) and minimum legal size limits (8cm minimum - 12.5cm maximum).

Indigenous fishers

Indigenous fishers collecting trochus for subsistence purposes are exempt from all forms of regulations and restrictions such as the use of apparatus, area closures, minimum and maximum size limits and bag limits. The level of fishing effort by traditional fishers is presently unknown. No indigenous catch of trochus was reported during the National Recreational and Indigenous Fishing Survey in 2000-01 (Henry and Lyle, 2003). Past catch rates of trochus by traditional fishers are also not documented.

Post-harvest processing

This fishery requires some degree of post-harvest processing before the market product is reached, and common techniques are briefly outlined below.

The shells are graded by size while diving and any sun-bleached or worm-ridden shells are left on the reef to contribute to breeding stock. Poorer quality shells also have little commercial value for button making. The nacre is later used to manufacture buttons and other handicraft, and the meat of the muscular foot is ready for human consumption (Castell, 1997).

Firstly, the shells are cleaned by tumbling the shell in mechanical tumblers, which is an efficient way of rapidly cleaning large quantities of shell. A more labour intensive method is to chip off the encrustations with a stainless steel bar, or by knocking two shells together. The shell is then boiled for 10-15 minutes in gas-fired boilers, depending on the size of the animal, and the flesh removed with a stainless steel wire hook. Any remaining animal is removed using a coil attached to a high pressure pump. It is imperative that the animal inside the shell is fully removed, as any remnants will result in putrification. The shell accounts for approximately 15% of the total weight of the animal (P. Brayshaw, HarvestMAC Representative, pers. comm. 1998). The trochus may then be re-bagged and stored in the hold awaiting return to port (Nash, 1985), or alternatively, the meat is frozen on board and dispatched to a nearby canning facility.

HISTORY OF THE FISHERY

Although trochus has been fished for subsistence purposes for centuries, it is only since the early 1900's that this tropical marine snail was commercially harvested. The commercial harvest of trochus shell dates back to 1912 when trial shipments were sent from Torres Strait reefs to Japan and Austria. Within 4 years the annual catch was nearly 500 tonnes and by 1917 trochus fisherman were harvesting along new grounds down the east coast of Queensland as far south as Mackay (Nash, 1989). In 1927 quantities of trochus shells were discovered in the Swain Reef complex large enough to support commercial exploitation and subsequent to this time commercial fisherman were accessing the entire stretch of the Great Barrier Reef.

Some vessels fished the reefs in a relatively small area, while others worked the entire Great Barrier Reef. During the 1950's, vessels working in this manner would reach the Swains Reefs in late spring or early summer, winding up the season with a meeting in mid-December at Bell Cay, and later heading north to reunite the crew with their respective families for Christmas.

A peak catch of 1380 tonnes was recorded in 1953. Soon after this in the mid-1950's, the introduction of plastics plummeted the industry into a depression (Nash, 1989). The industry recovered and flourished during the late 1970's as fashion demands changed and high prices were paid for natural buttons. The change in market demands throughout Europe, and later in Taiwan and other east Asian countries, to use natural buttons for garments was a significant turning point in this fisheries history and led to recovery that continues today (Nash, 1993).

In the late 1970s and early 1980s a few trochus collectors operated between Cairns and Mackay. Nash (1985) reported that only four trochus collectors were active between 1981 and 1983. Commercial harvesters based in Cairns targeted offshore reefs from the east coast between Innisfail and Cooktown, while their southern counterparts worked the reefs east and south east of Mackay. A further increase in demand for trochus shell occurred during the late 1980's and was accompanied by an increase in market price. The price for trochus shell peaked at $10.00 per kg during 1990 and more than 600 tonnes was landed

in this year. Following extensive research and development, commercial markets for trochus meat were established in 1992, and these continue to grow stronger each year (Brayshaw, 1998).

Catch rates typically fluctuated greatly from year to year which is a reflection of trochus being both an easy resource to exploit, yet capable of stock recovery following periods of inactivity in the fishery. Fluctuations in catch histories of trochus fisheries have been attributed to wartime abstinence, alternative economic activity, decrease in market demand, declines in stock abundance, changes in fishing effort and environmental conditions (Moorhouse 1933, McGowan 1958, Nash 1985, Bour 1990 cited in Ryan 1999). The Queensland trochus industry has been volatile due to the rapid fluctuations in market conditions. The market for trochus can undergo large changes depending on the level of demand, quality of shell, and the supply of shell from other trochus producing countries (Hyland, 1993).

Prior to 1995, management of Queensland's harvest fisheries was the responsibility of Queensland Department of Primary Industries (QDPI), and permits were issued to all participants who were involved in harvest fisheries. The *Fisheries Regulation 1995* outlined new management arrangements for wild stock fisheries in Queensland, and management responsibility was subsequently transferred to Queensland Fisheries Management Authority (QFMA). A Total Allowable Catch (TAC) was later adopted in 1990, following a study conducted by Nash (1985), and is presently set at 300 tonnes annually, however only 250 tonnes has been allocated for harvesting.

East coast licences for the remaining 50 tonnes were offered to two Torres Strait Islander collectors allowing them to operate on the east coast during 1991 and 1992. Each of the licences had a quota of 25 tonnes and only one community vessel was successful in obtaining a survey certificate and a pearling vessel licence to operate in 1991 (Hyland, 1993). No nominations from islanders for east coast entitlements in 1992 were received and the fifty tonnes quota was set aside for Torres Strait and Aboriginal communities. It has however remained unallocated since 1992. Currently DPI&F are looking to abolish the unallocated quota amount and to set the current TAC conservatively to 250 tonnes for the east coast.

In 1997, trochus authorities became transferable. The fishery became the responsibility of the Department of Primary Industries, Queensland Fisheries Service (now DPI&F Fisheries Group) in 2000, when the QFMA was disbanded.

HISTORIC CATCH AND FISHING EFFORT

The availability of historical catch and effort data, prior to daily logbook records collected since 1995, is inconsistent. Historical data is therefore limited for this assessment and is based primarily on information from Ryan (1999).

The total annual catch in the 1960s was greater than 1 000 tonnes and there were indications of over fishing (Larcombe 1993). However, similar catches have not been reported since, and there may be several causes of this decline. There is no corresponding estimate of effort, or Catch per Unit Effort (CPUE), for any period in time prior to the 1980's.

There have been two previous analyses of CPUE for the East Coast Trochus Fishery using various data sources. Nash (1985) utilised independent survey results from 1979 to 1982, calculating CPUE in terms of kg / diver day. Estimated CPUE ranged between 43.5 and 81.9 kg / diver day. Larcombe (1993) estimated an average fishing time of 5.72 hours per day. This converts the CPUE estimates from Nash (1985) to 7.605 to 14.318 kg / diver hour from 1979 to 1982.

Larcombe (1993) calculated CPUE in terms of kg / diver hour from data which included daily returns from all authority holders from 1990 to 1992 and personal logs from a single authority holder from 1983 to 1992. CPUE estimates in the GBR ranged from 40 kg / diver hour in the mid 1980s to 20 kg / diver hour in the early 1990s.

CURRENT FISHING EFFORT

Compulsory daily logbooks have documented fishing effort in the ECTF since 1995. Both fishing days and diver hours are recorded, however there is no provision for separately recording searching time. Trochus are unevenly distributed across a wide area including many reefs meaning that the whole stock is not equally vulnerable to fishing at any one time. Fishers typically select fishing sites based on areas with profitable stock levels where trochus aggregate in suitable habitats (Ryan 1999). Ryan (1999) outlines that in such situations search time is usually not proportional to the number of specimens collected over time, generally meaning that catch rates do not decline at the same rate as potential reductions in population density.

Although searching time is not recorded in the logbooks, DPI&F does not consider this to be a significant issue. Through the long history of the trochus fishery the industry has developed extensive information on known fishing areas, significantly reducing the time spent searching for areas of abundant trochus shell. In addition, the logbook records the diving hours expended, which includes time divers have spent searching while on a particular reef or site. While effort information is a vital statistic for any fishery, it should be remembered that management of the trochus fishery is primarily based upon the quota arrangements and TAC.

Figure 2 shows the total annual reported catch and effort for the fishery from the 1996/1997 financial year to the 2002/2003 financial year. There are 6 licenses included in this current fishing effort with a total of 18 endorsed fishing vessels. Data from both the 1995/1996 and 2003/2004 financial years are incomplete and are therefore not displayed. Catch is measured as live weight in terms of kilograms landed and effort is measured as number of hours fished. Since the collection of compulsory daily logbook data, total catch has remained below the allocated catch quota of 250 tonnes, with the highest catch (and effort) recorded at approximately 220 tonnes in the 1997/1998 financial year. Since this period, catch and effort has decreased to below 200 tonnes. Effort in the ECTF is strongly influenced by market forces and over recent years the overseas trochus market has declined and the value of the Australian dollar has increased (P. Gaffney, DPI&F, pers. comm. 2004). As a result there has been little harvesting over recent years with catch and effort rates lowest during 2003. Preliminary catch rates for the 2003/2004 financial year show less than 50 tonnes has been caught since July 2003. No fishing effort has been recorded yet for 2004. Compliance with reporting is at high standard within this fishery with the only concern associated with delayed logbook returns when no fishing is occurring.

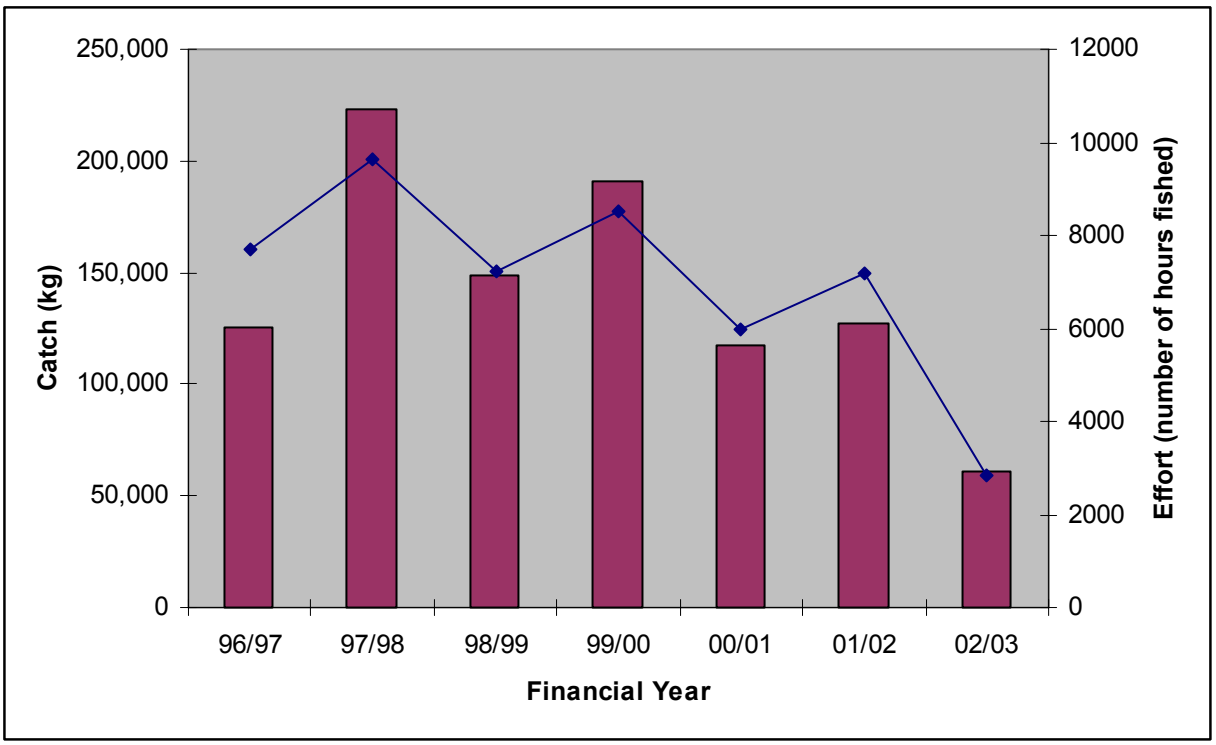

Figure 2. Total annual catch and effort (1995 logbook data is incomplete)

Figure 3 displays the CPUE for the fishery from the 1996/1997 financial year to the 2002/2003 financial year. Annual CPUE has maintained a relatively stable level at approximately 23 kg / diver hour.

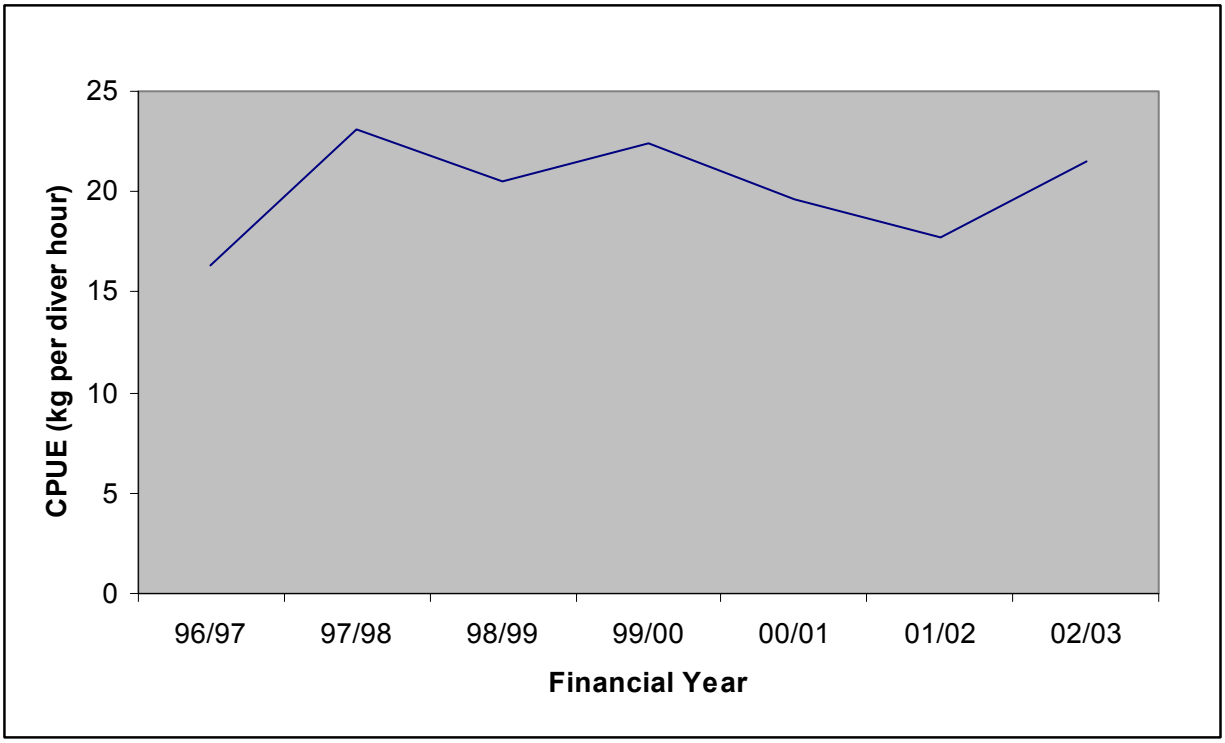

Figure 3. Annual Catch Per Unit of Effort in kilograms per diver hour since 1996. Catch rate is based on non-standardised annual catch and effort.

2. THE ENVIRONMENT LIKELY TO BE AFFECTED BY THE FISHERY

The majority of the catch and effort of the fishery occurs within the Great Barrier Reef World Heritage Area (GBRWHA), which places additional responsibilities on fisheries agencies to manage the area in respect to the world heritage values for which it has been listed. A process that has significant interrelationships with the ECTF is the implementation by the Great Barrier Reef Marine Park Authority (GBRMPA) of the Representative Area Program (RAP), a program that has been developed to protect the biodiversity of the GBRWHA. The RAP has incorporated significant input from a range of expertise and community based interest groups. A final revised zoning plan the *'Great Barrier Reef Marine Park Zoning Plan 2003'* has been implemented from 1 July 2004 and has resulted in significant increases to areas protected from all forms of fishing.

Harvesting in the fishery involves hand collection of individual trochus, which is a highly selective method of fishing. As a result, this fishery produces no bycatch. Hand collection also limits the potential for impacts on any endangered, threatened or protected (ETP) species or on benthic marine fauna or flora. No interaction with endangered, threatened or protected species have been reported or are considered likely within the fishery, and therefore no formal assessment has been conducted. The only potential impacts are associated with small vessel operations generally such as boat strikes with ETP species or damage to the sea floor due to anchoring. The potential interaction of the ECTF with species of conservation interest is documented in criteria 2.2.1 and 2.2.5.

There are no threatened ecological communities (current, past or proposed) that appear to be affected by the trochus fishery (as addressed in Criteria 2.2.5). Beyond the removal of the trochus species from the reef ecosystems, there is no evidence to suggest that there is an impact on other components of the benthic or pelagic communities in the area that the fishery operates. Broader ecosystem effects of the fishery have not been investigated.

3. MANAGEMENT ARRANGEMENTS FOR THE FISHERY

BASIS FOR CURRENT MANAGEMENT ARRANGEMENTS

Current management arrangements were introduced primarily to cap commercial fishing effort to allow trochus to spawn once before entering the fishery. This attempts to prevent recruitment overfishing. Minimum legal sizes are based on the principle of allowing 50% of individuals of the species to reach first sexual maturity. While this fishery is not managed on size limits alone, minimum legal size limits, if set high enough, allow a sufficient proportion of the egg production to be protected such that recruitment will be sustained, regardless of the level of fishing pressure on the fraction of the population that is larger than the size limit. That is, there will be sufficient breeding adults below the size limit to sustain recruitment even if all the animals larger than the size limit are harvested (Nash, 1993).

The spawning contribution of large individuals of some species is disproportionately high and this may create a need for enhanced protection of large specimens of some species through a maximum size limit. This is in part, the basis for an upper size limit of 12.5cm being applied to trochus. Large trochus shells are also often pitted owing to a lifetime of parasitic attack and are therefore of less use in the manufacture of pearl-shell buttons (King, 1995). This management tool therefore, is useful from both an economic and a biological viewpoint. It is important to recognise however, that an upper size limit alone should not be relied upon as a means of protecting the breeding stock. Its primary role is to maintain a high quality of marketable shell. This is because those animals larger than the upper size limit will sooner or later die from old age, disease or predation. The upper size limit will continue to protect larger, reproductive animals only if fishing mortality on the fraction of the population within the legal size range (8cm-12.5cm) is light enough to allow an adequate proportion of the population to grow beyond the upper size limit (King, 1995).

Bag limits, TAC's and Individual Transferable Quotas (ITQs) have essential roles in fisheries management, including:

- conserving heavily fished species;
- encouraging fishers to be more conservative in their fishing practices;
- encouraging fishers to spread their fishing effort across a number of fish species;
- spreading the catch more equitably among fishers; and
- reducing the potential for illegal marketing of excess catches by some fishers.

Commercial catch quotas regulate effort through output controls. As stated above, the ECTF is managed via a TAC in conjunction with ITQs and minimum and maximum size limits. Fishing effort is managed via input controls these include limiting the number of authorisations in the fishery to 6 with no more licences to be issued, limiting collection methods to collection by hand and limiting the number of crew authorised to dive for or gather trochus under an authority to 10 people.

These measures aim to ensure trochus are not over-harvested and that conservative management measures are precautionary in their approach, especially in situations where scientific information is lacking.

Legal minimum sizes limits for the commercial fishery aim to assist in the protection of juvenile trochus, improving their reproductive success by allowing individuals to spawn at least once before capture (King, 1995). The application of a minimum size limit also

prevents the marketing of individuals considered too small and is related to growth overfishing. Providing opportunity for individuals to spawn at least once before capture is aimed to prevent recruitment over fishing.

Limiting commercial harvest to specific regions also minimises conflict with other users and controls commercial effort to specific manageable areas. This increases the capacity for further development of the fishery and limits impact of commercial fishing to certain defined locations

CURRENT MANAGEMENT ARRANGEMENTS

Management arrangements now in use can be divided into these categories: those that apply to all fishers, those that apply only to the commercial fisheries and those that apply only to recreational and indigenous fisheries.

All fishers

Harvest of trochus is by hand or hand held non-mechanical implements only. Wading or free-diving using a face mask and snorkel are permitted and commonly used in shallow waters.

A minimum and maximum size limit for trochus applies to all forms of fishing (except by indigenous fishers collecting for traditional or customary purposes). Trochus smaller than 8cm and larger than 12.5 cm may not be taken.

A number of areas are also closed to all forms of fishing (except by indigenous fishers collecting for traditional or customary purposes) under Marine Parks legislation and include Marine National Park, Buffer, Scientific Research and Preservation zones. The area of these zones have increased to more than 35% of the Great Barrier Reef Marine Park (GBRMP) with the introduction of the revised GBRMP zoning from 1 July 2004. This allows for a minimum of 20% of each of the 70 known bioregions identified in the GBRMP during the rezoning process to be protected (GBRMPA, 2003). Limited collecting (not more than five individuals of a species) may be undertaken in Conservation Park Zones.

Commercial fishers

Commercial harvesting of trochus is controlled under the Fisheries regulation and carries the fishery symbol J1. Existing management arrangements for trochus allow for up to 6 authority holders to access the trochus fishery. All 6 licences have been issued for the ECTF and no more licences are to be issued. The taking of trochus must be carried out only by an authority holder or a person approved by the DPI&F. The boat identified in the authority and 4 other boats, no longer than 7 metres may be used to take trochus in the same location. No more than 10 persons stated on the authority may, at the same time, dive or gather trochus. Underwater breathing apparatus (SCUBA and hookah gear) is permitted for use only by commercial fishers and is necessary in deeper waters. Authority holders may sell trochus taken under the authority only to a licensed A or B class buyer or the holder of another authority. Licensed buyers are not required to report on the amount of trochus shell they have purchased and no information is gathered from them.

A Total Allowable Catch (TAC) for the Queensland trochus fishery was introduced during 1990, following a study conducted by Nash (1985). At present the TAC for the Trochus fishery is set at 300 tonnes by way of the *Fisheries Regulations 1995*, however, only 250 tonnes of the TAC is allocated as individual transferable quota to the six authority holders by way of a condition of the individuals' authority. Of this TAC of 300 tonnes, 50 tonnes is unallocated.

Recreational fishers

Minimum and maximum (8cm min.-12.5cm max.) size limits are now in place for recreational trochus fishing, and a bag limit of 50 shells per person in possession applies under Queensland fisheries legislation. Bag limits apply under Marine Parks legislation.

Indigenous and traditional fishing

Trochus taken for customary or traditional purposes by indigenous fishers are exempt from all of the above regulations.

Compliance and Enforcement

The Queensland ECTF is small in terms of size, volume (number of species harvested) and commercial value in relation to other fisheries. Resources to undertake monitoring, assessment and compliance of the ECTF are allocated by QFS commensurate with the size of the fishery. A range of enforcement and compliance measures are in place in the ECTF. One aspect of compliance in the fishery concerns the compulsory return of daily logbook information.

For the ECTF, the daily logbook records must be returned to QFS within 14 days at the end of every month.

If a fisher does not return the logbook data, the following steps are followed:

- a reminder letter is sent requesting the logbook, and also reminding the fisher of the compulsory logbook requirement;
- approximately one month later a 'show cause' letter is sent. The letter again requests the logbook and also asks the fisher to show cause why the non-compliance should not result in suspension of the fisher's license for that fishery.
- if the logbook is still not forwarded, the fisher's licence for the fishery may be suspended until the logbook is provided.

The Fisheries Act 1994 provides QFS with extensive mechanisms that ensure it can respond in a timely manner to any threats to the sustainability of the fishery. These include the power to:

(a) declare a closed season, closed waters or closed species (section 43 of the Act);
(b) declare a quota for a fishery (section 44);
(c) make an emergency fisheries declaration (section 46) where urgent action is needed to meet a significant threat to fisheries resources or habitat;
(d) refuse to issue or renew an authority (section 59) where it is necessary or desirable for the best management or protection of fisheries resources;
(e) impose conditions on issue or renewal of an authority (section 61);
(f) amend an authority (section 63); and

(g) suspend or cancel an authority (section 67) where it is necessary or desirable for the best management, use, development or protection of fisheries resources or fish habitats.

The Fisheries Act 1994 ('the Act') defines 'an offence against fisheries legislation prescribed under a regulation or Management Plan to be a serious fisheries offence'. In effect, the Act enables offence types common to many fisheries to be covered by regulation, and significant offences may be addressed within a management plan for that fishery. Section 108 of the *Fisheries Regulation 1995* establishes serious fisheries offences as:

- Forfeiture offences for which an inspector may seize fisheries resources in a heap (for example, fish in a processing establishment where, because of the quantity of fish, it is impracticable to count the fish of a particular species or type);
- Offences against fisheries regulation that involve:
  - contravening a closed season or closed-water declaration;
  - buying or selling fish;
  - obstructing, hindering or resisting an inspector; and
  - using or possessing illegal fishing apparatus.

A 'serious' offence can have several consequences. The most obvious is in the penalties applied to offenders. Magistrates have full discretion in setting penalties for fisheries offences up to a maximum level for each offence. If an offence is identified as 'serious', then it is likely that a higher-level fine would be applied.

The Queensland Boating and Fisheries Patrol (QBFP), a division of the QFS, undertakes compliance and enforcement activities for all Queensland's fisheries resources. Officers stationed at district officers along the Queensland east coast are involved in enforcement of the provisions of the *Fisheries Act* and the *Fisheries Regulations* described above.

Present compliance levels are encouraging with recent investigations revealing no major compliance issues within the ECTF. The only concerns have been associated with logbook returns and reports as there have been delayed logbook returns when no fishing is occurring. This issue has been addressed through the above measures and all fishers are currently compliant.

PROPOSED MANAGEMENT ARRANGEMENTS

The fishery is regularly reviewed to ensure that it is operating within ecologically sustainable levels as is legislatively required under the *Fisheries Act 1994*. Management advice on general fishery issues is provided to DPI&F through the management advisory committee for harvest fisheries known as HarvestMAC. DPI&F MAC process provides a consultative forum allowing all stakeholders to provide input into the management of particular fisheries.

HarvestMAC is comprised of a DPI&F appointed chair, DPI&F fishery manager, researcher, compliance officer, commercial fishers, recreational fishers, seafood marketer, conservation member, indigenous representative and a GBRMPA representative. There has been no recent participation by conservation or indigenous representatives although there is a standing invitation from DPI&F to participate. HarvestMAC reviews all issues arising from or of relevance to the fishery, including any impacts to target, bycatch or ETP

species, or the broader marine environment generally. HarvestMAC advises DPI&F on any management actions required to ensure the fishery continues to operate within ecologically sustainable levels. Fishery-dependent and independent information is available to HarvestMAC to guide its reviews. This includes fishery-dependent information from the logbook program and fishery-independent data sourced from stock assessments.

RELATED LEGISLATION IMPACTING ON THE EAST COAST TROCHUS FISHERY

The DPI&F ensures the appropriate management, use, development and protection of Queensland's fisheries resources through the preparation and implementation of regulations, management plans and declarations developed with regard to the principles of ecologically sustainable development (ESD).

The *Fisheries Act 1994* sets the direction for fisheries management while allowing for flexibility in management through subordinate legislation (Management Plans and Regulations) to deal with specific fishery management needs. The subordinate legislation for the ECTF is the *Fisheries Regulation* and its amendments. This plan provides for the sustainability of the species taken and the ecosystems upon which they depend.

The *Fisheries Regulation 1995* has legal status as subordinate Queensland fisheries legislation and material changes to the management regime require parliamentary approval. A management plan has not been developed for the ECTF. DPI&F manage the fishery in accordance with the *Fisheries Regulation 1995* described above.

A number of other Acts, both state and Commonwealth, also impact on the management of the ECTF. As highlighted in the introduction, for any fisheries with an export component the Commonwealth *EPBC Act 1999* requires state fisheries management agencies to demonstrate (through ecological assessment submissions) that the management regime complies with the objectives of ecologically sustainable development. As trochus harvested in this fishery are exported, this fishery must meet the requirements of the *EPBC Act.*

The *Great Barrier Reef Marine Park Act 1975* (Commonwealth) and Regulations significantly impact on managing trochus. The Act provides for the establishment, control, care and development of the Great Barrier Reef Marine Park (GBRMP) by the Great Barrier Reef Marine Park Authority (GBRMPA). The framework for planning and management of the multiple-use Marine Park is principally through zoning plans, which make provisions regarding the purposes for which each zone may be used or entered.

The GBRMP extends form latitude 10^{o}41' in the north (Cape York) to latitude 24^{o}30' in the south (Breaksea Spit) and covers waters from the coast east to beyond the outer edge of the Great Barrier Reef.

The *Great Barrier Reef Marine Park Act* 1975 and Regulations apply to the GBRMP. Under the relevant zoning provisions, permits are required for collecting trochus in General Use and Habitat Protection Zones. 'Limited collecting', as defined, is 'as-of-right' in Conservation Park Zones with defined bag limits. The Regulations list protected species and define 'collectable' species that can be taken. Under the revised rezoning approximately 15% more (in total area) of fishable trochus habitat is protected.

The *Marine Parks Act 1982* (Queensland) and Marine Parks *Regulations 1990* apply to State Marine Parks with provisions complementary to the GBRMP Act. The Act and Regulations deal generally with the marine parks while zoning plans determine which activities can occur 'as-of-right' in particular zones and which activities require permits.

DPI&F consults regularly with marine park management agencies to ensure that fisheries and marine park management planning arrangements are complementary and compatible.

The *Environment Protection and Biodiversity Conservation Act 1999* and *Regulation 2000* (Commonwealth) promotes the conservation of biodiversity by providing strong protection for listed species and communities in Commonwealth areas, cetaceans in Commonwealth waters and outside Australian waters; protected areas (World Heritage properties; Ramsar wetlands; Biosphere reserves; Commonwealth reserves; and conservation zones.

4. ENVIRONMENTAL ASSESSMENT OF THE FISHERY

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 that stock(s) will recover.

Objective 1. Fishery catch levels maintain ecologically viable stock levels within an acceptable level of probability

Information requirements

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 information collection systems

The DPI&F has developed and maintains a range of both fishery dependent and independent data collection systems for providing up to date information on fish stocks, fish species taken and the level and distribution of fishing effort and fish catches. This information is used by managers to make decisions about maintaining sustainable harvests of principal species and ensuring provisions of the Queensland *Fisheries Act* 1994 are met. It is also used by researchers in making scientific assessments about the status of these species and bycatch and by analysts monitoring and interpreting spatial and temporal changes and trends in fishing activity and catch levels.

The only data collection system currently in use for the ECTF is the daily *Commercial Fisheries Logbook Program (CFISH).*

Commercial Fisheries Logbook Program (CFISH)

A comprehensive compulsory daily logbook program for Queensland's commercial fisheries was introduced in 1988. Logbooks were introduced primarily as a performance and compliance tool for the fishery. Logbook entries are recorded daily and reported monthly. Prior to this, catch and effort data from specific elements of the fishery were collected as part of short to medium term research projects. The Commercial Fisheries Information System (CFISH) database was established in 1988 to manage the large flow of data from fishers and provide access to fishery dependent data for fisheries research and management.

Fishery-dependent data

The ECTF is a single species fishery and therefore data collection from the commercial fishery focuses on *Trochus niloticus*. The main source of fishery dependent data on the ECTF is from compulsory daily logbooks collected since 8 November 1995.

A review of the stock monitoring program for the ECTF was prepared for the QFMA based on logbook data and a stock assessment conducted in 1992 (Ryan, 1999). This also provided information on the status of the fishery.

Logbook data

A compulsory commercial fishing logbook (CFISH) has been in place in the ECTF since 1991. At that time, catch and effort data were entered on a quarterly basis. In 1995 the QFMA completely reviewed the fishery catch and effort logbook system so that daily catch reporting replaced the original quarterly reporting schedules (Ryan, 1999). A daily logbook provided more detailed information on catch, effort, depth and location. Consequently, there exists good quality catch and effort data on the fishery since November 1995.

As many of the fishers that operate in the ECTF also operate in the East Coast Bêche-de-mer Fishery (ECBDMF), a common logbook is used for both fisheries. The current version of the logsheet used is the BD02 (Appendix 1), which was first issued on 1 July 2000. This logsheet provides for better recording of catch and effort data in comparison to the previous logsheet BD01.

The BD02 logsheet collects information per tender vessel on the harvest method (i.e. Hookah, free-diving etc); total daily hours fishing; harvest depth, number and weight of trochus catch, latitude, longitude, fishing grid, authority and crew numbers. This information is collected and entered into the CFISH system, allowing for the analysis of catch and effort in the fishery to help evaluate the effectiveness of management arrangements.

Recreational logbook systems (RFISH) are designed to collect catch information on more commonly caught species on larger regional scales. As such, the RFISH logbooks collect only very limited data for the less commonly captured species such as trochus; it is not suitable for estimating recreational catches for the species. Similarly indigenous catch is has not been recorded for this species.

Stock Assessment Review

Ryan (1999) prepared a report for the QFMA, which reviewed the stock monitoring program for the ECTF using logbook data collected from the fishery. This report included a review of the historical and current catch and effort data, an investigation of the impact of exclusion zones (highly protected zones) by the GBRMPA on the fishery and a review of the TAC. This was used to justify the minimum data requirements needed to support the constant catch TAC management strategy.

Ryan (1999) outlined that the catch and effort data collected for the fishery provides minimal insight into the long-term sustainability of current catches, primarily due to the limited time series of reliable information and the lack of variation in the statistics recorded. It is generally accepted that at least ten years of accurate catch and effort information is required before reasonable population biomass estimates can be calculated. Furthermore, the data needs to show a range of possible values in catch and effort to provide accurate estimates of population biomass (Ryan, 1999).

Recommendations suggested by Ryan (1999) have been considered by management and are attached as Appendix 2. Those recommendations relating to the accuracy of data entry and daily catch and effort logbooks have been addressed under general fisheries

management arrangements. Recommendation 7, which suggests extinguishing the unallocated quota of 50 tonnes, is currently being considered by management.

Fishery dependent data reliability

Fishery dependent data for the ECTF are, for the most part, the best currently available sources of fishery statistics. Logbook information is inherently reliant on the goodwill and honesty of the operator. Commercial operators in the fishery, however, are committed to ensure compliance with fisheries regulations (e.g., providing logbook information).

New data from logbook returns are scrutinised for discrepancies or fisheries regulation breaches. The DPI&F Logbook Section investigates any discrepancies in commercial catch information provided by fishers to ensure data reliability when data are received. Enforcement officers from the Queensland Boating and Fisheries Patrol assist the verification process by follow-up investigating of abnormal catch and logbook entries when they undertake fishing vessel inspections during surveillance patrols. To date there have been no major compliance or enforcement issues in terms of logbook returns and reports for the ECTF. The only concern has been associated with delayed logbook returns when no activity has been occurring in the fishery.

Fishery-independent data

Fishery independent data for the ECTF is limited. Initial management of the fishery was based on information provided by Nash (1985) on the distribution and abundance of trochus. In 1991, the Department of Primary Industries commissioned a stock assessment of the Great Barrier Reef over concerns relating to the setting and allocation of the quotas and size limits based on the work of Nash (1985). This stock assessment provided an accurate estimate of the size of the trochus standing stock of the GBR, developed a model of trochus production and a reasonable estimate of the sustainable yield from the fishery. It also investigated basic biological characteristics including size distributions, size/fecundity relationships, growth rate and mortality of trochus (Larcombe, 1993). These scientific studies provided the foundation for current management arrangements.

Given the nature of this fishery and the current low levels of fishing activity, there is no current intention of by DPI&F to review the management arrangements for the ECTF and establishment of a statutory management plan is not considered a priority.

Fishery-independent data reliability

Data independent of the fishery has been collected through scientific studies. The results of these studies have provided a useful baseline for development of the fishery and for assessing stock structure and monitoring abundance during the course of the fishery. Results of independent studies are provided to DPI&F, Harvest Management Advisory Committee (HarvestMAC) and are used to guide management actions required to ensure the fishery continues to operate within sustainable levels.

Assessment

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.

Trochus stocks are vulnerable to unsustainable exploitation due to limited dispersal rates and easy collection methods (ie the harvest method allows specimens to be identifed and physically selected). The DPI&F therefore takes due regard to the precautionary principle. The DPI&F believes the management controls in place and proposed within the ECTF demonstrate a conservative and sustainable management approach for the fishery.

The dynamics and status of the trochus species in the fishery were initially established from the work and recommendations of Nash (1985) and the stock assessment commissioned by the DPI&F in 1991, as outlined in criteria 1.1.1. No further stock assessments have been conducted since this time. Ryan (1999) reviewed the stock monitoring program for the ECTF and suggested that the minimum requirement to ensure the fishery remains within sustainable levels is for reassessment to be undertaken if major changes occur in the fishery. Examples include changes in the availability of trochus habitat (or fishable areas) through management regimes or changes in the sustainability indicators monitored on an annual basis. A risk assessment for the ECTF will be undertaken within three years to assess any effects on the fishery due to the revised GBRMP zoning implemented on 1 July 2004. Given the vast areas still available to fishers and the current low level of fishing activity in the ECTF, the risk caused by the RAP changes would appear minimal at this stage. DPI&F will, however, carefully monitor the fishery and will review the management arrangements if any changes become apparent.

Detailed catch and effort data collected from compulsory daily logbooks is the main source of information used to continually monitor the fishery. Stock assessment of the ECTF is largely dependent on the provision of accurate information collected on the fishery. On-going sustainability indicators for the fishery include monitoring annual CPUE and the relationship between catch weight and number of individual shells harvested. Data validation following data entry is maintained for accurate analyses of catch and effort data and CPUE.

As seen in Figure 2, catch and effort rates have remained relatively constant until a recent decline from the 2000/2001 financial year to the 2002/2003 financial year. This recent decline in catch and fishing effort in the ECTF is believed to be due to the current market for trochus. There is currently a low demand from the fashion industry for buttons made from trochus shell. As is explained in section 1, the ECTF is strongly influenced by market forces and the market for trochus can undergo large changes depending on the level of demand, quality of shell, and the supply of shell from other trochus producing countries (Hyland, 1993).

Summaries of fishing trends used as sustainability indicators, for example catch, effort and CPUE, and any other relevant information for the ECTF are provided to HarvestMAC regularly for consideration. If HarvestMAC notes any potential negative impacts, advice on the appropriate management actions are developed and presented to DPI&F to consider and implement if considered appropriate. Over recent years HarvestMAC have not identified any potential sustainability concerns within the ECTF. The fishers in the ECTF have demonstrated a high level of compliance with management requirements.

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

Trochus are naturally distributed within the tropical and subtropical confines of the Indo-Pacific region between Sri Lanka, the Ryukyu Islands, New Caledonia and northern Australia. Since the 1920s they have been extensively translocated to areas including the Cook Islands and French Polynesia.

Commercial fisheries for trochus in Australia are restricted to tropical regions, occurring in the coastal waters of Queensland, Western Australia and the Torres Strait islands. In Queensland, trochus are generally found on the reefs and cays of the Great Barrier Reef (GBR) and its attendant lagoon channel, from Mackay to the New Guinea coast, as well as on many of the continental islands and in the Torres Strait (Moorhouse, 1933). *Trochus niloticus* is the only species commercially harvested in Queensland waters. Collection generally occurs on the reef tops at low tide or from the subtidal areas adjacent to the reefs.

There is little detailed scientific information on the current distribution and stock structure of trochus harvested in Queensland waters. A stock assessment of the East Coast trochus stocks was commissioned by the Department of Primary Industries in 1991 and conducted in 1992 (Larcombe 1993). For the purpose of trochus stock assessments in the Great Barrier Reef, Larcombe (1993) defined a stock as a population of trochus occupying an area and capable of intermixing through adult migration or by the drift of their larvae. Based on the movement patterns and survivability of larvae, Larcombe (1993) suggested two potential scenarios for stock definition. Adult trochus only occur in their habitat on the reef front and are not capable of moving between reefs (unless transplanted). Accordingly, if the larvae spawned from one reef do not generally reach other reefs then each reef represents a single stock. In contrast, if the larvae are capable of reaching neighbouring reefs then the group of reefs will represent a unit stock. Stocks are therefore dependent on the degree of larval connection between separate reef habitats of *T. niloticus*.

The 1992 stock assessment found densities of trochus ranged from 85.8/ ha to 1066/ ha on individual reefs depending on the type and size of the reef and the ability of the trochus populations to recover from fishing at each reef. The total legal sized standing stock of trochus for the East Coast of Queensland was estimated to be 1500 tonnes. Larcombe's (1993) findings were factored into the management arrangements developed at the time, and were used to establish a conservative TAC of 350 tonnes (given 20% fishing mortality). Following the introduction of protected areas in the GBR (including trochus habitat), this TAC was reduced to 300 tonnes in 1998 (Ryan, 1999). From this 300 tonnes, 50 tonnes is currently unallocated as a conservative measure and does not form part of individual quotas for the fishery.

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 all commercial removals are maintained in the CFISH database as detailed in section 1 (current fishing effort) and criteria 1.1.1. These provide accurate estimates of weight and number of individual animals that are retained by the operators. These estimates will provide the foundation of future stock assessments for this fishery. The estimates also provide accurate and timely indicators of catch levels for management

of species TACS. Recreational fishers are limited to 50 shells per bag per person. Information regarding catch rates and fishing effort for recreational and indigenous fishers are unknown.

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

Larcombe (1993) estimated a standing stock of 1500 tonnes of legal sized shell for trochus along the east coast of Queensland. This provided the foundation for a TAC of 350 tonnes. With the introduction of highly protected areas in the GBR, which were estimated to reduce available stocks of trochus by 50 to 70 tonnes, the TAC was reduced to 300 tonnes in 1998 (Ryan. 1999). Fifty tonnes of the TAC is currently unallocated and is not being fished.

Management responses

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.

Although reference points have not been established for the fishery, the ECTF has Total Allowable Catch (TAC) limits in place for trochus, based on an estimate of available biomass. This has been set conservatively under the principles of ESD and under the DPI&F's best understanding of the biological bottom line for the species. Quotas are reviewed each year, and DPI&F has the power to amend these quotas on annual renewal of the fishing authority.

DPI&F has been monitoring catch and effort in the fishery through the processes outlined in Guideline 1.1.1. Fishery-dependent data is used to provide an indication of any overfishing through trends in commercial catch rates. There currently is no sustainability concern for the ECTF as catch rates have remained relatively stable and catch has been well below the available TAC since compulsory daily logbooks were introduced in 1995.

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

Management strategies are in place to restrict the level of take in the fishery. These consist of both output and input controls.

Output controls

Total Annual Catch: The primary output control on the fishery is a total allowable catch (TAC) of 300 tonnes. Of this total, 250 tonnes of the TAC is allocated as individual transferable quota to the 6 authority holders by way of a condition of the individuals' authority. The remaining TAC is unallocated. Quota's are reviewed each year, and the DPI&F has the power to amend these quotas on annual renewal of the authority, or in the case of just a quota amendment, the DPI&F can amend this by notice to the authority holder at any time.

It is standard DPI&F practice in all quota-managed fisheries that quota holders are sent a letter of notice when 25% and 10% of their quota is remaining. Actions to control the catch to within the TAC limit are enacted under s.27 of the *Fisheries Regulations 1995* (Notice of filling of certain quotas) and enforced by QBFP. The Regulations state:

a) When the chief executive becomes aware that a quota (other than a daily or time quota) has been, or is likely to be, filled on or by a particular day, the chief executive must immediately notify a relevant authority holder, in writing, that the quota has been, or is likely to be, filled by a stated day.
b) The authority holder must immediately tell persons acting under the authority that the quota has been, or is likely to be, filled on or by the stated day.
c) A person given notice under subsection (1) or (2) must not take fish to which the notice relates after the day stated in the notice or, if the stated day has passed, the day after the notice is received.

Individual Transferable Quotas for each of the authority holders are monitored within the fishery through logbook records and routine inspections by QFBP. Trochus quotas and legal size limits along the east coast of Queensland used to be managed by way of inspections by QFBP officers, where shells were individually counted and measured and then bags were tagged to ensure compliance with quota levels. This quota monitoring system was abolished in the mid-1990s and the CFISH daily logbook program and routine inspections became the main form of monitoring catch within the fishery.

DPI&F have also recently established a Quota Monitoring Unit designed to monitor and audit the level of take in quota managed fisheries. While this unit will initially be focussing on the coral reef fin fish and spanish mackerel fisheries quota systems, in the future, this unit is to ensure adequate monitoring and auditing of all quota managed fisheries. The Quota Monitoring Unit will provide intelligence information on quotas to the QBFP. This system is designed to build a more consistent approach to managing fisheries quotas and will help ensure compliance with fisheries TACs and ITQs.

Size Limits: Minimum and maximum size regulations of 80 and 125 mm respectively apply to the fishery.

Recreational Bay Limit: Recreational bag limits are in place and restrict fishers to 50 animals per person in possession.

Input controls

Gear restrictions: Gear restrictions are in place to limit the collection of trochus. Trochus is either collected by hand or by using hand held non-mechanical implements. Underwater breathing apparatus are also permitted for use only by commercial fishers.

Vessel restrictions: Only the boat identified on the authority and 4 other tender boats may be used to take trochus in the same location. A tender commercial fishing boat may not be more than 7 m in length.

Number of fishers in the operation: No more than the number of persons stated on the authority may, at the same time, dive or gather trochus.

Area restrictions: A number of closed areas exist in the ECTF. The GBRMP has a number of zones closed to commercial trochus fishing and these include Marine National Park, Buffer, Scientific Research and Preservation zones. Approximately 15% of the area previously open to trochus harvesting has now been closed with the implementation of the revised zoning arrangements from July 1 2004. This estimate was based on the assumption that most trochus is collected at depths from 0 – 20 metres.

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

The *Fisheries Regulations* 1995 prescribe that only trochus may be taken under the "J1" fishery symbol, prohibiting the take of any bycatch or byproduct species. In practice, neither byproduct nor bycatch are taken in the ECTF as all harvesting occurs by hand collection of selected specimens. Hand collection is a selective method of fishing as only those individuals specifically chosen for harvesting are collected.

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

The data collection and assessment processes and management responses described under guidelines 1.1.1 to 1.1.8 ensure a high probability that the catches of trochus stock will remain sustainable in the long-term. Management controls presently in place for the ECTF appear to be providing for the fishery to be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, and within acceptable levels of probability. Trochus stocks are generally at risk from overexploitation, however these risks are minimised to acceptable levels in the Queensland ECTF through the previously described fishery management measures in place, by the protection from fishing off reefs through the GBR Marine Park Zoning arrangements and by the natural fishing patterns of the limited number of authority holders. While fishing occurs offshore between Cairns and Gladstone, the majority of trochus fishing effort takes place off the inner reefs between Bowen and Gladstone. The distribution of effort in the ECTF does however vary over time and in recent years there has been a broad spread of effort throughout the northern coast of Queensland from Cape York to Gladstone.

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.

Management responses

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.

Since the collection of compulsory daily logbook data commencing in 1995, total catch for the ECTF has remained well below the combined allocated quota of 250 tonnes. DPI&F set the TAC at what were considered very conservative levels in order to ensure the fishery remains within ecologically sustinable limits. Based on this information, the DPI&F believes that the trochus stocks harvested in the ECTF are at a low risk of overfishing under currently authorized harvest levels.

In the unlikely event that stocks are assessed as overfished, changes to conditions on authorities or if required, emergency fishery declarations to close the fishery can be made under the *Fisheries Act 1994* and enforced by QBFP.

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.

Information requirements

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

The ECTF is a highly selective single-species hand collection fishery and as such there is no bycatch taken by commercial operators.

Assessments

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

Management responses

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.

2.1.4 An indicator group of bycatch species is monitored.

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

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 absence of bycatch associated with this fishery, criteria 2.1.2 to 2.1.6 are assessed together.

In the ECTF, hand collection is the only harvesting method permitted. Hand collection is a highly selective method of fishing as only those individuals specifically chosen for harvesting are collected. As such, there are no threat abatements plans, recovery plans or bycatch reduction strategies applicable to the fishery.

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.

Information requirements

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

The ECTF has no reported interaction with endangered, threatened or protected species. The fishery operates in regions where marine turtles and dugongs are present, however Queensland and Commonwealth legislation prevents the taking of turtles and dugongs in the course of any fishing other than traditional fishing. Therefore while these species may be seen within the area of the ECTF they are protected from non-traditional fishing. Interactions with these species could occur during regular vessel transit through the fishery area.

No threatened ecological communities have been identified within the area of the fishery

Assessments and Management responses

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

and

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

As mentioned above, no reports of interactions with ETP species have been reported. Indeed, no interactions are expected during the harvesting activity given that hand collection is the only permitted method of harvesting.

Highlighting the low impacts emanating from this fishery, a recent assessment by the Australian Marine Conservation Society (AMCS) rated hand collection dive fisheries such as the ECTF Fishery as the equal most prefered fishery type in terms of long term sustainability. The assessment undertook a comparitive analysis of the actual and potential environmental impacts arising from Australia's most widely used commercial fishing gears and methods. The potential impacts both to wildlife and on habitats were rated as low (www.amcs.org.au).

The only potential impacts to ETP species arising from the fishery are through interactions with the vessels used. The fishery does operate in regions where marine turtles and dugongs are present, with some areas designated protection zones. Therefore while these animals may be frequently seen during the course of fishing, interactions with them are unlikely and only would occur during vessel transit through the fishery area.

Currently Trochus fishers are not required to report on interactions with ETP species. This is because it is a hand collection fishery and it has been considered most unlikely that there would be any impact on ETP species. Regardless of this, implementation of the Species of Conservation Interest (SOCI) logbook already used in other fisheries for recording any interactions with ETP species is currently being considered.

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

and

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

No threatened ecological communities have been identified in the area of the fishery and interactions that impact on endangered, threatened or protected species are considered remote in this hand collection fishery. Therefore an assessment has not been undertaken and management measures have not been developed. If there are indications that interaction is increasing, assessment will be undertaken as appropriate.

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

The information detailed for criteria 2.2.1 to 2.2.5 indicate that there is a high chance of the objective being achieved as the ECTF is a highly selective fishery harvested through hand collection.

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

Information requirements

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.

and

Assessment

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.

1. Impacts on ecological communities

- **Benthic communities**
- **Ecologically related, associated or dependent species**
- **Water column communities**

2. Impacts on food chains

- **Structure**
- **Productivity/flows**

Impacts on ecological communities and food chains

As the fishery operates by hand collection it is highly selective to the target trochus species and has no direct impact on benthic communties or associated or dependent species. Accordingly, the primary potential impact to the environment arising from this

fishery appears to be the removal of the target trochus species from associated food webs. The scale of the impact has not been assessed however it is considered to be minimal given the conservative TAC, the recent low catch levels and considering the food webs of the species which prey on trochus. Species such as turtles, fish, crabs, octopus, stomatopods and carnivorous gastropods have been identified as predators (Nash, 1993). These species are not specialists but rather species that opportunistically feed on a wide range of species.

3. Impacts on the physical environment

- **Physical habitat**
- **Water quality**

Physical habitat

While it is recognised that divers in hand collection fisheries are likely to have some contact with the benthos, the level of contact and impact is minimal. The main impact on benthic ecological communities is through anchor damage from the vessels that operate in the fishery. The level of impact arising from the boats must be considered in the context of the considerable level of boating that occurs along the east coast as a result of of commercial and recreational fishing, tourism and other commercial shipping generally. In addition, any anchor impact arising from the vessels in the fishery are negligible in comparison to the damage caused by a range naturally occurring phenomena such as extreme weather conditions.

Water quality

Water quality is unlikely to be affected by the fishery due to the low number of participants, the unlikely concentration of potential impact sources, and the vast area of the ECTF operation.

The only concern to water quality would be poorly maintained vessels and the leaking of mechanical fluids and fuels, however no such problems have been reported by QBFP. Given that the success of the fishing operations depends on the vessels reliability it is highly unlikely that the operators would allow maintenance to lapse. The *Transport Operations (Marine Pollution) Act 1995* requires all vessels to be maintained and not discharge any materials into the water. The Department of Transport is responsible for checking vessel maintenance and safety through annual survey inspections. Vessels can be inspected both wharfside and at sea for their compliance and sea worthiness.

Due to the types of fishing gear used in the ECTF, it is not considered that the fishery has a significant physical impact on the environment. Should any change in the ecosystem or any of its components be identified through existing monitoring activities, the DPI&F would undertake a review of the fishery and its operations to determine any possible cause and identify appropriate management responses.

Management responses

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.

And

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.

And

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

No specific management responses have been developed, as the components of the marine environment described under Guideline 2.3.1 are not considered to be significantly impacted by the fishery. Should the need arise, appropriate management measures will be considered by the relevant advisory groups and where necessary, implemented by DPI&F.

REFERENCES

Brayshaw, P. 1998. Trochus Industry Profile – May 1998.

Castell, L. 1997. Population studies of juvenile *Trochus niloticus* on a reef flat on the north-eastern Queensland coast, Australia. Journal of Marine and Freshwater Research. 48, pp211-217.

Fletcher, W.J., Chesson, J., Sainsbury, K.J., Hundlow, T., Fisher M., (2003). National ESD Reporting Framework for Australian Fisheries: The ESD Assessment Manual for Wild Capture Fisheries. FRDC Project 2002/086, Canberra, Australia.

GBRMPA. 2003.
www.gbrmpa.gov.au/corp_site/management/zoning/rap/rap/pdf/FAQs_3Dec2003.pdf.

Green, R., Harris, S. and Throsby, C. D. 1991. Ecologically sustainable development working groups – Final Report. Fisheries Volume. Australian Government Publishing Service: Canberra.

Henry, G.W., and Lyle, J.M. (eds). 2003. The National Recreational and Indigenous Fishing Survey. Final report to the Fisheries Research and Development Corporation FRDC Project 99/158.

Hyland, S. 1993. A background paper for the management of the trochus fishery in Queensland. Queensland Department of Primary Industries, Fisheries Division.

King, M. 1995. Fisheries Biology, Assessment and Management, Fishing News Books. Victoria. Australia

Larcombe, J.W.P. 1993. Stock Assessment of the Queensland *Trochus niloticus* Fishery, Great Barrier Reef, Australia. A report commissioned by the Queensland Department of Primary Industries, Fisheries Division. Townsville.

Moorhouse, F.W. 1933. The commercial trochus. Reprint from the reports of the Great Barrier Reef Committee 4(1), pp23-29.

Nash, W. J. 1985. Aspects of the biology of *Trochus niloticus* and its fishery in the Great Barrier Reef region. Report to the Queensland Department of Primary Industries and to the Great Barrier Reef Marine Park Authority.

Nash, W. J. 1989. Trochus shells, Reef Notes. Great Barrier Reef Marine Park Authority.

Nash, W. J. 1993. Trochus, in “Nearshore marine resources of the South Pacific” (eds. A. Wright and L. Hill). Forum Fisheries Agency, Honiara, Institute of Pacific Studies, Suva.

Ryan, K. 1999. Review of the Stock Monitoring Program for the East Coast Trochus Fishery. A report prepared for the Queensland Fisheries Management Authority.

APPENDICES

APPENDIX 1. LOGBOOK AND INSTRUCTION PAGES FOR THE EAST COAST TROCHUS FISHERY

Beche-de-mer and Trochus Fishery Trip Logbook (BD02)

Log Book No 059 Serial No 01

PART A

Vessel Name	Symbol	Authority/Permit Holder	Authority/Permit Number

I have not been collecting for the period: Non-collection code: .....

from ...../...../..... to ...../...../.....

Non-Collection Codes
S = Snorkel H = Hookah
W = Wading Sc = Scuba

Non-Collection Codes
1 = Weather 2 = In Port
3 = Gear maintenance 4 = Steaming
5 = Other
7 = Working in another fishery

Form Code (beche-de-mer only)
S = Salted SF = Salted & Frozen
C = Chilled FG = Frozen & green
SC = Salted & chilled FB = Frozen & boiled
BS = Boiled & salted BC = Boiled & chilled

Date			Location		Effort					Harvest Information - Number of specimens only for beche-de-mer										Form
Day	Month	Year	Latitude and Longitude OR Grid and Site OR Reef ID		No tenders	Harvest method	No. divers	Indiv divers hours	Av harvest depth	Trochus KG	Trochus NO	Black teat	White teat	Prickly red	Surf red	Black fish	Red fish	Sand fish				Beche-de-mer form code
																						← Totals

PART B

Log Book No Serial No

Beche-de-mer Fishery Landing Docket

Authority / Permit Holder

Licensed Buyer Name

Species	Weight (kg)	No of specimens	Form
Black teat fish			
White teat fish			
Prickly red fish			
Surf red fish			
Black fish			

Species	Weight (kg)	No of specimens	Form
Red fish			
Sand fish			

Signature _____ Date ___/___/___ Port _____

Declaration: I declare the above trip report to be an accurate and true record:

Signature _____ Date _____

Total quota remaining from last trip	
Total quota taken this trip	
TOTAL QUOTA REMAINING	

Instructions for Use

This logbook is designed to collect information for management and research.

The logbook does not require carbon paper. The foldout writing template must be placed under the yellow page when you are filling in the logsheet to prevent accidental marks on the next set of forms. You may find the instructions on the template useful when completing each day's entry.

THE LOG MUST BE COMPLETED ON A DAILY BASIS

The yellow duplicate page is designed to remain in the logbook for your use. There is space available on this sheet where you can write private information.

The white top pages are perforated across the top so that they can be torn out, placed in the prepeid envelopes and mailed monthly.

Logsheets are to be sent to:

Logbook Coordinator
PO Box 227
BNE Roma Street
Qld 4003

Logsheets should be forwarded so as to reach the QFMA not later than 15 days after the end of the month to which it relates.

Should you have any enquiries about the Logbook Program or about using the logbook please phone on (07) 3227 6299.

Gear Description Form

To be completed and sent in with the first return from each logbook.

Filling in the Log Form

Each line is for a 24 hours period of fishing. This allows you to put 14 days fishing per page.

Non-fishing days **must** also be accounted for using the appropriate **NON-FISHING CODE**.

Blank columns are provided for species not listed. Please add names accordingly.

Position Reporting

Please provide your position for the greatest catch daily. This can be given as a 30 minute GRID using the charts in the front of the book. The 6 minute grid on the charts is the SITE. This is included for those who wish to give us more accurate position data.

Alternatively you may record the latitude/longitude from your plotter or Sat Nav. Please let us know if your readout is in decimal minutes.

Requirements

Under the Fisheries Act 1994 it is compulsory under Queensland law that this logbook shall be completed by all vessels licensed to operate in the Queensland Beche-De-Mere and Trochus Fisheries.

The Master Fisherman in charge of the vessel for and on behalf of the licence holder and/or the holder of the Commercial Fishing Vessel Licence shall provide information for each fishing day or submit a "nil" return if no fishing activities occurred for any particular month. The original page should be kept as evidence of completion in case of loss of carbon copies.

APPENDIX 2 RECOMMENDATIONS FROM THE 'REVIEW OF THE STOCK MONITORING PROGRAM FOR THE EAST COAST TROCHUS FISHERY' (RYAN, 1999)

RECOMMENDATIONS

Recommendation 1: Catch and effort records prior to the daily logbooks should be collected and entered on the computer database supported by QFMA.

Recommendation 2: The accuracy of recording and data entry of the daily catch and effort logbooks should be improved.

Recommendation 3: The total biomass of legal sized trochus should be estimated to allow changes from the original estimate.

Recommendation 4: Annual monitoring of CPUE should be maintained as a sustainability indicator for the ECTF.

Recommendation 5: Annual monitoring of the relationship between catch weight and number of individual shells should be adopted as a sustainability indicator for the ECTF.

Recommendation 6: The Total Allowable Catch should be reduced according to a revised estimate of the total biomass of legal sized trochus.

Recommendation 7: The unallocated quota of 50 tonnes should be extinguished.