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Sea Cucumber (Beche-de-mer) Fishery Management Workshop

PROCEEDINGS

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Contents

Foreword

The sea cucumber (beche-de-mer) fisheries in Australia, are small but significant. With around 1,000 tonnes of product being caught per year the fishery provide valuable export dollars to Australia. Unlike many other countries, Australian sea cucumber fisheries have had the benefit of appropriate management strategies to make sure that they remain sustainable. Some countries involved in beche-de-mer fishing have fallen into boom and bust exploitation cycles. While fishing remains good for some time, the vulnerable species often become overfished leading to a significant decline in stocks.

A workshop to discuss and share information between fisheries agencies on sea cucumber (beche-de-mer) fisheries in Australia was recommended by the Northern Australian Fisheries Management Workshop. Long-term management plans for many sea cucumber (beche-de-mer) fisheries in Australia are currently being developed. It was determined that a forum to discuss present management strategies used in Australia and around the world would assist in developing a set of national management principles for Australian sea cucumber fisheries.

I would like to extend a special thanks to Mr Gary Preston who travelled from New Caledonia to participate in the Workshop and assisted greatly in providing a global perspective on the proceedings. The Queensland Fisheries Management Authority's (QFMA) Harvest Fisheries management team: Mark Elmer, Bev Tyrer and Sian Damschke did an excellent job in co-ordinating the Workshop and in compiling these proceedings. Thanks must go to all Workshop participants for their invaluable contributions and to the Fisheries Research and Development Corporation (FRDC) for their assistance in funding the Workshop.

J Miller
Chairman
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Non Technical Summary

Sea cucumber fisheries in Australia have increased production in recent years to supply new Asian markets with processed beche-de-mer. Management of sea cucumber fisheries was raised at the recent Northern Australian Fisheries Workshop, and a need for a collaborative approach between state agencies for management of sea cucumber fisheries was identified.

Sea cucumber (Holothurians) are found throughout the world's oceans. However, only a few tropical species are sought for their commercial value for production of the final processed product, beche-de-mer. Harvesting methods and processing techniques vary widely between countries and generally Australia is thought to have quite sophisticated techniques for preparation of the final product. Total global production of beche-de-mer was approximately 90,000 tonnes in 1989 (Conand and Byrne, 1993). There are seven major countries where beche-de-mer is imported, the most significant are Hong Kong, China and Singapore. Price per kilogram varies between species, grades and production method. Sandfish, and black and white teatfish are the most valuable species, with prices ranging between $A20 - $65/kg processed weight.

Tropical sea cucumber is harvested commercially in Western Australia, the Northern Territory and Queensland as well as some Commonwealth waters in the Coral Sea. The predominant species harvested in Australian waters are sandfish and blackteat fish. Harvesting in Australia takes place by hand only, either diving or wading. Management strategies differ between jurisdictions, but are all cautious in their approach. The management objectives of each state fishery include the objective of managing the fishery in an ecologically sustainable manner, consistent with the principles of Ecologically sustainable development (ESD). Management strategies used in Australian sea cucumber fisheries include restrictions on: methods of harvest; the number of authorities given to allow sea cucumber fishing; limit to the number of crew/assistant divers; implementation of a total allowable catch (TAC); size limits; and individual quotas (IQs).

Harvest of sea cucumbers in Western Australia has increased in recent years, while harvest in the Northern Territory fishery has remained relatively constant. There are two fisheries in Queensland: the Torres Strait and East Coast. Both have shown a decline in harvest in the past two years. Further monitoring of all fisheries is required to establish long-term catch and effort trends.

In addition to state and federal fisheries agencies, several other Commonwealth agencies are involved in sea cucumber fisheries. Environment Australia has the primary responsibility for wildlife conservation and restricts commercial export of some native animals including sea cucumber. On the east coast of Queensland, much of the blackteat fish fishery is within the Great Barrier Reef Marine Park and is subject to regulation via the Marine Park zoning, and management plans in the area. The Australian Quarantine and Inspection Service manage the operational aspects of inspection and certification of fish and fish products for export.

Workshop One identified management issues through discussion of the current management strategies employed in each state. Objectives for sea cucumber fisheries in northern Australia already focus on sustainability, the precautionary approach to management, and economic and social benefits. The key biological features identified important when considering appropriate

management strategies include: level of vulnerability; reproductive biology; survival; growth rate; and favoured habitat. The research required to better evaluate the status of Australian sea cucumber to assist in developing appropriate management strategies included: many aspects of their biological features and taxonomy as well as social and economic studies. Stock management strategies, performance indicators and monitoring and enforcement issues warranted particular attention and it was recognised that a precautionary approach must be taken in these areas.

Sea cucumber fishery management principles identified the need for fundamental baseline information to ensure all the objectives of sea cucumber resource management in Australia are met. The following forms the basis of information requirement guidelines that would assist in in developing management tools and ensuring sustainability of the sea cucumber fisheries in nothern Australia. Information requirements included:

- resource abundance and distribution of commercially important species in Australia;
- taxonomic research into sandfish populations in Australia;
- size-based information, and monitoring of size of sea cucumber harvest;
- investigation into the advantages of seasonal and area closures;
- gear restriction to diving and hand take methods (exclude trawl method);
- investigation into potential environmental impacts from processing and harvesting; and
- coordination and data exchange between states and agencies to maximise the resource information base for management of these fisheries throughout Australia.

SECTION ONE

1. Introduction and background

Beche-de-mer fisheries in Australia have increased in production over the past decade supplying Asian markets with fresh, frozen and dried product. The tropical region is the largest producer of Australian sea cucumber, with the target species being sandfish (*Holothuria scabra*) and blackteat fish (*Holothuria nobilis*). The Asian market has demanded an increase in fishing effort in Australia and management agencies have recognised the need for cautious management of these stocks. Historically, beche-de-mer fisheries have been characterised by periods of overfishing followed by resting periods when stocks are able to recover. These 'boom and bust' cycles are not a viable option for most management agencies, and a steadily exploited fishery is the preferred option for ensuring ecologically sustainable development (ESD).

Memoranda of Understanding between Northern Territory (NT), Queensland (Qld) and Western Australia (WA) and the Commonwealth of Australia under Offshore Constitutional Settlement (OCS) agreements provide for exchanges of information on a variety of fisheries matters. In addition, a Joint Statement between adjacent State fishery agencies sets out guidelines for consultation, particularly for the matters of: management; research and monitoring; surveillance and coordination. The parties to the Memoranda agreed to schedule a common forum annually to give effect to the guidelines. That forum is known as the Northern Australia Fisheries Management Workshop which has met twice to date: Cairns, Queensland - 1996 and Broome, WA - 1997.

The Northern Australia Fisheries Management Workshop held in Broome on 22-23 May 1997 identified the need for northern states to further examine management strategies for beche-de-mer fisheries in Australia on a collaborative basis. Likely benefits of such an approach were identified in the areas of information sharing; determining research needs; developing basic biological information; and determining complementary management arrangements (closures, size limits).

The Beche-de-mer Fishery Workshop held in Brisbane on the 8-9 December 1997 bought together managers, scientists, compliance officers, and an expert resource person who assisted in management and biological issues as well as other representatives engaged in the management and conservation of sea cucumbers in Australia.

SECTION TWO

2. Exploitation, ecology and management of fisheries for sea cucumbers (beche-de-mer) G.L. Preston

2.1. Introduction

Beche-de-mer, also called trepang, is the name given to the dried product manufactured from the marine animals commonly called sea cucumbers (or, incorrectly, sea slugs). Sea cucumbers are members of the class Holothuroidea in the phylum Echinodermata, and are sometimes referred to as holothurians or holothuroids.

Holothurians are found throughout the world's oceans, at all latitudes and at all depths from shallow coastal seas to the abyssal plain. In the deep ocean, holothurians may account for very high proportions of the benthic biomass (Sibuet, 1985). Among coastal species, the holothurians of the order Aspidochirotida, which contains the commercial species, tend to predominate in tropical waters, while dendrochirotid species, which are generally of no commercial interest, are more common in temperate seas (Conand, 1986).

The international beche-de-mer trade began in the waters of India, Indonesia and the Philippines over 1,000 years ago (Conand and Sloan 1989), spreading to Oceania in the latter half of the 20th century.

Economic liberalisation and growing affluence in mainland China has led to a substantial growth in demand for beche-de-mer in the past 15 years, and steadily climbing prices have resulted in large increases in production, frequently followed by fishery collapse, in many countries. During the 1980s demand also grew because of changes in the Chinese system of exchange control, that led to the extensive use of certain types of beche-de-mer as a barter currency.

The nature of beche-de-mer and the simple, low-technology way in which it is processed makes it an ideal commodity for rural areas in developing tropical countries, where the raw resource is often plentiful, and where cold storage or other facilities needed for trade in alternative types of marine produce may not be readily available. In some developing countries beche-de-mer fisheries play an important role in maintaining rural social stability by providing income-earning opportunities in remote locations where other earning opportunities may be limited by the lack of resources or infrastructure.

In more recent times, beche-de-mer has continued to be an important, although variable, source of revenue in many developing countries. The beche-de-mer trade has also had significant environmental consequences, some of which are probably irreversible. The most obvious of these is the deforestation of coastal areas of much of their firewood, 10 t of which is needed for smoking 1 t of beche-de-mer. The destruction of forests, especially mangroves, for beche-de-mer production continues to be a matter of concern today.

2.2. Holothurian fisheries

2.2.1. Exploited species

The main holothurian species used for beche-de-mer production are listed in table 1 below. All commercial sea cucumbers are members of the class Aspidochirotidae and all are relatively large species with thick body walls.

Table 1 Sea cucumber species traditionally used for beche-de-mer production

Scientific name	Common name
Actinopyga echinites	Deep-water redfish
Actinopyga lecanora	Stonefish
Actinopyga mauritiana	Surf redfish
Actinopyga miliaris	Blackfish
Holothuria atra	Blackfish
Holothuria fuscogilva	White teatfish
Holothuria fuscopunctata	Elephant's trunk fish
Holothuria nobilis	Black teatfish
Holothuria scabra	Sandfish
Holothuria edulis	Pinkfish
Stichopus chloronotus	Greenfish
Stichopus variegatus	Curry fish
Thelenota ananas	Prickly redfish
Thelenota anax	Amberfish
Bohadschia marmorata	Chalkfish
Bohadschia argus	Leopard fish or Tiger fish
Bohadschia vitiensis	Brown sandfish

Many of these species are distributed widely in the Indian and Pacific Oceans. Some members of the family Holothuriidae, including commercial species such as *Holothuria nobilis* and *H. scabra*, and some of the Stichopodidae, are found as far west as East Africa and Madagascar. Species diversity decreases in an easterly direction across the Pacific and few of the traditionally exploited holothurian species are found as far east as the Hawaiian islands (Clark and Rowe, 1971).

2.2.2. Fishing methods

Harvesting of sea cucumbers varies of complexity. At its simplest harvesting is by hand-collection or free-diving. In many situations holothurians can be harvested by wading at low tide. A small boat or floating container is normally required for collecting some of the more valuable species, such as *Holothuria nobilis, H. fuscogilva*, and *Thelenota* species. These types are normally found in water that is too deep for them to be collected while walking, but they can be gathered by free-diving with a face mask.

In deeper waters where free-diving is difficult or too tiring, some collectors use 'bombs' made of a lead or concrete weight with a steel barb protruding from the base. The weight is dropped onto the holothurian by a diver swimming at the surface, usually alongside a small boat.

Because the weight needs to be very heavy to pierce the tough holothurian skin, the hooked animal is then hauled up by the boatman. This system is not widely used and is only practical in areas of weak current.

Fisheries in more developed locations, such as the west coasts of Canada and the USA tend to use underwater breathing apparatus (SCUBA or hookah gear), that makes the task of collecting animals from deeper water much easier. Hookah gear, is rapidly becoming more widespread in many developing countries as small, relatively low-cost compact units spread in the recreational diving market. The use of this type of equipment has the potential to significantly increase the likelihood of local over-harvesting and consequent adverse effects, as well as presenting a high risk of accidents to beche-de-mer collectors who, for the most part have no formal dive training.

In some fisheries, such as those of the Palk Strait separating India and Sri Lanka, holothurians are harvested by dredge or bottom trawl, or are taken as a by-catch of trawling operations for other species, such as prawns.

2.2.3. Processing

Traditional processing of holothurians into beche-de-mer is done by rural producers who do not have access to sophisticated or costly processing equipment. Processing typically involves the use of discarded oil drums as boiling containers, improvised smoke-sheds or smoking racks, and large quantities of firewood. Where copra processing is carried out, beche-de-mer may be smoked inside the copra dryers. More usually, however, they are smoked in small, purpose-built smoke sheds or over open fires of mangrove wood close to the landing point. Australia is one of the most developed countries involved in sea cucumber fishing and processing and technology and methodology is somewhat different to developing countries. When properly processed, beche-de-mer will keep for many months without the need for refrigeration or other forms of preservation.

A typical beche-de-mer processing operation involves several stages and comprises: gutting; cooking (boiling); cooling and drying/smoking stages. There are variations on this basic procedure depending on the species being processed. The process of smoking may be reduced or eliminated altogether and the animals simply dried in the sun, in which case the drying process may take several days. This is sometimes the case for low-value species such as blackfish (*Actinopyga spp*) and greenfish (*Stichopus chloronotus*). Van Eys and Philipson (1989) note that Singaporean buyers would prefer to see less smoked product, and a greater use of sun-drying by Pacific Island beche-de-mer producers. While other countries tend to use solar power for drying, Australia uses fairly sophisticated drying rooms and sun drying rooms to provide high quality product to the dried markets. *Holothuria scabra*, has a chalky epidermal layer which requires an additional processing stage to remove. Processors have sought to improve sandfish quality by using cleaning machines (a revolving drum containing abrasive grit, similar to a large stone-polisher or cement mixer).

Variations to the processing method may also be made according to the requirements of the individual buyer, and these will be reflected in the price paid to the processor. Purchasing agents often provide detailed instructions regarding their particular requirements, or processing demonstrations, to processors.

The basic grading criteria for beche-de-mer are nevertheless universal. Price is first of all determined by species. Buyers dealing with Hong Kong traders will have different species preferences from those shipping to Singapore, and it is not unusual to find quite different prices offered for the same species by different buyers. Within a given species, higher prices are always paid for larger animals with a low moisture content (20-30 percent by weight is desirable), a firm, hard texture, a regular, even shape, and smooth incisions without ragged edges. Odour and colour are also taken into consideration, since both are used as indicators that the product has been processed correctly and is free of decomposition.

Low-grade product is still readily purchased by most buying agents, and is even sought after by some, since it can be re-processed to convert it to a higher-grade product. The economies of scale achieved by doing this at a central location have made it a more profitable activity for some agents than the purchasing of high-grade product direct from individual producers.

2.3. International trade in beche-de-mer

2.3.1. Production

The quantity of beche-de-mer produced in the world has never been known very accurately. During the first half of the 20th century about 15 countries were thought to producing a total of between 1,000 and 3,000 t annually (Conand, 1986). Production in the late 1970s and early 1980s ranged between 10,000 and 15,000 t annually, with Philippines and Indonesia being the largest producers. Other production areas include or have included south and east Africa, the islands of the Indian Ocean, India, Sri Lanka, Thailand, Malaysia, Australia, China, Taiwan, Korea, Japan and the Pacific Islands. Beche-de-mer fisheries comprise a substantial proportion of total fishery production in some countries..

Table 2 shows the most recent available estimates of world sea cucumber production.

Table 2 Estimated world catches of sea cucumbers (tonnes wet weight) (from Conand and Byrne, 1993).

Country	1983	1984	1985	1986	1987	1988	1989
Pacific Islands	578	3,110	3,240	8,000	23,200	18,040	7,020
West-central Pacific	11,271	9,333	45,360	26,800	49,600	54,120	60,060
Eastern Indian Ocean	1,445	990	540	1,200	800	4,100	6,240
Western Indian Ocean	1,156	707	4,860	4,000	6,400	5,740	4,680
Sub-total - Tropical fisheries	14,450	14,140	54,000	40,000	80,000	82,000	78,000
Western Pacific	12,310	11,115	10,980	10,721	9,998	9,725	9,657
Eastern Pacific	648	1,100	578	932	1,905	2,743	2,265
Sub-total - Temperate fisheries	12,958	12,215	11,558	11,653	11,903	12,468	11,922
Total	**27,408**	**26,355**	**65,558**	**51,653**	**91,903**	**94,468**	**89,922**

Beche-de-mer production has increased very markedly in the past decade or so. The increase has been in two marked phases: in 1984 - 1985 production increased threefold over previous years, and during 1986-1987 it doubled again (Conand and Byrne, 1993). In Pacific Island countries, and probably in other areas, much of this growth was caused by increases in the price of traditionally low-valued species, which had previously not been worth collecting. One such species, *Actinopyga miliaris* (blackfish), made up the bulk of the increase in

production from Fiji (T. Adams, unpublished documents: Preston *et al.*, 1988) and New Caledonia (B. Fao, *pers. comm.*) in the late 1980s.

In the last three years anecdotal evidence suggests that beche-de-mer production from the Pacific Islands, Sri Lanka, Madagascar and probably other areas is tailing off due to over-exploitation and unsustainable harvesting practices. However there are no recent studies or statistical information which allow quantification of any such changes in production.

2.3.2. Markets

In the late nineteenth century, commercial statistics indicate the predominance of China as a beche-de-mer importer, with about 1,000 t annually (Conand and Sloan, 1989). Today, the seven major markets are Hong Kong, China, Singapore, Taiwan, Malaysia, Korea and Japan, with secondary markets in several non-Asian cities that have sizable Oriental populations.

Table 3 shows data on beche-de-mer imports into the seven major Asian importing countries. These data represent almost 90% of the international trade in beche-de-mer, which is estimated to average about 13,000 tonnes annually (Ferdouse, 1997).

Table 3 Asian imports of fresh, frozen and dried beche-de-mer (tonnes), 1992 - 1994 (from Ferdouse, 1997)

Countries	1992 Qty (t)	1992 Value (US$ '000)	1993 Qty (t)	1993 Value (US$ '000)	1994 Qty (t)	1994 Value (US$ '000)
Hong Kong	7,030	35,136	7,401	29,774	7,281	35,136
China	2,423	NA	3,508	9,140	3163	8,260
Singapore	1,435	11,001	880	6,953	1,242	11,341
Malaysia	401	1,081	335	761	400	1,000
Taiwan	1,191	9,229	1,135	6,030	1,124	5,543
Republic of Korea	18	265	21	327	25	400
Japan	40	1,263	17	635	17	635
Total	**12,538**	**57,975**	**13,297**	**53,620**	**13,252**	**62,315**

Most beche-de-mer produced in tropical countries is exported to Hong Kong or Singapore, from where extensive re-packaging and re-export takes place to smaller centres of consumption scattered throughout SE Asia, mainland China and in Chinese communities worldwide. The two centres procure from and export to different hinterlands, with Singapore trading principally to the west, and Hong Kong having major links to neighbouring countries and those to the south (van Eys and Philipson, 1989). The functions of importers/exporters are not limited to physical movement of product, but also include activities aimed at improving the product and adding value, such as grading, cleaning, drying and packing. The considerable tranfer of product between ports that occurs among these markets complicates the interpretation of trade statistics.

Trade into and out of the various markets is influenced by consumer preferences, tariffs and traditional trading practices. Local consumers in Hong Kong, Singapore and Taiwan demand mainly high-quality product which is mostly consumed in restaurants or on special occasions rather than as a daily domestic food item. However, exports to China and some other areas contain large volumes of low-quality, lower-cost types. The preferential tariff rates which exist among ASEAN (Association of South-East Asian Nations) member countries encourage

Malaysia, Brunei and Thailand to import beche-de-mer through Singapore rather then direct from producing countries.

2.3.3. Value

The beche-de-mer production boom which took place in the late 1980s and early 1990s is a result of increasing prices generated by a growing demand for this product. In particular the last decade has seen a marked increase in the price of traditionally low-valued species, which is attributed to increasing demand in mainland China for inexpensive beche-de-mer types. This has led to a change in the species composition of exports from many producer countries, with greatly increased proportions of low-value types. McElroy (1990) presents data to show that, in Fiji and Solomon Islands, increases in beche-de-mer production during the previous decade were accompanied by a marked decline in the average value per kg, attributed to increased proportions of low-value species.

In 1988 prices declined somewhat, especially for low-grade species, and this led to a leveling off in production in some countries. Prices for high-grade species, however, have remained inflated or have increased in response to declining relative volumes of these types. As a result, in most countries production is still substantially higher than pre-1986 levels. This may justify concern over the long-term sustainability of some fisheries.

Although production and export statistics are not generally available on the different types of beche-de-mer, they are nevertheless traded by species, and, within the species categories, by grade, which is generally determined principally by size. The type and grade of beche-de-mer greatly influences the price. Table 4 shows reference prices for various beche-de-mer types in 1990 and at present, based on several sources - McElroy (1990), Ferdouse (1997) and recent issues of the fortnightly INFOFISH Trade News which publishes sample prices for various seafood commodities. Where a range of prices is shown, this reflects typical values for the lowest and highest grades for that particular species.

Table 4 Reference prices (US$/ kg) for beche-de-mer products in SE Asian markets

Product	(McElroy, 1990) Hong Kong and Singapore Mid-1990	(Ferdouse 1997) Singapore March 1996	(INFOFISH, 1997) Hong Kong, Singapore and SE Asian markets Dates in 1997
White teatfish (*Holothuria fuscogilva*)	14 – 24	25 - 30	15 - 26
Black teatfish (*Holothuria nobilis*)	11 – 12	20 - 25	14 - 19
Sandfish (*Holothuria scabra*)	5 – 15	30 - 45	22 - 65
Prickly redfish (*Thelenota ananas*)	12	10	12 - 15
Greenfish (*Stichopus chloronotus*)	8	12 - 15	13 - 18
Surf redfish (*Actinopyga mauritiana*)	7 – 8	12 - 15	10 - 12
Curryfish (*Stichopus variegatus*)	6 – 7	15 - 20	15 - 25
Blackfish (*Actinopyga miliaris*)	6		
Stonefish (*Actinopyga lecanora*)	4 – 6	15 - 18	10 - 12
Deep-water redfish (*Actinopyga echinites*)	4		
Amberfish (*Thelenota anax*)	4		3.50
Elephant's trunk fish (*Holothuria fuscopunctata*)	3		2.50 - 3
Lolly fish (*Holothuria atra*)	2 – 4		2 - 7
Pinkfish (*Holothuria edulis*)	2		
Chalkfish (*Bohadschia marmorata*)	10		
Leopard fish or Tiger fish (*Bohadschia argus*)	4	5 - 7	5.50 - 7
Brown sandfish (*Bohadschia vitiensis*)	2 – 3	5 - 7	5 - 6

The table indicates strengthening prices for most beche-de-mer types, although these may often be masked by short-term fluctuations caused by variation in supply and demand. Prices for most species have at least doubled over the past 7 years, and in the case of some of the higher-value types, especially sandfish, the best grades are now worth five times what they were in 1990. The strengthening demand and increasing prices will undoubtedly encourage higher levels of exploitation in sea cucumber fisheries.

SECTION THREE

3. Management of sea cucumber (beche-de-mer) fisheries in Australia

3.1. Western Australia beche-de-mer management

Ms Leonie Cooper Fisheries Western Australia

3.1.1. Objectives of fisheries management

Management objectives of beche-de-mer stocks in Western Australia include:

- ensuring that harvesting of beche-de-mer is developed in accordance with the principles of Ecologically Sustainable Development (ESD);
- ensuring that harvesting of beche-de-mer is undertaken in a manner that does not jeopardise the conservation of any harvested species; and
- obtaining information on the distribution, abundance and sustainability of commercially exploited species of beche-de-mer in Western Australian waters from which long term management programs can be developed.

3.1.2. Management history

Prior to 3 February 1995, under Offshore Constitutional Settlement arrangements (OCS), the State jurisdiction for beche-de-mer, extended from the shore line to the 200 metre isobath for the entire Western Australian coastline. Commonwealth laws applied seawards from the 200 metre isobath to the outer limit of the Australian Fishing Zone, and in other proclaimed waters. On 3 February 1995 new OCS arrangements came into effect extending Western Australia's jurisdiction over sedentary and associated species to the outer limit of the Australian Fishing Zone. In other proclaimed waters Commonwealth laws still apply.

The level of commercial exploitation of beche-de-mer in Western Australian waters has historically been, and continues to be, controlled by a series of input and output controls. These controls include:

- prohibition on fishing for beche-de-mer without an Western Australian fishing boat licence;
- prohibition on fishing for beche-de-mer without a commercial fishing licence (a fishermen's personal licence which authorises the take of fish for the purpose of sale);
- prohibition on fishing for beche-de-mer without a specific endorsement on the fishing boat licence and commercial fishing licence;
- prohibition on fishing for beche-de-mer by means of underwater diving and/or breathing apparatus without an endorsement on the fishing boat licence;
- limitation on the number of specific beche-de-mer endorsements issued;
- restriction on the method of harvest;
- restriction on the number of crew members;
- restriction on the number of divers per boat harvesting beche-de-mer;

- prohibition on the take of beche-de-mer in particular areas.
- minimum size at which particular species of beche-de-mer may be harvested.

3.1.3. Current management arrangements

Fisheries in Western Australia are managed in accordance with the provisions of the *Fish Resources Management Act 1994* (Act) and the *Fish Resources Management Regulations 1995* (Regulations), that are administered by Fisheries Western Australia. The Act makes provision for the determination of a management plans for a fishery. A fishery may be either a fully managed fishery or an interim managed fishery.

A management plan is currently being drafted into legislation for the Western Australian Beche-de-mer Fishery. The fishery will be an interim managed fishery until the year 2000 following which the management arrangements for the fishery will be reviewed.

The fishery is presently managed by means of an endorsement on the Fishing Boat Licence and commercial fishing licence, developed in accordance with the management arrangements outlined in the document titled "Draft Interim Plan for Beche-de-mer Fishing in Western Australia."

The issuing of beche-de-mer endorsements are subject to the submission of a comprehensive fishing plan by the fishermen applying for the endorsement. Renewal of beche-de-mer endorsements are subject to the endorsement holder meeting a minimum catch criteria (currently 4 tonnes per annum) and the submission of an annual report on fishing activities for the fishing season. This ensures that there are no latent fishing licences in the fishery.

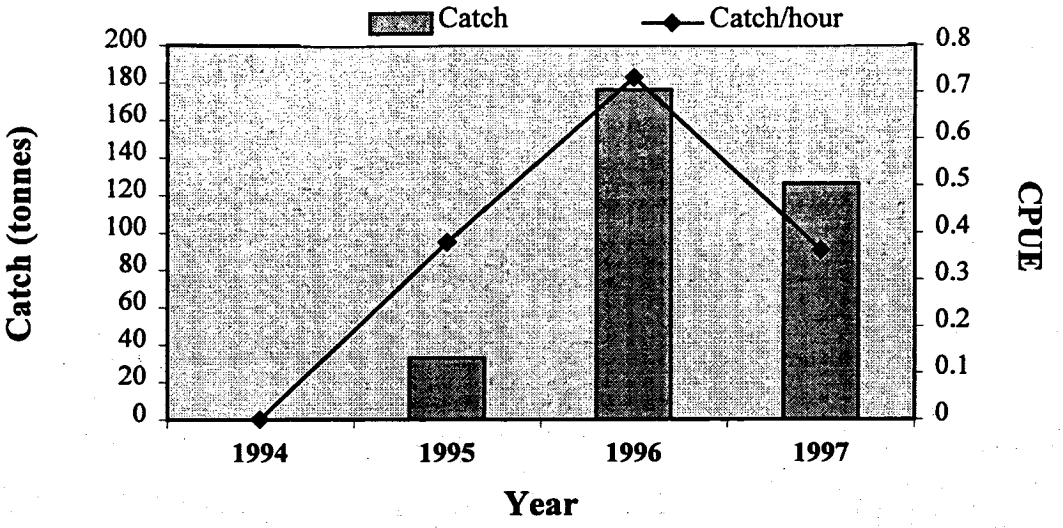
Endorsement holders have a statutory requirement to submit detailed monthly catch and effort logbook return. The information provided in the endorsement holders' returns are entered into a fishery database and analysed on a regular basis by management and research staff.

3.1.4. Overview of catch and effort information

Prior to 1994, there was relatively little effort expended in the harvesting of beche-de-mer. However, with the increase in demand from Asian countries in 1995 and 1996, and a reduction in quantity of beche-de-mer being harvested in other states of Australia, there emerged an increasing interest from fishermen to harvest beche-de-mer from Western Australian waters.

In 1995 there was approximately 33 tonnes wet weight of beche-de-mer reportedly taken from Western Australian waters by authorised fishermen. Catches increased dramatically over the next two years (Figure 3.1) with peak catches of beche-de-mer being recorded in 1996 at approximately 176 tonnes wet weight. Catch information provided for the year to September 1997 indicated that similar quantities of beche-de-mer were also expected to be harvested in 1997 as those harvested in the preceding year. There was approximately 126 tonnes wet weight of beche-de-mer harvested until September 1997.

Figure 3.1 Annual Beche-de-mer Harvest (tonnes wet weight) Western Australia



The number of endorsements issued in any one year (six) has remained constant over the period 1994 to 1996. The number of active divers, however, operating under each endorsement has increased over that same period as holders have increased their operation to the full allowable entitlement. Four divers are permitted to dive at any one time under each endorsement with six crew permitted to be on board the authorised boat at any one time. Similarly, the number of hours dived annually in the fishery has increased although the number of hours dived by each person has remained relatively constant.

Catch per unit effort (catch per diver per hour) increased over the period 1994 to 1996 and then remained relatively constant until the end of 1996. Analysis of the data available until September 1997 indicates that CPUE is declining in 1997. This may be consistent with the normal trends of a developing fishery or may be the initial indications of over-exploitation of the resource. Fisheries WA will continue to monitor trends in the fishery throughout 1998 and adjust management strategies accordingly.

3.2. Northern Territory beche-de-mer management

Mr Ric Fallu - Fisheries Division, Northern Territory Department of Primary Industries and Fisheries

3.2.1. Objectives of fisheries management

The 1996/97 business plan for the Fisheries Division of the Department of Primary Industry and Fisheries in the Northern Territory stated that the objective for aquatic resource management as a whole was to manage the fish and aquatic life resources of the NT on a sustainable basis. The specific management objective for the trepang fishery was to manage the trepang fishery in the NT to provide for sustainable utilisation and maximum benefits to the NT.

3.2.2. Management history (from Northern Territory DPIF, Status Report 1996)

The commercial fishery for trepang in Australian waters has a long history. From about 1700 onwards, large numbers of Macassan fishermen regularly made the voyage from Indonesia to the northern coast of Australia to fish for trepang and other species which were dried and taken back. Trepang may have been Australia's first export industry. Macassan fishing ceased in 1907. The most likely cause was that the fishery became unprofitable, perhaps exacerbated by high licence fees. There is no evidence that a decline in the abundance of trepang was responsible.

A lower level of commercial exploitation continued until about 1945. Participants were generally Australians of European origin assisted by Aboriginal people living along the remote Arnhem Land coast. After 1945, activity ceased. In the late 1980s, reports indicating that there was a significant trepang resource and the fishery was potentially. Interest was rekindled and in 1992, the fishery was re-opened with six licences issued.

3.2.3. Current management arrangements

Fisheries in the Northern Territory (NT) are controlled under the *Fisheries Act 1993* (the Act) and the *Fisheries Regulations 1993*, which are administered by the Department of Primary Industries and Fisheries, Fisheries Division. The Act has provision for creation of formal management plans for individual fisheries. In the immediate future it is not intended to create a statutory management plan for the trepang fishery, but the establishment of a formal management plan would be desirable in the long term.

Following a precautionary approach, the Northern Territory Government issued six licences when it re-opened the fishery in 1992. This number of licences has not changed since. Licences became transferable during 1993 to further encourage development and investment in the fishery and licence transfers have occurred since that time.

Initially, the fishery was divided into three zones, with two licences permitted in each zone. However, once operators commenced, licensees in the far western zone indicated that there was not enough product for their operations to be economically viable. In response, the central and western zone were merged. Currently, one zone extends east of Cape Grey in the Gulf of Carpentaria to the Queensland border (including Groote Eylandt) and the other zone

extends west of Cape Grey to the Western Australian border. There are three licences in each zone. A number of licence lease agreements have been arranged in the fishery since licences became transferable.

Other controls on the fishery have been developed. Underwater collecting was initially restricted to free diving. However fishermen claimed this was unsafe with crocodiles posing a particular threat. The use of scuba and hookah gear was approved to allow fishermen to use safety cages, although some divers find cages restrictive. Most operations involve armed spotters in dinghies, who keep a look-out.

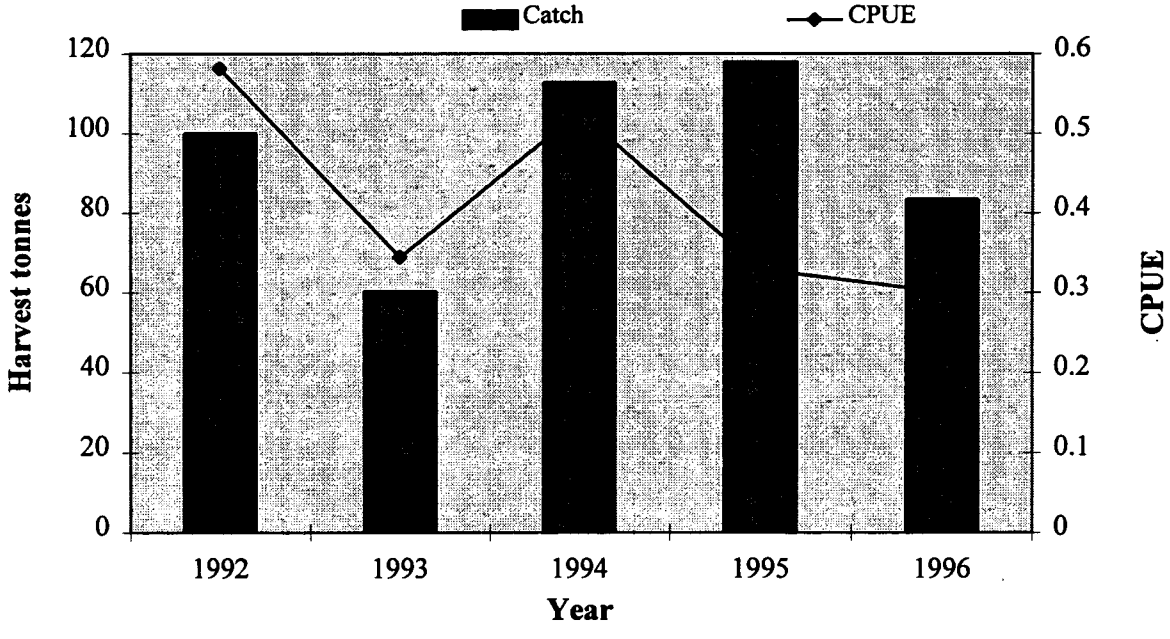
To minimise the effect the fishery is having on non-target species and the general environment, the only fishing method allowed is by hand ensuring that minimum environmental damage occurs. Dredging for trepang is not allowed.

The main monitoring tool is data from compulsory daily catch/effort logbooks that are completed by licensees and submitted on a regular basis.

3.2.4. Overview of catch and effort information

Since 1992, total catches and catch per unit effort in the fishery have shown significant fluctuation (Figure 3.2). There has been insufficient time, or direction in changes, to indicate trends. It would seem possible that the changes reflect changes in fishing power rather than fluctuations of the amount of trepang present. The reasons for this may be varied: fishermen are undertaking an exploratory approach and technique may change; there are limited numbers of fishermen and changes in one fisherman's operation may influence aggregate results; the best times and places for efficient fishing may not yet be determined and trepang also may move under the sand or be exposed at different times, influencing catch.

Figure 3.2 Annual beche-de-mer harvest (tonnes wet weight) and CPUE (tonnes per days fished).



At this time (1997), trepang fishery licence holders do not appear to be very active (pers comms Fallu, 1997). It would appear that effort could dramatically increase if fishermen so decided, perhaps stimulated by an increase in price. The possibility of a large increase in fishing effort requires continual monitoring of the fishery and a preparedness to respond if necessary.

Reasons for the low level of activity are not fully understood, especially when there are a variety of potential entrants expressing interest in obtaining access to the fishery. Some licence holders may be speculating on the capital value of the licences, or are 'keeping the trepang in the bank' to hedge bets against loss of other sources of supply.

3.3. Queensland beche-de-mer management

Ms Bev Tyrer, Queensland Fisheries Management Authority

3.3.1. Objectives of fisheries management

Two beche-de-mer fisheries operate in Queensland: Torres Strait (TS) and East Coast (EC). In addition, the possibility for developing a sea cucumber fishery in the Gulf of Carpentaria is being investigated. Beche-de-mer fisheries in Queensland are yet to have management plans finalised. The objectives of management are within the broad context of the *Fisheries Act 1994*: ensuring fisheries resources are used in an ecologically sustainable way; achieving the optimum community, economic and other benefits obtainable from fisheries resources; and ensuring access to fisheries is fair.

The objectives for managing the Torres Strait beche-de-mer fishery are: to provide for the sustainable use of all beche-de-mer stocks in the Torres Strait; subject to the above, to develop those stocks for the benefit of Australian Traditional Inhabitants (as defined in the Torres Strait Treaty); and within the scope of those objectives, to exercise considerable constraint in harvesting stocks at the present time pending the conduct of a survey of the standing stocks of beche-de-mer in Torres Strait.

3.3.2. Management history

The beche-de-mer fishery has historically been an important source of income in Torres Strait involving more than 100 boats and with annual catches of more than 500 tonnes earlier this century. Beche-de-mer continued to be important up until the second world war but 'boom and bust' cycles are typical in this fishery. Another boom started in the late 1980s in the beche-de-mer fishery on the Papua New Guinea (PNG) side of Torres Strait, centred mainly on the northern reefs of the Warrior Reef complex. This cycle lasted until the fishery was closed in 1993 due to concerns about overfishing. The fishery on the Australian side of Torres Strait recently experienced a similar boom which began in 1994 and mainly centred on the southern reefs of the Warrior Reef complex. Levels of exploitation were similar to those prior to the closure of the PNG fishery, and the fishery is now recognised as being over-exploited.

The beche-de-mer fishery holds a significant place in the history of Northern Australia, and was a key factor in the permanent settlement of the area, providing substantial income for Queensland until the 1940's. From this time to 1978, there was virtually no commercial harvesting of holothurians, and between 1978 and 1986, only a few fishing permits were

issued to allow assessment of the feasibility of renewing a beche-de-mer industry on the Great Barrier Reef.

Before 1995, management of Queensland's beche-de-mer (and other harvest fisheries: aquarium fish; coral; baitworms; yabbies; trochus) rested with the Queensland Department of Primary Industries (QDPI). Permits were issued to all participants who were involved in the beche-de-mer fishery.

The *Fisheries Regulations 1995* outlined new management arrangements for wildstock fisheries in Queensland and management was transferred to the Queensland Fisheries Management Authority (QFMA). During the boom period in the late 1980s, the number of participants increased in Queensland's beche-de-mer fishery: up to 26 permit holders on the east coast, and many communities in the Torres Strait. From 1 January 1995, the east coast beche-de-mer fishery became a limited entry fishery, and no new permits have been granted since that time. In July 1996, QFMA granted beche-de-mer east coast permit holders with a new authorisation: "Authority to Take Fish For Trade Or Commerce" endorsed with the fishery symbol B1. Torres Strait communities received a similar authority endorsed with the symbol B2 authorising fishing operations within Torres Strait. There are no authorities granted for operators in Queensland waters of the Gulf of Carpentaria at this time, although interest in implementing a developmental fishery has been expressed.

3.3.3. Current management arrangements

The beche-de-mer fishery in Queensland is controlled under the *Fisheries Act 1994* and the *Fisheries Regulations 1995* and administered by the Queensland Fisheries Management Authority. The QFMA's primary function is to ensure the appropriate management, use, development and protection of fisheries resources having regard to the principles of ecologically sustainable development (ESD). The Torres Strait beche-de-mer fishery and the east coast fishery are managed as separate fisheries and have separate management regimes in place.

3.3.4. Torres Strait beche-de-mer fishery

The Torres Strait (TS) fishery comprises tidal waters within the Torres Strait Protected Zone, and the outside but near area declared under the *Torres Strait Fisheries Act 1984*. Fishing authorities endorsed with the symbol B2 are issued to Torres Strait Island community councils. Each council authority specifies a list of community members and dinghies that are permitted to harvest beche-de-mer under that authority. Only traditional TS inhabitants are authorised to harvest, and any non-islander involvement in the fishery is permitted only if it is for the long-term benefit of Islanders. Currently there are no limitations on the number of community authorities issued in the TS or the number of Islanders allowed to fish. Any community and any number of community members wishing to harvest beche-de-mer may apply for an authority to do so.

Beche-de-mer stocks in the TS are managed through implementation of a Total Allowable Catch (TAC). This is a competitive TAC, where the individual participants do not have a quota but the whole fishery is subject to annual quotas of:

- 260 tonnes - *Holothuria scabra* (sandfish);

(subquota of 40 tonnes for each of the first three months commencing February)

- 260 tonnes - *H. nobilis, H. fuscogilva* (teatfishes);
- 260 tonnes - *Thelenota ananas* (prickly redfish); and
- 80 tonnes - all other species of beche-de-mer.

Once these quotas have been reached, the fishery closes for the remainder of the calendar year. Minimum legal lengths on all commercial species also apply. Another strategy to limit fishing effort is to ensure collection methods are by hand only. Future methods may also include prohibiting the use of hookah equipment for harvesting.

It has been recognised that the presence of boat-based buying vessels or 'mother ships' and land-based processing operations increase demand for product, and fishing expands to fill this demand. A limit on the number of mother ships allowed to operate in the TS has assisted in controlling demand fishing for beche-de-mer.

A detailed logbook program operates in the fishery. Both community councils and buyers are responsible for submitting logbook returns. These are forwarded to QFMA each week, providing managers with records of catch and location of harvesting activities. Data are entered into the fishery database and analysed on a regular basis by management and research staff. The TAC is monitored via logbook returns for the fishery.

It is likely that responsibility for management of the TS Beche-de-mer Fishery will be transferred from the QFMA to the Protected Zone Joint Authority (PZJA) jurisdiction in the near future under the Torres Strait fisheries single jurisdiction initiative. While the management jurisdiction may change, QFMA may continue to undertake the administration of the fishery on behalf of the QFJA.

3.3.5. East coast beche-de-mer fishery

The East Coast (EC) beche-de-mer fishery comprises all tidal waters on Queensland's east coast from Tin Can Bay north to the tip of Cape York. A Discussion Paper is currently being prepared for the EC fishery which is the first step in the process leading to a statutory fishery management plan. Until the Management Plan has been finalised, the fishery is managed under a statement of interim management arrangements.

The major management strategies in place in the EC beche-de-mer fishery are those which limit the harvest of beche-de-mer (output controls). These take the form of:
- TAC;
- supplementary quota;
- individual quotas; and
- minimum legal sizes.

The TAC of beche-de-mer is 500 tonnes collectively. Of this total, 380 tonnes is individually allocated to participants in 15, 25 or 50 tonne lots. The remaining 120 tonnes is available to supplement any individual's quota. At present quotas are not transferable, nor species specific.

Fishing effort is managed by:
- limiting the number of authorisations in the fishery;
- limiting collection methods to either diving or collecting fish by hand;

- limiting the number of crew authorised to fish under an authority to 10;
- limiting the use of dinghies attached to a primary fishing boat to two with a maximum size of 6 metres.

A detailed logbook program also operates in the fishery. Participants lodge logbook returns containing monthly records of catch (wet and processed weight), effort and location of all harvesting taking place on all authorities. Data are entered into the fishery database and analysed on a regular basis by management and research staff. Individual quotas and the supplementary quota is monitored through the logbook program.

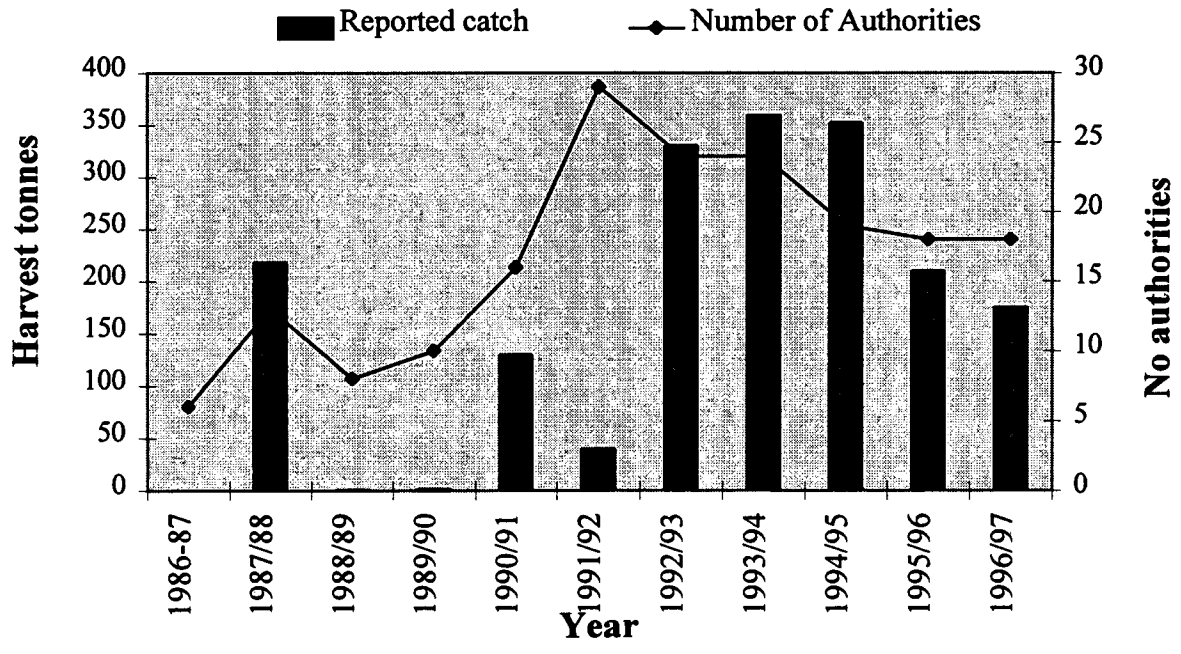
3.3.6. Overview of catch and effort information

Harvest statistics for Queenland's beche-de-mer fisheries are far from complete. The logbook program was initiated in 1991. At that time, catch and effort information was recorded on a quarterly basis. In October 1995, a daily logbook was introduced allowing detailed information to be recorded on daily catch, effort and location information.

The primary species harvested on the east coast is blackteat fish, which is found in all reef areas of the Great Barrier Reef, and makes up 65% of the total catch. Sandfish is the secondary species, being harvested primarily in the Tin Can Bay area. Around 15% of the harvest is made up of lesser valued species such as whiteteat fish, redfish, lolly fish, elephant trunk fish amongst others.

During the years 1992/93 and 1993/94, total harvest peaked at around 350 tonnes (Figure 3.3). The limited entry policy was introduced at around this time to control effort in the fishery. Long-term trends are difficult to detect due to the short time span of available data. However, anecdotal information suggests that blackteat fish stocks have decreased in recent years.

Figure 3.3 Total harvest of beche-de-mer (wet weight) in the East Coast fishery and the number of authorisations issued.



The main areas of harvest are Tin Can Bay (sandfish); the far northern section of the Great Barrier Reef; and around the Cairns area. While there are 18 issued authorities for the EC beche-de-mer fishery, only 9 - 10 are active. It is estimated that nine boats engage regularly in blackteat fish harvesting , while a further two or three concentrate on sandfish harvesting.

Landings of beche-de-mer in the Torres Strait fishery has been high in recent years (Table 3.1). During 1995, the reported landings of sandfish totalled approximately 1000 tonnes, with industry participants predicting that unreported catches would place total sandfish landings between 1200 - 1400 tonnes for the year. As a precautionary measure, a TAC of 260 tonnes was set for sandfish in 1996, and this TAC has been reached in 1996 and 1997. Traditionally sandfish was the primary species in the TS, however pressure on the stocks has forced buyers and fishers to target other species. Redsurf fish and blackteat fish are also harvested in large numbers in the TS.

Table 5 Torres Strait beche-de-mer harvest over past four years.

Year	*Reported Catch*
1994	50 tonnes (sandfish)
1995	1000 - 1400 tonnes (sandfish)
1996	260 tonnes (sandfish + other species)
1997	260 tonnes (sandfish + 80 tonnes other species)*

Fishery-dependent data on the TS beche-de-mer fishery has not yet been collated or analysed, however further fishery-independent stock assessment information can be found in reports by Long *et al.* (1996) and Skewes *et al.* (1998).

3.4. Beche-de-mer management in Commonwealth waters

Martin Kick Australian Fisheries Management Authority

3.4.1. Objectives of fisheries management

The Commonwealth objectives in accordance with the *Fisheries Management Act 1991* and the *Fisheries Administration Act 1991,* specify that AFMA must pursue the objectives of:

(a) implementing efficient and cost-effective fisheries management on behalf of the Commonwealth;

(b) ensuring that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ecologically sustainable development and the exercise of the precautionary principle, in particular the need to have regard to the impact

* A recent survey of the southern Warrior Reefs by CSIRO has shown in summary , that sandfish stocks are severely depleted. As a consequence a *Fisheries (Torres Strait Emergency Closed Waters) Declaration 1998* was made closing the Torres Strait sandfish fishery for a period. A long term closure of the sandfish fishery has been recommended but had not come into effect at the time of preparation of this report.

of fishing activities on non-target species and the long term sustainability of the marine environment;

(c) maximising economic efficiency in the exploitation of fisheries resources;

(d) ensuring accountability to the fishing industry and to the Australian community in AFMA's management of fisheries resources; and

(e) achieving government targets in relation to the recovery of the costs of AFMA.

The Fisheries Management Act 1991 also specifies that the Minister, AFMA and Joint Authorities have regard to the objectives of:

(a) ensuring, through proper conservation and management measures, that the living resources of the Australia Fishing Zone (AFZ) are not endangered by over-exploitation; and

(b) achieving the optimum utilisation of the living resources of the AFZ;

but must ensure, as far as practicable, that measures adopted in pursuit of those objectives must not be inconsistent with the preservation, conservation and protection of all species of whales.

3.4.2. Management history

Commonwealth offshore fisheries on the east coast of Australia (excluding tuna fisheries) have undergone several administrative changes since the late 1980s. The offshore fisheries adjacent to Queensland have been managed under various management titles. These changes have primarily reflected the internal administrative arrangements within the Australian Fisheries Service (AFS) and subsequently the Australian Fisheries Management Authority (AFMA). However the 1995 OCS agreement between the Commonwealth and Queensland also widened AFMA's jurisdiction over certain species which had previously been managed by Queensland. Consequently, the Coral Sea Fishery (CSF) now includes sectors covering line fisheries, trawl, aquarium fish and other harvest fisheries including beche-de-mer.

3.4.3. Current management arrangements

Fisheries in Commonwealth waters are controlled under the *Fisheries Management Act 1991* and the *Fisheries Administration Act 1991*, which are administered by the Australian Fisheries Management Authority (AFMA) based in Canberra. AFMA in ensuring that the development of the CSF is conducted in a precautionary manner has implemented interim management arrangements while longer term management arrangements are being developed.

To date very little is known about the status of beche-de-mer in the Commonwealth sector of the CSF. Since 1993 AFMA has issued permits to two operators to take beche-de-mer in the CSF. In allowing the exploitation of beche-de-mer in the CSF, AFMA in accordance with the precautionary approach to the management of the fishery by adopting the following arrangements:

- setting a TAC of 100,000 live beche-de-mer specimens per fishing permit holder;
- ensuring collection of beche-de-mer is by hand only, with the use of SCUBA equipment;
- allowing only the use of the vessel specified in the permit and two tender boats registered with that vessel;
- limiting the number of divers per beche-de-mer permit to less than five;

- not allowing transshipment of fish, except between the boat referred to in the permit and its tender boat(s); and
- requesting completion of official logbooks for each day of fishing.

All CSF permits are non transferable and a performance criteria must be met in all sectors of the CSF for continuance. The performance criteria are:

- a minimum of 10 fishing days for the period 23 October 1997 to 30 June 1998; and
- a minimum of 20 fishing days per year after 30 June 1998.

At the completion of each fishing season the permit holder is required to provide AFMA with an annual report covering all aspects of the fishing operation, including fishing area, detailed catch and marketing arrangements.

In accordance with interim management arrangements for all sectors of the CSF, no further access will be considered until longer term management arrangements for those sectors are formalised.

3.4.4. Overview of catch and effort information

Commercial catches of beche-de-mer in the CSF were last recorded in June 1993 and a total of approximately 8 tonnes had been taken up to March 1995 (Table 3.4). Since this period no recorded catches of beche-de-mer have been taken in the Commonwealth sector by the operators. Since November 1997 two exploratory expeditions have been conducted by a permit holder in this fishery.

Around 38% of the total beche-de-mer harvest in the CSF sector is Black Teatfish, while another 10% is Prickly Redfish.

Table 6 Catches of individual beche-de-mer for the period 1993 to 1995.

Reef	*Time (Hrs)*	*Black Teatfish*	*Prickly Redfish*	*Surf Redfish*	*Unknown*	*Total*
Cato	17.5	950	450	140	95	1635
Wreck	25	1155	225	45	200	1625
Saumarez	26.5	980	147	53	9	1189
Fredrick	5				0	0
Dianne	12				259	259
Bank						
Bouganville	13				250	250
Moore	12				366	366
Osprey	33				2269	2269
Flora	8				379	379
TOTAL	152	3085	822	238	3827	7972

3.5. Other Agencies

3.5.1. Environment Australia

State and Territory Governments have the primary responsibilities for wildlife conservation and management. The Commonwealth Government has responsibility for the management of wildlife on Commonwealth lands and waters and the control of export of wildlife products from Australia.

The Commonwealth Government controls international trade in most native wildlife through the *Wildlife Protection (Regulation of Exports and Imports) Act 1982*. Under this legislation, the commercial export of native animals and plants is restricted to specimens taken under an approved management regime or derived from approved captive breeding operations.

The object of the Act is to comply with Australia's obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and to further the protection and conservation of wild fauna and flora of Australia and of other countries.

The fact that a native species is subject to export control under the Act does not necessarily imply that the species is endangered. The Act applies to all species of native Australian animals and plants, except those that are listed on Schedule 4 of the Act.

A number of fisheries species are listed on Schedule 4, including three species of beche-de-mer (*Stichopus variegatus*, *Actinopyga obesa* and *Holothuria mammifera*). These are species which were apparently subject to commercial fisheries in 1982 when the Act was promulgated. Over 200 Holothurian species are known to occur in Australian waters, and these are all subject to export control under the Act.

The Act does not prohibit export of native species as long as a permit or authority has been issued by Environment Australia (formerly known as the Australian Nature Conservation Agency - ANCA). Where harvesting (in this case, fishing) is occurring in the wild, permits may be issued if the Minister for the Environment has approved the management arrangements to ensure that the activity is ecologically sustainable.

Currently the management arrangements for the beche-de-mer fisheries in Queensland, the Northern Territory and Western Australia are approved under the Act.

An Environment Australia export permit or authority is in addition to any approval which may be required by the Australian Quarantine and Inspection Service (AQIS) under the *Export Control Act 1982*.

3.5.2. Great Barrier Reef Marine Park Authority

The Great Barrier Reef Marine Park Authority's (GBRMPA) goal is "to provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef in perpetuity through the care and development of the Great Barrier Reef Marine Park". GBRMPA's aims reflect an obligation to ensure that the natural resources of the multiple-use Marine Park are used in accordance with principles of ecological sustainability, and to consider the impacts of activities on amenity, cultural and heritage values and other uses of the Marine Park.

GBRMPA also acts as Commonwealth lead agency in respect of matters that may affect the values of the Great Barrier Reef World Heritage Area.

GBRMPA has separate legislative permitting requirements in relation to commercial harvest or 'collecting' fisheries under the *Great Barrier Reef Marine Park Act 1975* (GBRMP Act). These fisheries include trochus, beche-de-mer, marine aquarium fish, coral and specimen shells. The Queensland Department of Environment (QDoE) has delegated responsibility for assessment of applications for permits under the GBRMP Act.

GBRMPA consults with QFMA regularly through a range of mechanisms to ensure that fisheries policy and marine park management, policy and planning arrangements are complementary, and to assist in the review and monitoring of policy and management arrangements for each fishery. GBRMPA is represented on most fisheries management advisory committees and/or working groups established by QFMA for each fishery in the Great Barrier Reef Region including stakeholder working groups established in respect of the beche-de-mer fishery.

3.5.3. Australian Quarantine and Inspection Service

The Australian Quarantine and Inspection Service (AQIS), in partnership with industry, delivers quality services improving Australia's competitive position, and protecting its plant, animal and health environment.

The gross value of Australian fisheries production in 1995-96 was estimated at $1.63 billion, of which $1.32 billion was exported. These exports represent 81 per cent of the total value of Australian production. The Asian market (Japan, Hong Kong, and Taiwan) is the major destination for Australian export of fisheries products.

There are several programs undertaken by AQIS including the Export Fish Inspection Program. The objectives of this program are to ensure that:

- export certification systems facilitate access to the world's markets for Australian fish and fish products;
- inspection systems are effective and responsive to our clients (both industry and overseas government authorities) needs; and
- the program is financially viable.

It is the responsibility of the Export Fish Inspection Program, in consultation with the export fishing industry, to manage the operational aspects of inspection and certification of Australian fish and fishery products for export. This involves providing operational and technical advice to both field staff and industry about the legislative requirements for exporting fish and fish products, as well as importing countries' requirements. Other duties include ensuring compliance of all export and import requirements and providing necessary export certification.

Certification to export is not granted until AQIS is satisfied that sea cucumber has been harvested by authorised fishers and vessels. This information is provided by processors through transfer certification.

AQIS registers processing establishments for sea cucumber and beche-de-mer. These must comply with standards set out in the *Export Control (Processed Food) Orders*. AQIS inspection staff perform scheduled or random audits on processing establishments to ensure compliance with the orders.

SECTION FOUR

4. WORKSHOP ONE — Chair Mr G.L. Preston
Identification of management issues

The objectives of the first workshop were to further examine the strategies used in managing sea cucumber fisheries in Australian waters. Concerns relating to achieving management objectives for each of the fisheries were raised and identified in this forum.

4.1. Appropriate management objectives

Presentations on existing management approaches outlined in the preceding section have highlighted the need for establishing common management objectives for the sea cucumber fisheries in Australia. The following common objectives were identified by the workshop participants.

- **Sustainability**

It was agreed that sea cucumber fisheries should be managed according to the principles of *ecologically* sustainable development where the impacts of the fishery on the entire ecosystem are taken into account. Other options reviewed but not accepted included: *environmentally* sustainable development where management is geared to minimising the more obvious environmental consequences instead of taking a holistic, ecosystem approach; or *economically* sustainable development in which management simply aims to protect economic returns over the long term.

- **Precautionary approach**

The adoption of precautionary management principles was identified as a critical objective of beche-de-mer management in Australia. This approach was stressed particularly in view of the incomplete state of knowledge of the fisheries in Australia, and the fact that many beche-de-mer fisheries around the world have been known to follow "boom and bust" cycles. Precautionary approaches include: the setting of quotas at conservative levels; and the definition of target, alert and action levels that would result in predetermined management responses.

- **Economic benefits**

Maximising economic benefits and achieving maximum economic yield from beche-de-mer fisheries were seen as a desirable management goal. Given the developing nature of Australian beche-de-mer fisheries, it was accepted that the current lack of information made it difficult or impossible to set such targets with any degree of reliability.

- **Social benefits**

Maximisation of social benefits was considered as a broad principle. Each jurisdiction differed in their definitions and prioritisation of exactly which social benefits should be targeted. Maximising participant numbers may be a suitable aim in some cases although this

may not correspond with other goals, such as maximising economic yield from the fishery. Increasing involvement by indigenous communities was important for some jurisdictions. In these cases the use of education programs, especially aimed at children, was seen as a means of enhancing environmentally responsible behaviour, not only in regard to beche-de-mer fisheries but in respect of all uses of sensitive coastal and marine areas.

Other management goals discussed included participant recognition, the requirement for full accountability by all stakeholders in the fishery, minimisation of illegal fishing, and the development of management arrangements that were cost-effective and in proportion to the value of the fishery.

4.2. Key biological features of beche-de-mer

Biological features and characteristics of the managed species are critical in determining appropriate management regimes and strategies. The workshop identified a number of key biological features of beche-de-mer to be considering when preparing management plans and determining strategic management directions of these fisheries throughout Australia.

- **High vulnerability**

It was determined that beche-de-mer have a high vulnerability to harvesting, due to their sedentary and easily accessible nature. This is shown in the "boom and bust" cycles of many beche-de-mer fisheries globally. An Australian example of this is found on the Warrior Reef complex in the Torres Strait, where sandfish are harvested from the reef top at low tide in shallow water.

- **Reproductive biology**

Poor knowledge of all aspects of the reproductive biology of sea cucumbers, including spawning seasonality, fecundity, patterns of larval dispersal and size at first maturity all impeded the development of biologically-sound management regimes. Reproductive success is thought to be at least partly density-dependent, and thus the relationship between harvesting and recruitment may be complex.

- **Survival rates**

Survival rates of juvenile sea cucumbers are unknown, and juveniles are difficult to study since for most species they are rarely encountered and their habitat and distribution is unknown.

- **Variations in physiology**

Attempts to use traditional size-based fishery study techniques are hampered by the difficulty in obtaining reliable measurements of sea cucumber size (either length or weight), caused by the plastic nature of the animals, seasonal variations in body wall thickness, and variation in the quantity of sand in the intestine. The occurrence of asexual reproduction (fission) in many commercial species further confounds the use of these research approaches.

- **Age and growth**

Age and growth have been studied in other countries, but it is not known to what degree this information is directly applicable to Australian sea cucumber populations.

- **Species habitats**

The spatial and depth distribution, habitat preferences, and species associations/ assemblages of Australian sea cucumbers are all poorly known, and as a result there is little information on the extent and magnitude of the resource.

- **Taxonomy**

Research elsewhere has indicated that there may be two species of sandfish (*Holothuria scabra*) rather than one, as presently assumed. This has management implications as sandfish are currently Australia's most valuable species and makes up the majority of total landings.

4.3. Research requirements

Virtually all aspects of holothurian biology, including distribution and abundance, life history, stock structure, and population genetics were identified as requiring research attention, given that the information currently available is so incomplete. In addition research is needed on the impacts of fishing, both on the target species, and on the ecosystems of which they form a part. Even simple harvesting techniques such as reef-walking and collection by diving may have potentially significant environmental impacts. In addition, the effects on the ecosystem of large-scale removal of these animals is unknown. Discharge into the sea of toxic water produced from boiling the animals may also be a potential problem area.

Social and economic studies were also identified as being required, in particular market studies and monitoring of market trends. Study of the distribution of benefits from fishing was recommended, particularly in those areas where indigenous community involvement in the fishery was defined as a management goal. Studies of domestic marketing and distribution arrangements were also seen as necessary to obtaining a fuller understanding of the industry within Australia.

Prospects for holothurian aquaculture were identified as a potential research topic. Various overseas institutions have successfully advanced holothurian aquaculture techniques which could be emulated in Australia, although the economics of sea cucumber aquaculture have not been studied so far in Australia.

4.4. Evaluation of stock management strategies

The workshop discussed various management options. Output controls identified included size limits; total allowable catches (TACs), and individual transferable quotas (ITQs). These options have been commonly used by managers in Australia. Other management strategies aim to control total effort (output controls) including: limited entry arrangements; initial entry criteria; ongoing access criteria; preferential access; licence limitation; gear restrictions; numbers of vessels; numbers of divers; closed areas from either seasonal closures, area closures, or permanent reserves; export controls; and other possible arrangements.

Potentially useful indirect management tools were also discussed, including AQIS processing standards and hygiene controls, product labeling arrangements, exchange of data between state and federal government agencies, public education campaigns, standardisation of logbooks to enable comparison of data from different states, and the use of vessel monitoring systems.

4.5. Performance indicators

Performance indicators are potentially useful tools used to assess the performance of management arrangements against a standard limit or value. Indicators relating to the condition of the resource itself included both fishery independent and fishery dependent sources of information. Independent data may detect changes and trends in the relative abundance of sea cucumbers and the size-frequency distribution of each target species (if a reliable means could be found to obtain such data). Generally these sources of information are lacking in Australian beche-de-mer fisheries. Fishery dependent data obtained from catch return records and annual reports from industry that may be used against performance indicators include: catch per unit effort (CPUE), absolute biomass, and the amount of effort being expended in the fishery.

Other possible performance indicators that could be used in Australian beche-de-mer fisheries included the total value of the fishery, the market value of fishing licences (in cases where these were transferable) and the socio-economic structure of the fishery (level of participation, product prices, etc.).

In both cases the need to identify target, alert and action levels for each indicator or group of indicators were emphasised. When reached, these various levels would trigger predetermined management responses. Such arrangements are a feature of precautionary management, especially where the information base on which to manage the fishery is poor, as is the case for sea cucumbers.

4.6. Fishery monitoring and enforcement

Options discussed included observer programs, logbook sampling and verification, correlation of logbook returns with AQIS product transfer certificates, seasonal and area closures, size limits (both at the point of capture and at various points in the processing chain, including the point of export), and the use of VMS.

SECTION FIVE

5. WORKSHOP TWO — Chair Mr F. Antram
Development of management principles

The aim of the second Workshop was to work through management issues raised in the first Workshop and identify fundamental information required on sea cucumber fisheries to ensure the objectives of management are met. These agreed set of principles would assist in identifying future research required on sea cucumber, primary tools for management, identify other ecological effects of the fishery and detail cooperative mechanisms to work between agencies on sharing of information for the common benefit of sea cucumber fisheries in Australia.

5.1. Resource abundance and distribution

Little is known of the abundance of commercially important sea cucumbers in any Australian state. Some information has been gathered for parts of the Torres Strait, but in general the extent of the resource and distribution is not known. Lack of information on these fundamental ecological characteristics hampers the estimation of appropriate quotas and the development of other management arrangements.

Resource assessments could be developed through the integration of fishery data, independent abundance estimates derived from field sampling programs, and remotely-sensed information (satellite imagery) that could be used to estimate the extent of sea cucumber habitat.

5.2. Taxonomic research

In other countries research has indicated that there may be two species of sandfish (Preston pers comms, 1997). Sandfish are an important component of the Australian fishery particularly in WA, NT and the Torres Strait. If two species are involved rather than one, as presently assumed, this will have implications for management since research elsewhere indicates that the two species have different biological characteristics. There is thus a need for verification of the taxonomic status of sandfish.

Inconsistency in the naming of sea cucumbers and their derivative products, and the use of out-of-date taxonomic references in some legislative instruments (such as the *Wildlife Protection (Imports and Exports) Act*) hinder the interpretation of statistics and enforcement of legislation. There would be merit in a study which would rationalise and standardise the scientific and common names in use for beche-de-mer in Australia. Environment Australia indicated a willingness to consider funding such a study. It was agreed that QFMA would undertake to prepare a proposal on behalf of all interested states.

5.3. Size-based management

Minimum size limits are currently in force in all of Australia's tropical beche-de-mer fisheries but in each case these are based on biological data from the South Pacific (mainly New Caledonia) whose relevance to Australian sea cucumber populations has not yet been verified. There is a need for basic research to establish critical size-related information (especially growth rates and size at first sexual maturity) for sea cucumber populations in Australia. A proposal by the Australian Institute of Marine Science to undertake a 3-year research project on black teatfish in Queensland will, if approved, provide the required information for one of

the two main species. However there is currently no plan to obtain similar information for the other main resource, sandfish.

Information on the size composition of exploited sea cucumber populations is important as a means of monitoring the condition of the resource. It is also desirable to manage the fishery through the use of size limits, because this will have benefits in both biological and economic terms. However the use of size limits as a management mechanism present almost insurmountable enforcement difficulties, both during the fishing operation itself, and at the point of export. A compromise arrangement would be for size-frequency information to be used as an indicator of population condition which would then serve as a trigger for other management measures, such as area or temporal closures, which are not based on size limits. It might be possible to obtain size-frequency information from the fishery itself, but it would be desirable to supplement and verify this using fishery-independent data gathered by observers.

5.4. Seasonal closures

It is not known whether seasonal closures, for instance to protect the animals during their main spawning periods, would have specific advantages for beche-de-mer fishery management. Although the reproductive seasonality of the most important commercial species has been documented in other countries, there is a need for verification of this information in relation to Australian populations. In addition there is a need to assess whether the animals become more vulnerable to capture during the spawning period, since if they do not then seasonal closures may not confer any advantage. Data on changes in vulnerability may be obtainable from catch-per-unit-effort data recorded by fishermen.

Although perhaps not specifically advantageous in themselves, seasonal closures could provide the best means of managing beche-de-mer fisheries in conjunction with fisheries for other species, such as trochus and lobster, in which beche-de-mer harvesters may participate. For instance it may be possible to put in place an arrangement whereby Torres Strait fishermen target lobsters for part of the year and beche-de-mer for the rest, thus providing a period in which each fishery gets some relief from harvesting.

5.5. Area closures

Closed areas, in the form of permanent or rotating reserves, are thought to be a useful part of beche-de-mer fishery management arrangements. In areas where the animals are protected from exploitation, densities can be expected to remain high, and the chances of reproductive success (which is at least partially density-dependent) maximised. In selecting areas for closure, attention should be paid to information on local hydrography and the likelihood of any particular area acting as a source or a sink in terms of larval production and dispersal.

5.6. Gear restrictions

There was general agreement that the use of trawls to harvest sea cucumber could have negative environmental consequences but that in some circumstances, such as where hand-collection involved threats to the safety of the collectors (because of dangerous marine animals in the area) there may be justification for allowing more intrusive methods of fishing. The Northern Territory is still considering the issues involved, while other states in general saw no justification for the introduction of a potentially destructive fishing method.

In areas where holothurian populations extend into deep water beyond the range of hand-collectors, prohibiting or limiting the use of underwater breathing apparatus on the fishery may provide protection for part of the population and thus effectively establish a breeding reserve.

5.7. Environmental impacts

The principal cause for concern was the discharge from boat-based processing operations of water which contains a toxin (holothurine) originating from the boiling of holothurian skin. This practice has resulted in fish kills in shallow coastal areas in other countries but the effects of discharge into deeper waters, as practised in Australia, has not been studied. There is a need to examine this issue further.

Other potential environmental impacts of these fisheries are poorly understood but may include changes to the condition and nature of seafloor sediments following extensive removal of holothurians, some of which are responsible for bioperturbation and oxygenation of the sea floor, and all of which extract bacteria and organic material from bottom sediments.

5.8. Inter-state/ inter-agency coordination

There is considerable interaction between beche-de-mer fisheries in various states. Many licence holders have interests in more than one state. Product caught in one state is often landed in another or transported elsewhere for processing, and then again for export. There is thus a need for the various state agencies to cooperate with each other and with federal bodies in the management of Australian beche-de-mer fisheries.

5.9. Data exchange

It was agreed that state-level fishery management arrangements could be enhanced if state fishery management authorities could access export and product transfer data held by AQIS, as well as the detailed information by species contained in export permits issued by Environment Australia. Both these agencies agreed to examine the means by which such information could be made available to state authorities on a routine basis.

5.10. Summary

The workshop concluded with participants expressing satisfaction at the progress made and the various commitments to follow-up action (specific research proposals, data exchange arrangements, etc.) that had been generated. It was agreed that further interaction between state authorities involved in beche-de-mer fisheries management would be desirable, and that this should take place on an opportunistic basis. Participants thanked the QFMA for having organised the meeting, and the FIRDC for having provided financial support.

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Appendix 1

WORKSHOP AGENDA

Date: 8-9 December 1997

Venue: 6th Floor 40 Tank St BRISBANE QLD

Time: Commencing 9:00 AM

Day 1

Introductory session
Chair Ms Bev Tyrer

9:00	Introduction to workshop	Ms Bev Tyrer (QFMA)
9:20	Global view of beche-de-mer fisheries and discussion of wider issues	Mr Garry Preston

Session 1 Situation reports from participating states

10:00	Northern Territory	Mr Ric Fallu (NT)
10:30	Western Australia	Ms Leonie Cooper (WA)
11:00	Queensland (East Coast and Torres Strait)	Ms Bev Tyrer (QLD)
12:00	Commonwealth perspective	Mr Martin Kick (AFMA)
12:30	Summary	Mr Garry Preston

Session 2 Identification of management issues
Chair Mr Mark Elmer

2:00 Group session to identify key issues relating to:

- appropriate management objectives;
- evaluation of stock management strategies and their effectiveness;
- key biological features of the species important when considering options for management;
- research requirements;
- performance indicators; and
- fishery monitoring and enforcement.

4:00 Summary and identification of topics to be developed at the 2nd day of the workshop and groups identified.

Mr Gary Preston

5:30 **End of day 1**

Day 2

Session 3 Work on issues developed during day 1
Chair Mr F Antram (EA)

9:00 Discussion and development of options for dealing with major issues identified during day 1.

Session 4 Development of management principles

1:30 Workshop outcomes
Chair Mr G Preston

The purpose of this session is to draw all the results of discussions together to develop a set of management principles that can be used by northern Australian management agencies when managing beche-de-mer fisheries.

4:00 **Close**

Appendix 2

LIST OF PARTICIPANTS

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