DEPARTMENT OF PRIMARY INDUSTRY, **FISHERIES** AND MINES




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This report was collated and edited by Peter Zeroni

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Fishery Status Reports 2005

INTRODUCTION

The waters of the Northern Territory hold an abundance of aquatic life which is underpinned by the pristine nature of much of the environment. A key avenue by which NT Fisheries, within the Department of Primary Industry, Fisheries and Mines reports publicly on the status of these aquatic resources is through the annual publication of a Fishery Status Report. I am therefore pleased to introduce the *Fishery Status Reports 2005*, the sixth publication in the series.

The 2005 Report provides detailed information on the NT's wild harvest fisheries, the aquaculture industry, recreational and fishing tourism sectors, Indigenous fishing activities and aquatic pest management. It also provides an overview of the types and numbers of licences issued for the 2005 calendar year. Individual reports include information on the ecological sustainability of each fishery as specified under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999*.

The 2005 report also allows an opportunity to highlight the diverse range of projects and activities undertaken by NT Fisheries and a selection of these appear on the following pages.

As in previous years, the *Fishery Status Reports* provide a detailed insight into how Fisheries manages the NT's valuable aquatic resources on behalf of all Territorians, and I trust you will find the information contained in the 2005 edition of value.

William Flaherty
A/Executive Director, Fisheries
Department of Primary Industry, Fisheries and Mines

NT Fisheries - 2005 Highlights

Economic Value

- In 2005, the gross value of production (GVP) at the point of first sale from wild stock harvest fisheries and aquaculture activities in the Northern Territory was $28.5 million and $22.8 million respectively.
- The NT's three highest catch value wild harvest fisheries in 2005 were shark ($6.2 m), mud crab ($5.4 m) and barramundi ($4.6 m). Other high catch value fisheries include finfish trawl, Timor Reef and Spanish mackerel.
- In 2005, the two highest production value aquaculture activities were pearling ($14.2 m) and barramundi farming ($7.3 m).

Fisheries Management

- Attained export accreditation for the Offshore Net and Line Fishery and the Aquarium Fishery.
- Completed a review of the *Mud Crab Fishery Management Plan*.
- Implemented new management arrangements for the Offshore Net and Line Fishery.
- Finalised the Northern Operational Plan for Sharks.
- Held the first Barramundi Fishery Strategic Planning Workshop with a view to preparing a 5-year plan and a 10-year vision for the Barramundi Fishery.
- Undertook consultation to establish an offshore sectorial plan for the Territory's offshore snapper fisheries.

Aquaculture

- Developed policies on: accessing prawn broodstock from the Northern Prawn Fishery; a translocation zoning strategy for the NT; risk assessments for the translocation of aquaculture species (including for the barramundi and pearl oyster fisheries); and sea cucumber ranching.
- Developed a draft Indigenous Aquaculture Policy and Development Strategy.
- Provided over one million barramundi fingerlings to the Marine Harvest sea cage aquaculture operation at Port Hurd on Bathurst Island.
- Produced over two million barramundi fingerlings, with excess fingerlings continuing to be used to stock Territory impoundments.
- Completed technical work on a major study of hatchery and nursery stages of mud crab aquaculture, with a final paper currently being developed.
- Undertook pond grow-out trials of crablets for potential use in the mud crab aquaculture industry.
- Advanced commercialisation trials for mud crab aquaculture with industry and Indigenous partners.
- Established a joint-venture with the Gwalwa Daraniki community to develop a mud crab grow-out and demonstration farm on Indigenous land in Darwin.
- Established a pilot mud crab farming venture in a mangrove enclosure, in association with the Bawinanga Aboriginal Corporation at Maningrida.
- A private company continued operating a pilot sea cucumber hatchery in association with the Darwin Aquaculture Centre.
- Drafted a new compliance program for the pearling sector.
- Finalised and published a Histological Atlas of Pearl Oysters.
- Case-managed the application process for three sea cage sites for barramundi culture.
- Streamlined the aquaculture licence acquisition process through agreements on process with the EPA.
- Worked with industry to streamline the administrative process for the collection of prawn broodstock in NT waters.

Aquatic Research

- Initiated the Northern Stock Assessment Group.
- Revised the stock assessments of blacktip sharks in the northern Australian fishery.
- Successfully obtained FRDC funding for a two-year project to examine using GIS spatial statistical methods to develop ecosystem-based fishery management strategies (using the NT Demersal and Timor Reef fisheries as case studies).
- Organised and hosted the 2005 Australian Society for Fish Biology Conference and Workshop, and co-hosted the Australian Marine Science Association Conference.
- Hosted a national Barramundi stock assessment workshop.

- Developed a Northern Australia Barramundi Model.
- Successfully completed the 2005 *Barracade* research project on the Mary River.
- Successfully completed the field component of a project using acoustic tags for tracking jewfish relative to aggregations.
- Continued 'Genetag' genetic sampling mark-recapture monitoring for the Spanish Mackerel Fishery with several recaptures. An application to FRDC to continue the project was successful.
- Genetag research team won a number of awards including: the inaugural NT innovation award; an episode of the ABC "New Inventors" program as well as the program's "Viewers Choice award"; and the NT Seafood Industries' Award for Innovation.
- Successfully applied to the FRDC to fund a stock assessment structure study of grey mackerel (a collaboration with WA and Qld fisheries agencies and led by the Reef CRC).
- Continued research project on the assessment of grey mackerel in NT and Qld waters.
- Initiated a collaborative research project to develop tagging as a monitoring method for NT shark fisheries.
- Adopted a new three-directional approach for mud crab research.
- Shark fishery sustainability study continued (an FRDC-funded, collaborative across northern fisheries agencies led by CSIRO).
- Continued a study into the Artisanal shark and ray fisheries of Indonesian sharks and rays (ACIAR-funded and led by CSIRO).
- Research on offshore snappers using GIS and Fuzzy Logic undertaken to maximise the use of catch, effort and environmental information.

Recreational Fishing

- Expansion of the NT's *River Watch Program* to include two new centres in Kakadu - Aurora Kakadu Resort for the South Alligator River, and the Border Store for the East Alligator River.
- Assisted in the establishment of the Northern Territory Guided Fishing Association with funding provided to enable the fishing tourism sector to employ its own executive officer to oversee activities of the newly created Association.
- Barramundi fingerlings released into Lake Bennett and Lake Todd, in addition to the continued stocking program being undertaken in Manton Dam.
- Delivery of a three-day junior fishing workshop held in both Katherine and Nhulunbuy.
- Promoted the NT at the Sydney and Melbourne fishing and boating shows and at various Northern Territory exhibits.
- Logistical support was provided to five of the NT's major annual fishing tournaments.
- The addition of the *Kay Lee* (a 15.6 metre donated fishing vessel) and approximately 4000 large anchors donated by Paspaley Pearls to further expand the artificial reef complex off Lee Point.
- Installation of fishing tour operator licensing advice signs throughout the Territory.

Indigenous Liaison and Economic Development

- Successfully convened meetings of the Aboriginal Fisheries Consultative Committees across the NT.
- Fostered the Northern Australian Indigenous fisheries networks.
- Provided direct funding to six marine ranger programs across the NT, all of which are now equipped with vessels to undertake coastal surveillance and monitoring activities.
- Assisted with the establishment of the Goulburn Island and the Marthakal Marine Ranger Programs.
- Supported marine ranger programs across the Territory through the provision of extensive training activities, and assisted members of three marine ranger programs to complete certificate 2 level courses in fisheries compliance.
- Gifted three seized fishing vessels to ranger groups and the NLC.
- Agreement signed with the Gwalwa Djaraniki Association to commence a mud crab aquaculture venture on Indigenous land owned by the Kalaluk Community.
- Worked with Traditional Owners to establish a pilot mud crab aquaculture operation north-east of Maningrida.

- Worked with representatives from Groote Eylandt, Croker Island, Goulburn Island, Howard Island, Ngukurr, Amangal (Adelaide River) and Wooliana (Daly River) on identifying suitable sites for undertaking community-based aquaculture activities.
- Provided advice to the Bawinanga Aboriginal Corporation (Maningrida) assisting their successful purchase of a fully commercial mud crab licence, and to Yirwarr Seafoods in support of efforts to establish Indigenous operated seafood industries in the Nhulunbuy region.
- Assisted Indigenous operators with their efforts to purchase a fully commercial coastal line licence to undertake fishing activities in the Cobourg region.

Aquatic Pest Management

- Successfully maintained the aquatic pest monitoring program with interest and support from private industry. Monitoring sites are located at Garden Point, Gove Harbour, Raffles Bay, Milner Bay and Darwin Harbour including marinas. The monitoring program did not identify any incursions of recognised marine pest species.
- The NT Government signed the Inter-governmental Agreement on a *National System for the Prevention and Management of Marine Pest Incursions*.
- Maintained involvement in and representation of the NT on the National Introduced Marine Pest Coordination Group.
- Inspected 135 recreational and 58 apprehended vessels, resulting in the successful detection of recognised marine pest species (black-striped and Asian green mussels) on two occasions. Emergency response activities in each instance were highly successful.
- Fourteen marine and freshwater pest reports were received and investigated. A population of exotic freshwater fish was successfully removed from stormwater drains in the Darwin region.

Data Collection

- Collected, entered and validated all 2005 commercial catch and fishing tour operator data used for reporting purposes to assist with research and management activities targeting the Territory's aquatic resources.
- Maintained the *Discoverer* database that allows for the retrieval of logbook data information for the purposes of report generation and assessment.
- Provided advice required for the issuance and renewal of over 1000 licences and permits.

wild harvest fisheries

Aquarium Fishery Status Report 2005

INTRODUCTION

The Aquarium Fishery is currently a small scale, multi-species fishery operating in inland waters and waters seaward from the coastline to the outer boundary of the Australian Fishing Zone (AFZ).

There is potential for significant development in the Northern Territory. However, the full potential for expansion in the Aquarium Industry has yet to be realised. The Northern Territory has abundant native fish fauna and a tropical climate suited to the production of aquarium species.

The Aquarium Fishery is based on the harvesting of a wide range of fish, plant and coral species from freshwater and marine environments for the purpose of display.

The demand for aquarium species continues to increase. Over the past 10 to 15 years new technology has provided significant improvements in harvesting techniques. Improved techniques for packaging and transporting aquarium species has enabled the industry to cater for the needs of a growing interstate market, as well as that for a potential export market.

The Aquarium Fishery harvest to date has been low by national and international standards, both in numbers and value, with the majority of product being directed to interstate distributors.

The Northern Territory Aquarium Committee (NTAC) was established in 2003 to provide a representative forum for industry members to achieve a review of the Aquarium Fishery, and devise an approach to capitalise on the recognised potential of the local industry. A review was undertaken on the collection of coral and associated benthic species, and proposed future management arrangements to promote development within the principles of Ecologically Sustainable Development (ESD).

In 2004, a report was submitted to the Australian Government Department of Environment and Heritage (DEH) to assess the management arrangements of the fishery against the *Guidelines for the Ecologically Sustainable Management of Fisheries*. The fishery was subsequently declared an approved Wildlife Trade Operation (WTO) under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (the 'EPBC Act'). The WTO declaration means that product can be exported from the fishery for a period of three years. A further review will occur in 2008.

PROFILE OF THE FISHERY

Commercial Sector

In 2005, there were 24 licences issued for the Aquarium Fishery. Eleven were Aquarium Trader licences that allow trade in aquarium species, but do not permit the collection of stock from the wild. The remaining 13 licences were Aquarium Fishing/Display licences that permit the collection and sale of all aquatic life, including freshwater and marine fishes, plants and coral.

Following a review of the fishery in 2004/2005, all of the 13 collection licences are now able to collect strictly limited quantities of coral and associated benthic species.

Area

The harvest area of the Aquarium Fishery includes all inland waters (freshwater) and waters seaward (marine) from the coastline to the outer boundary of the AFZ. However there are a number of designated protected areas, such as Doctors Gully and East Point Aquatic Life Reserves located within the Darwin Harbour area, and designated non-harvest areas (eg. Aboriginal sacred sites and farm leases).

The major areas utilised for the commercial collection of freshwater fish are the streams and creeks in close proximity to Darwin and the Adelaide River and Daly River systems.

Commercial harvesting of marine species is concentrated in coastal waters near Nhulunbuy, although some marine harvesting also occurs in the Darwin area.

The harvesting of undersized barramundi (ie. those less than 55 cm in length) is permitted by some licences issued within the fishery. However such collection is restricted to a maximum of 1,000 individuals per licence. The harvesting of Spanish mackerel, mud crab, cherabin (*Macrobrachium)* and redclaw (*Cherax)* species is not permitted without the approval of the Director of Fisheries.

Coral and associated benthic species can be collected from anywhere in the NT with the exception of Managed Areas, Marine Reserves, Darwin Harbour and Gove Harbour. This is set out as a condition on each licence.

Fishing method

Aquarium Fishery licensees are entitled to use barrier, cast, scoop, drag and skimmer nets, hand pumps, freshwater pots, and hand held instruments in the collection of aquarium

species. However, when a net is used to harvest species, the licensee or an assistant must be in attendance at all times.

Catch

Since 1995, over 1.2 million individual aquatic organisms have been harvested by licensees working in the Aquarium Fishery. During 2005, 10 categories of aquarium organisms accounted for 82% of the 84,638 individual specimens collected. Hermit crabs continue to be the most popular aquarium animal harvested accounting for 14.6% of the total take. The main harvested species for 2005 are listed in Table. 1

	Species	% of total take
Marine	hermit crabs	14.6
	coralomorphs	4.0
	live rock	3.4
	corals	3.2
	clownfish	1.7
Freshwater	chequered rainbowfish	11.9
	banded rainbowfish	11.8
	sail-fin perchlet	11.8
	silver scat	9.5
	hardyhead	5.9
	common archerfish	5.9
	red scat	2.9

Table 1. Major species harvested in the Aquarium Fishery for 2005

Effort

Within the Aquarium Industry it has proven difficult to standardise the concept of effort. This is due to the varied nature of species targeted, the selective harvest techniques used by licensees and the variation in the number of hours among operators as to what they would consider to be 'one day' of fishing effort.

Marketing

Recent advances in affordable aquarium technology have led to significant growth in the demand for a wider range of aquarium species for private aquaria, including corals, sponges and live rocks, in addition to freshwater fish species. Most of the local Aquarium Fishery harvest is exported interstate via air freight.

Recreational Sector

There are no specific regulations on collecting fish for personal aquariums other than current recreational fishing rules and regulations with respect to minimum sizes and possession limits. Recreational aquarium hobbyists are not to be in possession of under-sized individual barramundi unless they have proof of purchase from a licensed aquarium trader.

Fishing method

Targeted species may be collected by hand or by using a cast or scoop net, hand pump or a freshwater pot.

Catch

The harvest of fish species taken by the recreational sector for aquarium purposes is unknown, but is assumed to be very low. Neither the 1995 nor the 2000 surveys of recreational fishers reported the collection of aquarium fish, despite the inclusion of a specific question examining this issue.

Non-retained Species

There is minimal bycatch within the Aquarium Fishery primarily due to the highly selective fishing methods employed. Observers accompanying licensees during their harvesting activities have verified the extremely low mortality rate for all species caught within this fishery. The underlying reason may be attributed to both the specialised and selective nature of the fishing methods used, and the condition of licence requiring that all non-target species be immediately returned to the water with as little damage as possible.

Threatened Species Interaction

The Commonwealth EPBC Act requires fishers to make a report to the Australian Government Department of Environment and Heritage within seven days of becoming aware of any interaction with listed threatened, endangered and protected species found in Commonwealth waters.

Hard corals and giant clams are the only two species targeted by operators in the fishery which are listed on the Convention on International Trade in Endangered Species (CITES). While listed under CITES, these species are still allowed to be harvested in low numbers and their collection is considered to be within acceptable limits for the fishery. There are also a number of natural factors that provide protection to these

two species, including the extensive area of the fishery, seasonal closures and the wide distribution of the species.

In 2005, there were no recorded interactions with any threatened species of mammal, reptile, amphibian or bird as listed by the Parks and Wildlife Commission of the Northern Territory.

Ecosystem Impact

The potential for the Aquarium Fishery to impact on the environment is limited as a result of the nature of the industry and the unique climatic and regional characteristics of the Northern Territory.

The current harvest is considered to fall well within an extremely precautionary management approach to the utilisation of a valued natural resource.

The distance of collection sites from population centres imposes economic constraints on aquarium collectors and has led to the majority of effort being observed around Darwin and Nhulunbuy.

Other constraints on the activities of operators within the fishery is the limited access to more than 70% of the Northern Territory due to restrictions imposed by Aboriginal and private ownership of land; National Parks and Northern Territory Conservation Park regulations; and marine exclusion zones. Furthermore, the monsoon season weather conditions experienced in the tropics render large portions of both inland and coastal waters of the NT inaccessible or unsafe for a significant period of each year.

All of these factors serve to provide extensive "protection zones" which are not available for commercial or recreational exploitation.

Social Impact

The harvesting of coral in areas adjacent to major population centres is a significant issue for NT Fisheries largely due to a general lack of community awareness regarding the real impacts of coral harvesting. In an effort to minimise social conflict, NT Fisheries and the NTAC have negotiated for the closure of both Darwin and Gove Harbours for the purposes of coral collection.

Economic Impact

The catch value for the Aquarium Fishery is not available for the 2005 calendar year. However, previous data indicates that in 1998, the catch value of the fishery was worth between $600,000 and $700,000. It is safe to assume with the increase in quantity and quality of aquarium species now harvested that the current value of the fishery is far greater.

STOCK ASSESSMENT

Monitoring

Monitoring of the Aquarium Fishery is undertaken in two ways. Firstly, licensees are required to complete and submit monthly logbook returns reporting catch and effort data from their operations. Secondly, officers from NT Fisheries undertake observer trips. The associated monitoring provides significant information on areas that are fished, capture methods used and identifies which are the more common aquarium fish species targeted by licensees at a particular point in time.

An observer trip was conducted in October 2005 to monitor the operations of the sole marine aquarium collector. The operation based in Nhulunbuy targets mainly coralomorphs, clown fish and coral. The monitoring trip was undertaken in conjunction with officers from NT Department of Natural Resources Environment and the Arts (NRETA). In addition to monitoring aquarium operator methods, the trip also provided the opportunity to observe the effect of cyclone Ingrid in March 2005 on the coral reefs in the area.

During the trip the need for finer spatial reporting was raised. The issue is of great importance to ensure that analysis of catch and ecosystem impacts can be undertaken at a scale that is appropriate to the fishery. A draft log sheet was designed and trialed during the monitoring trip.

Numerous attempts to conduct an observer trip in a freshwater environment failed to eventuate due to an extended wet season coupled with low licence activity.

Observer monitoring will continue in this fishery with more emphasis placed on the collection of corals and live rock, focusing on the species of corals collected, the collection methods used and the areas from which they are collected. The Aquarium Industry has shown a willingness to participate in the increased monitoring needed in this fishery as part of the Commonwealth ESD process.

Current Harvest Status

From an aquatic resource protection perspective, the current level of harvest is low, and the impact on the resource by commercial operations is considered to be insignificant.

Future Assessment Needs

The future assessment needs of the Aquarium Fishery will be driven by the requirements for ESD reporting, in accordance with the EPBC Act.

RESEARCH

Summary to Date

Dr Gomelyuk (NRETA) has been undertaking monitoring of coral reefs around Nhulunbuy and Coburg Peninsula for several years. In March 2005, cyclone Ingrid destroyed some areas of reef within the Aquarium Fishery. Additional funding is currently being sought by Dr Gomelyuk and Ms Lloyd (DPIFM) to monitor coral reef recovery after cyclone Ingrid.

Taxonomic studies are currently being undertaken by scientists from the Museum of Tropical North Queensland (Townsville) and Kansas University (USA), on anemones, coralomorphs and hard corals in the Nhulunbuy area using both taxonomic and genetic methods to clarify identification of individuals to species level within these groups. Dr Phil Alderslade (NRETA) is also conducting research on the soft corals around Nhulunbuy.

There are two major freshwater research projects planned for 2006 involving NT Fisheries. The first, “Water Regime Dependence of Fish in the Wet-dry Tropics,” is managed by the Charles Darwin and Griffith Universities with the objective to sample the fish communities of the middle and upper-reaches of the Daly River Basin. The second project, “A comprehensive Analysis of the Freshwater Fish Faunas and their Key Management Issues across Northern Australia,” is being coordinated by the James Cook and Griffith Universities and aims to sample all catchments where comprehensive studies have yet to be undertaken. These two projects will ultimately map the geographic distribution, biodiversity and habitat requirements of freshwater fish in all major catchments across the Northern Territory. It is anticipated that the results of these two projects will provide a wealth of information on which to base future decisions regarding the harvest of freshwater fish species.

MANAGEMENT/GOVERNANCE

Management

Objective

The fishery is currently managed by conditions specified on Aquarium Fishing/Display licences. Licences are non-transferable and aquatic species are only allowed to be collected using gear specified on the licence.

NT Fisheries liaises with stakeholders in the Aquarium Fishery individually or as needed through the NTAC, or through separate consultative processes catering for specific stakeholder groups.

Specific objectives of the management arrangements for the Aquarium Fishery are to ensure the ecological sustainability of collected species with minimal impact to threatened species and the aquatic environment. Management objectives are achieved through a combination of input and output controls and include limited entry, catch restrictions, area and gear restrictions.

Due to the low number of participants, low harvest levels and multiple species targeted, the large area of habitat available to these species and the selective nature of this fishery, the impact on the resource by commercial operations is considered to be relatively insignificant. Historically, very few operators have been active while several of those who are active only operate on a part-time basis.

Recreational capture of marine and freshwater fish and benthic species by hobby aquarists is controlled by regulating the gear able to be used, access to areas, and the size and possession limits for managed species.

History

From the 1970s, aquarium fish collecting, trading and aquaculture were permitted under a C class licence. These licences were specifically endorsed for trading, collection and aquaculture of aquarium species.

In 1990 the harvest of redclaw by aquarium collectors was prohibited. Redclaw is only permitted to be harvested for recreational or aquaculture purposes.

In 1993 the C class licences were separated into three individual licences depending on the original endorsement: 1) Aquarium Fishing/Display licence permitting the collection, display and sale of aquarium species; 2) Aquarium Trader, dominated by importers of aquarium species, and 3) Aquaculture.

The Aquarium Fishing/Display licence authorises the licensee to harvest aquarium species from the wild for subsequent supply to the Aquarium Trader. The Aquarium Trader is generally an importer of product, largely from interstate.

Up until 1994, all aquarium collecting licences were permitted to collect coral. In 1994, a prohibition on coral harvesting was imposed. In response to subsequent submissions from a number of licensees, some aquarium collectors were permitted to take restricted quantities of coral.

A moratorium on the issue of any new aquarium collection licences was implemented in 2001 in response to concerns over coral collection and the need for a comprehensive review of the Aquarium Fishery.

The review of the fishery was completed in 2005. The review process resulted in changes to licence conditions for both the Aquarium Fishery/Display licence and the Aquarium Trader licence.

The new conditions allowed all Aquarium Fishery/Display licence holders to collect limited coral and associated benthic species. The collection of coral and associated benthic species is linked to a maximum trigger point and collection is prohibited in Darwin and Gove Harbours as well as designated protected areas such as Doctor's Gully and East Point Aquatic Life Reserves.

The Aquarium Trader licence conditions were changed to allow the licensee to establish display aquaria. Collection of aquatic life is strictly prohibited under an Aquarium Trader licence.

In 2004, a draft report was submitted to DEH to assess the management arrangements of the fishery against the *Guidelines for the Ecologically Sustainable Management of Fisheries*. DEH concluded that the Aquarium Fishery would not be detrimental to the survival or conservation status of any taxon to which it relates in the short term. Similarly, it is not likely to threaten any relevant ecosystem in the short term. This assessment resulted in the fishery being declared an approved Wildlife Trade Operation (WTO) in December 2004. The WTO declaration means that product can be exported from the fishery for a period of three years. During this three year period, NT Fisheries will report annually to DEH on activity within the fishery and progress to date on the implementation of recommendations made by DEH to ensure the sustainability of the fishery. A further review of the fishery will occur in 2008.

Current issues

NT Fisheries are currently working with the NTAC to meet DEH recommendations to retain if not improve on the WTO approval. Part of this process involves conducting an environmental risk assessment of the NT Aquarium Fishery. The outcomes of this risk assessment will be used to drive the development of performance indicators for the fishery. Additionally, commercial log book recording will be altered to implement finer spatial recording of catch and effort information.

Future plans

The NT Government will maintain a monitoring program with logbooks and the observer program coincident with the development of appropriate indicators. These activities are designed to ensure the ecological sustainable development of the resource with a view to maintaining the export status of the fishery under the EPBC Act.

Compliance

The Police Marine and Fisheries Enforcement Section of the Northern Territory undertakes compliance for this fishery through random on-the-spot inspections of harvesting activities, and the conduct of targeted enforcement programs with fishers and traders. In 2005, there were no recorded convictions for compliance breaches within the Aquarium Fishery.

Consultation, Communication and Education

The NTAC was formed in February 2003 and is the peak body representing the licensees of the Aquarium Fishery. The NTAC operates under the Northern Territory Seafood Council (NTSC). Members are drawn from the Aquarium Fishery and from the NTSC.

In addition, a series of Aboriginal consultative committees have been formed to provide NT Fisheries with the opportunity to consult with coastal Aboriginal communities on all aspects of fishing including aquarium species.

Prepared by

Steven Matthews – Aquatic Resource Manager

Julie Lloyd – Senior Research Officer

Reference

Fisheries Division (2001) *Review of the harvest of benthic and associated species in the Northern Territory Aquarium Fishery.* Department of Primary Industry and Fisheries, Fisheries Report No. 59, 24 pages.

Barramundi Fishery Status Report 2005

INTRODUCTION

Barramundi *(Lates calcarifer)* grow to a large size and have sweet white flesh. As such, barramundi are a highly regarded table fish and thus command a high market value. The barramundi is also a highly regarded sport fish and its reputation within Australia and internationally underpins the Northern Territory's reputation as an excellent sport fishing destination.

The Barramundi Fishery is currently fished within sustainable limits and has recovered from a period of over fishing in the 1970s. Since management intervention in the 1980s, catch rates in both the commercial and recreational sectors have increased, although in certain accessible and heavily fished areas, recreational fishing pressure in conjunction with commercial fishing may increase the total harvest in these specific areas to levels approaching full utilisation.

PROFILE OF THE FISHERY

Commercial Sector

Area

The commercial Barramundi Fishery operates from the high water mark to three nautical miles seaward from the low water mark and is restricted to waters seaward of the coast, river mouth or closure lines. Fishing is not permitted within the confines of Kakadu National Park, the Mary River Fish Management Zone, Darwin Harbour, Shoal Bay, or in various key river systems. In addition, fishers may not operate or anchor within the dugong protection area in the south-western Gulf of Carpentaria. The extent of the commercial fishing area was further clarified in the *Barramundi Fishery Management Plan* of 2004, with the inclusion of additional closure lines, defining the inland boundary of the fishery.

The commercial fishing season operates each year from 1 February through to 30 September, and the majority of commercial fishing currently takes place in the Murgenella, North Arnhem, Blue Mud Bay, Roper River and Daly River regions.

Fishing method

Commercial operators in the Northern Territory fish tidal mud flats and associated gutters and inside a restricted number of rivers using monofilament gillnets. Nets are set and retrieved from dinghies and fish are processed onboard mother ships. Nets can only be set across half a watercourse and must not be set within 25 m of another net in rivers. Outside river mouths, the minimum legal mesh size is 150 mm (6 inch) and within a river 175 mm (7 inch). The maximum net allowance per licence is 1,000 meters (10 units of 100m) and there are restrictions on the amount of spare netting that may be stored on board vessels.

Catch

The primary target species are barramundi and king threadfin (*Polydactylus macrochir*). Barramundi enter the fishery during their third year and are generally fully recruited (i.e. large enough to get caught in a 150 mm gillnet) by the end of the fourth year. Commercial operators target barramundi of three to eight years of age.

The commercial catch in 2005 was 552 tonnes of barramundi and 323 tonnes of king threadfin (Figure 1). Several other species are also caught while targeting barramundi and king threadfin. However, most commercial barramundi fishers have participated in the fishery for several years and their knowledge of where to set nets to minimise bycatch is considerable.

There are also a number of byproduct species taken in the commercial fishery, depending on their marketability. The most commonly retained byproduct species are blue threadfin (*Eleutheronema tetradactylum*), black jewfish (*Protonibea diacanthus*), queenfish (*Scomberoides commersonianus*), and triple-tail (*Lobotes surinamensis*). Sharks are also a byproduct, although the amount which can be taken is restricted (Figure 2). In 2005, the total amount of retained byproduct was 48 tonnes or about 5% of the total harvest, representing an increase of 8.8 tonnes and probably due to higher prices being paid for byproduct species in the market.

Effort

In 2005, there were 24 fully transferable licences in the commercial fishery, all of which were fully utilised. The majority of these licences were a 'full 10 unit' licence (1 unit = 100 m net) and equated to a total of 19,100 m. Effort is measured in '100 metre net days' (hmd), where one hmd equals 100 m of gillnet set for one day.

In 2004, the number of commercial Barramundi licences was reduced from 25 to 24 as a result of a licence buy-back. This was reflected in a decrease in the 2004 commercial effort (28,190 hmd) from that recorded in 2003 (30,600 hmd). A further decline in effort was observed in 2005 (25,328 hmd) when cyclonic activity delayed the opening of the commercial barramundi season (Figure 1).

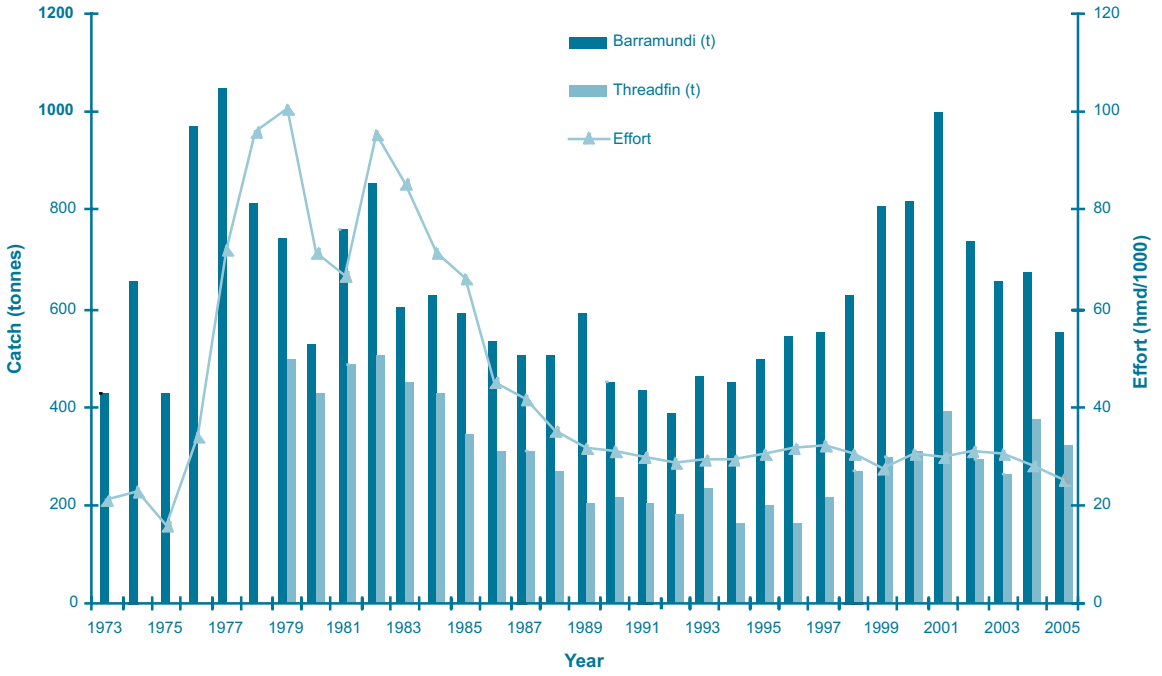

Figure 1. Catch and effort for the commercial Barramundi Fishery, 1973 to 2005

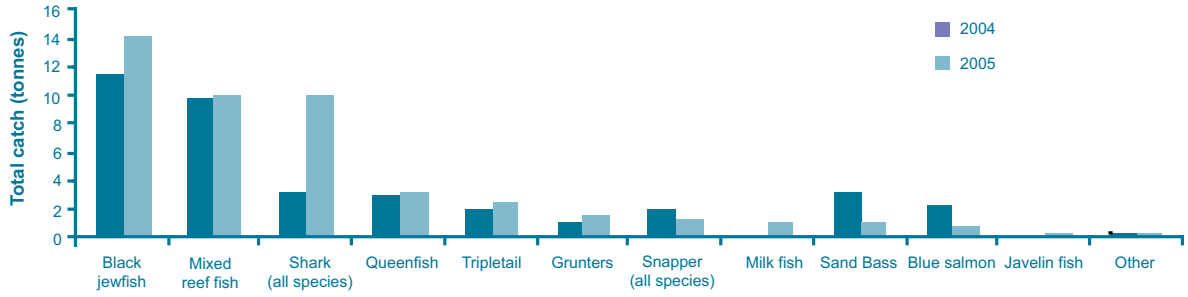

Figure 2. Bycatch composition for the Barramundi Fishery, 2005

Substantial changes have occurred in the distribution of commercial effort over the past 15 years with effort moving away from those areas where commercial activity has been constrained or excluded, (e.g. the Mary River Fish Management Zone, Kakadu National Park and the McArthur and Adelaide Rivers) to more remote areas such as Blue Mud Bay.

Catch rates

In the late 1970s and early 1980's the Catch per Unit of Effort (CPUE) for barramundi showed a sharp downward trend, reaching levels as low as 7.1 kg/hmd. This decrease was probably caused by excessive commercial fishing effort. Following management changes, the CPUE has steadily increased, reaching 20.8 kg/hmd in 1998. The 2005 barramundi CPUE was 21.8 km/hmd (Figure 3).

In recent years, the CPUE for king threadfin has shown a very similar trend to that of barramundi catches. These trends indicate that the fishery has largely recovered from overexploitation during the 1970s, where CPUE was 5.0 kg/hmd. In 2005, CPUE has increased to 12.7 kg/hmd and present fluctuations in CPUE appear to be the result of annual variation in environmental conditions, rather than the level of exploitation.

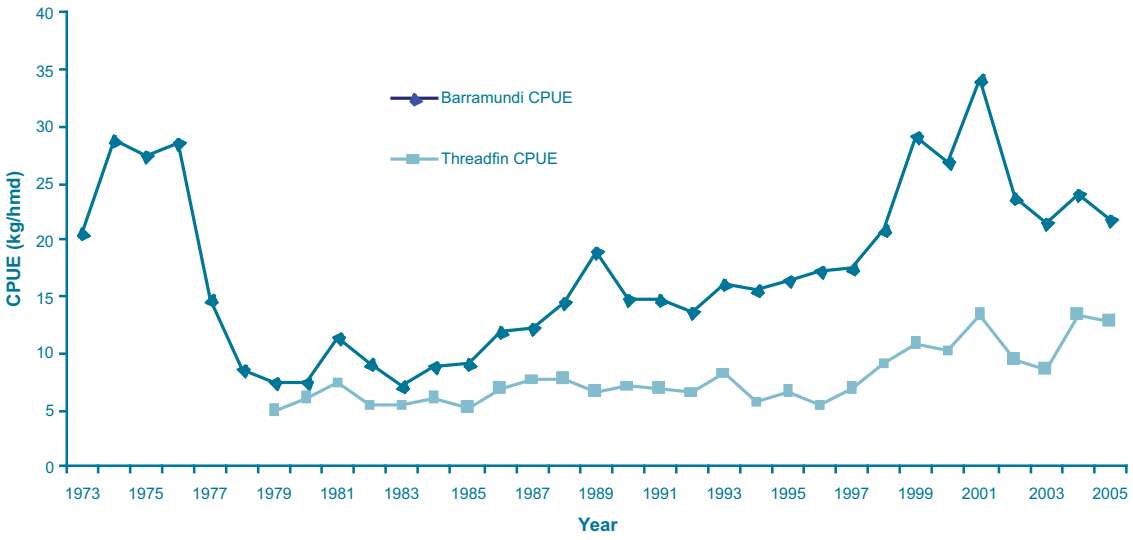

Figure 3. Catch rates for barramundi and king threadfin for the Barramundi Fishery, 1973 to 2005

Marketing

Historically, barramundi and king threadfin have been sold as frozen fillets to local and interstate markets. However, fishers are now enhancing their fishery by providing the market with barramundi wings and swim bladders, and selling whole barramundi and king threadfin fresh on ice to southern markets.

Recreational Sector

Area

Barramundi have historically been caught by anglers throughout inland billabongs and the upper reaches of rivers and creeks. However, as recreational fishing access has developed enabling greater access to the coast, many anglers now target larger barramundi in the tidal mouths of rivers and estuaries.

Seasonal closures are currently in place, restricting recreational fishing from spawning grounds near the mouths of the Daly and Mary Rivers, between 1 October and 31 January each year.

The Mary and Daly Rivers, as well as the rivers in Kakadu, are important fishing locations due to their proximity to Darwin. Further south, the Victoria, Roper and McArthur Rivers are also well utilised by Northern Territory anglers from outside of Darwin and interstate anglers.

Fishing method

Recreational fishing for barramundi is predominantly carried out from boats, between three and six meters in length, using light rods and reels, fly fishing gear and handlines to cast or troll a wide range of lures or live baits. Mullet are the most popular live bait species used in estuarine environments, whilst freshwater prawns (*Macrobracium rosenbergii*) are favoured in billabongs and the upstream portions of rivers.

Gear restrictions and reduced possession limits apply in the Mary River Fish Management Zone and additional controls are in place within 100 m of the Shady Camp Barrage.

Catch

Recreational fishers generally target the same species as the commercial fishery, and also catch many of the same non-target species. Target and non-target species may be either retained or released.

Barramundi caught in the non-tidal reaches of rivers and billabongs are between one and five years of age, whereas those caught in the tidal reaches near river mouths can range between one and 15 years of age (fish of three to ten years are most common).

In 2000, *The National Recreational Fishing Survey*: *The Northern Territory* (NRFSNT), identified barramundi as the most popular target species, with an estimated total catch of over 400,000 barramundi and an annual harvest of 100,400 barramundi (Coleman, 2004). The total number of barramundi caught has increased by about 60% from that recorded in 1995 (240,000 barramundi), although the actual number of retained fish has remained about the same (Coleman, 1998; Coleman, 2004). Information from the recreational fishing surveys indicates an

increasing trend in catch and release within the recreational barramundi fishery. In 2000, it was estimated that 76% of the barramundi caught were released, an increase from 58% recorded in the 1995 survey.

Effort

Recreational fishers often fish for a range of species. However fishing for barramundi is quite specific in the choice of fishing equipment and location. In 1995, targeted barramundi fishing accounted for 38% of the total recreational fishing effort, amounting to over 840,000 hours. In 2000, targeted barramundi fishing effort increased to 43% of the total recreational fishing effort, but the number of hours fished had decreased from 1995 levels to 788,726 hours.

Catch rates

Angler creel surveys in the Mary River indicate that the total catch rate increased from 0.11 barramundi per angler hour in 1986 to 0.23 barramundi per angler hour in 1995. The subsequent FISHCOUNT survey (1995) and National Recreational and Indigenous Fishers Survey (2000) determined that the number of fish caught per hour (all species) in the Mary River region remained consistent at 0.54 fish per angler hour. However the proportion of barramundi caught in 2000 had increased significantly accounting for 63% of all fish caught, as compared with only 43% of all fish caught in 1995.

Fishing Tour Operator Sector

The number of Fishing Tour Operators (FTOs) utilising the Northern Territory's aquatic resources is growing, driven primarily by client demand.

Area

FTOs target barramundi in both salt and freshwater areas, often changing their fishing location according to the season. Generally, the mouths of rivers are targeted for large barramundi at the end of the wet season, with a switch to billabongs during the dry season months.

Fishing method

FTOs and their clients use the same fishing gear as recreational fishers. Casting or trolling artificial lures accounts for 95% of targeted barramundi fishing effort, while live bait accounts for the remaining 5%. The relative proportions of lure and bait fishing have remained stable since 1995.

Catch

In 2005, FTO clients caught 47,389 barramundi, representing a catch increase of 23.8% on the 2004 FTO catch of 38,288. Eighty seven percent of barramundi caught in 2005 were released (41,055) and 13% (6334) were retained. Allowing for post release mortality of 10%, the total harvest of barramundi by the FTO sector was estimated to be 11,397 individuals in 2005.

While targeting barramundi, 51 other species were also caught, totaling 26,559 individuals. The most frequently caught species (84%) were mangrove jack (*Lutjanus argentimaculatus*), catfish, golden snapper (*Lutjanus johnii*), trevally (*Carnax spp.*), cod (*Epinephelus spp.*), queenfish, king threadfin and blue threadfin, respectively.

The proportion of captured barramundi which were retained by FTO clients was much lower than for general recreational fishers and has remained relatively consistent at around 15%, since 1995.

Over 65% of the barramundi caught by FTOs were from a relatively small number of areas, which included Bathurst Island and western Melville Island, the Mary River region and eastern Arnhem Land.

Effort

In 2005, FTOs undertook 4,469 trips targeting barramundi. This is an increase of 25% on the 2004 figure of 3,572 trips, with a corresponding increase in the number of hours targeting barramundi of 25% or 84,911 hours. The proportion of FTO trips targeting barramundi has also increased to 55% of all FTO fishing charters.

Catch rates

The catch rate for barramundi remained stable from 1995 to 1998 at 0.5 barramundi per hour. From 1998, it gradually increased to 0.8 fish per hour in 2001, but decreased to 0.4 fish per hour in 2003. In 2004, the catch rate improved to 0.5 barramundi per hour and has remained at this level since. These fluctuations in FTO catch rates have followed a similar trend to that seen in the commercial fishery, where recruitment is affected by high and low rainfall periods.

Indigenous Sector

Barramundi are one of the species harvested by Aboriginal people in coastal and some inland areas of the Northern Territory, having significant economic, health and social value to this sector. In addition, barramundi also has a high totemic value to some Aboriginal groups.

Area

Most fishing for barramundi occurs in inland rivers which drain into the sea or in inshore coastal waters.

Fishing method

Over 90% of all fishing is shore based using baited lines and spears.

Catch

The NT supplement of the *National Recreational and Indigenous Fishing Survey* (NRIFS) found that Indigenous fishers harvested 44,134 barramundi in 2000, and that negligible numbers were released.

Non-retained Species

Barramundi gillnets are quite selective in targeting barramundi and king threadfin when placed on mudflats and in rivers. Non-target species may be either retained as byproduct or discarded as bycatch, depending on market price.

A small percentage of bycatch that may be discarded includes catfish, blue salmon, queenfish, trevally, tripletail and sharks. Bycatch has been noted to increase when nets are set in deep channels rather than shallow mud flats.

The Barramundi Licensee Committee has agreed on restrictions limiting the take of shark, as part of the National Plan on Sharks. Commercial barramundi fishers must have no more than 500 kg of converted whole shark weight on board each vessel at any time, and must unload all shark products prior to the commencement of their next voyage.

In the 2000 NRIFS, recreational fishers targeting barramundi also caught threadfin, snappers, grunters and catfish of which 35.9% were retained. However, retention rates were variable depending on the species. For instance, most of the threadfin were retained, while most catfish were released.

Threatened species interaction

In 2005, there were no reported interactions with threatened species in the NT Barramundi Fishery.

Ecosystem Impact

Gillnets are relatively selective in catching targeted finfish species, however the incidental capture of dugongs, crocodiles and turtles has been recorded in the past.

A set of guidelines to minimise the incidental capture of dugong has been developed by the Northern Territory Seafood Council. In addition, a dugong protection area is in place in the south-western Gulf of Carpentaria effectively excluding commercial fishers from fishing and anchoring in this area.

Crocodiles and turtles may also be caught in gillnets however, as nets are mostly checked at each tide, these animals are normally released alive.

The commercial Barramundi Fishery is restricted to tidal waters, while historically; recreational fishers have targeted the freshwater stocks. But, with improved access, they are increasingly targeting the same stocks as commercial operators in the tidal reaches of rivers and mudflats.

Social Impact

The commercial Barramundi Fishery employs around 100 people as crew and another 50 are employed in the processing, trading and marketing of barramundi to local and interstate markets. A large service industry also supplies gear and consumables to barramundi operators, as well as servicing equipment and freighting product.

Barramundi fishing is an iconic feature of the Northern Territory and a popular recreational pastime. About 30% of the resident population go fishing, and at some time, most recreational fishers target barramundi. Recreational fishers also purchase gear, bait, fuel and service equipment at local businesses.

Many interstate and overseas tourists come to the Territory to catch wild barramundi, as the Territory has a reputation for having high numbers of large fish. Visitors accounted for 37% of the total fishing effort (hours) in the NT in 2000, an increase from 23% in 1995.

Barramundi also holds an Aboriginal totemic value in some communities. Abundance of barramundi is important not only as a major food source of some coastal communities but as an important component of Aboriginal wellbeing.

Economic Impact

At the point of first sale in 2005, the overall catch value for the commercial Barramundi Fishery was $4.6 million. In 2004, the barramundi component was just over $3.6 million (2004 - $4.1 million)

and the king threadfin component was $0.88 million (2004 - $0.92 million). The value of byproduct sold in 2005 was $0.13 million. Whilst the commercial Barramundi Fishery is not the largest of the Territory's fisheries, its return to the NT community is substantial.

The recreational sector also contributes to the Northern Territory's economy, especially in the service and fishing tackle industries. In 2000, it was estimated that over $26 million was spent on recreational fishing in the NT, although this cannot be directly attributed to any one fishery (Coleman, 2004).

STOCK ASSESSMENT

Monitoring

Monitoring of the Barramundi Fishery is largely focussed on analysis of catch and effort trends in the commercial fishery based on monthly catch returns provided by licence holders to the Fisheries Division of the Department of Primary Industry, Fisheries and Mines. A number of observer trips onboard commercial vessels are also undertaken each year. In 2005, three commercial observer trips were conducted, one each to the Finniss River, Chambers Bay and Arnhem Bay.

During these three trips, a combined total of 437 fish were measured, of which 60% were barramundi and 28% were king threadfin. Byproduct species contributed 9% to the total observed catches and consisted of jewelfish (*Johnius spp.*), black jewfish, tripletail and mullet (*Liza spp.*). A further 3% of the total catch was not kept, of which a significant proportion were catfish (*Arius spp.).*

Stock Assessment Methods and Reliability

The Barramundi Fishery has been assessed a number of times since it was first assessed using catch and effort data in 1978 and 1979. The early assessments assumed that the barramundi population of the NT was a single stock. However, between 1980 and 1983, Dr John Salini and Dr James Shaklee determined that there are in fact numerous genetic stocks associated with the major rivers across northern Australia. Armed with this knowledge and improved modelling techniques, subsequent models of the Barramundi Fishery have improved in their reliability.

Stock assessment models since 2000 have used age structured and biomass dynamic models and the Deriso delay-difference model to assess the barramundi populations of the Northern Territory. The Deriso delay-difference model was then enhanced by inclusion of a habitat area parameter to appropriately scale the model for each of the regions assessed, which also allowed for the inclusion of the many different stocks present. In 2005, the National Barramundi Workshop held in Darwin, attempted to create a more complex model which would include all variables used in previous models, as well as further biological information and recreational, fishing tour operator and Indigenous sector catches.

All recent reviews have concluded that the barramundi population of the Northern Territory has largely recovered from the overexploitation of the 1970s and that the current level of exploitation in all targeted stocks is below the maximum sustainable level. Given the long and informative time series of catch and effort data available for this fishery, and the extensive knowledge of barramundi biology, the stock assessment is considere d to be very reliable although the latest model developed will require further refinement before it can be used as a basis for management decision making.

Current Harvest Status

No direct estimates of total harvest rate are available for the Barramundi Fishery, but output from the stock assessment model indicates that the overall commercial harvest rate is currently around 10%. Analysis of tag recoveries from the Daly River in recent years indicates that around 12% of tagged fish are recovered by commercial fishers, closely supporting the computer model output. The model output also indicates that the total biomass of barramundi is currently at around 85% of unfished levels.

Trigger points and performance measures for the Barramundi Fishery are being developed and incorporated into the *Barramundi Fishery Management Plan.* These trigger points will then be reviewed annually to assist in setting the harvest rate of the fishery.

Future Assessment Needs

Catch and release fishing is becoming increasingly popular as anglers become aware of barramundi biology and conservation values. Increasingly, fish that could legally be retained

are being released. Research investigating the physiological effects and survival rate of released juvenile barramundi has been conducted. Findings from this research show that overall post-release mortality, for juveniles is about 10%. However, survival rates varied greatly, depending on water temperature. During the cooler months when water temperatures are low, no deaths were recorded during the catch and release experiment, while 20% of barramundi caught and released during warmer months died (Fishery Report 73).

The next step is to investigate the effects of catch and release on the reproductive capacity of the larger mature 'trophy fish'. A pilot study is being planned for 2006, which aims to assess the viability of further research in this area.

Future assessment of the commercial Barramundi Fishery is needed to meet the requirements of the *Environmental Protection and Biodiversity Conservation Act 1999.* This assessment includes identifying the impact of the fishery on bycatch species, byproduct stocks and environment in general.

RESEARCH

Summary to Date

Research on barramundi in Northern Territory waters began in 1972 with sampling and tagging on the Mary River and sampling on the Victoria and Roper River systems. Between 1974 and 1978 no research was conducted on barramundi because of Cyclone Tracy, but recommenced in late 1978 with an assessment of the fishery and extensive sampling to establish baseline biological information on barramundi stocks between 1978 and 1980. Results of the 1978/1979 assessment highlighted substantial over fishing which led to licence reductions and identified the rising significance of recreational fishing.

During the mid 1980s concern was raised about the status of barramundi stocks in the Mary River system, where management measures had been less successful than in other areas. A major assessment of the status of barramundi was undertaken in the Mary River system, including intensive monitoring of both commercial and recreational catches during 1986 and 1987. Results from this study showed that the stock was over fished, with a substantial reduction in the abundance of mature fish. The results of this study created some controversy and an independent assessor, Professor William Fox of the University of Miami was engaged. The results of the independent assessment confirmed that the mature stock was over fished and caused a seasonal closure to be put in place to protect spawning fish accompanied by a reduced recreational bag limit (Griffin 2006).

In addition to monitoring commercial and recreational catches on the Mary River, an annual fishery independent monitoring experiment was set up on Corroboree Billabong in 1989. During this annual experiment, 450 metres of the billabong is closed off using heavy nets to stop the movement of barramundi into or out of the study site. The area is then fished using gillnets and an estimate of the total population within the study site is made. Results from this annual experiment have revealed a very consistent pattern of cyclic abundance with high numbers of recruits every second year. In 2005, the estimated population of barramundi in the 450 metre study site was 1141 (between 711 and 1571 with 95% confidence). This was the third highest recorded estimated number of barramundi, with only 1997 (2865 fish) and 2001 (1928 fish) recording greater numbers. One feature of the 2005 results was the complete absence of new recruits. This absence could have been due to a number of factors, the most likely being:

- the high proportion of one year old and two year old fish present in 2005, which either ate or out competed the smaller barramundi entering the billabong; and
- lower monsoon rainfall in 2004/2005 which reduced the available juvenile habitat on the lower Mary River flood plane and access to Corroboree Billabong.

Research effort between 1996 and 2001 focussed on the assessment of the possible impacts of saline intrusion control activity in the Mary River wetlands on barramundi in the region (de Lestang and Griffin, 2000; de Lestang et al., 2001). It was identified that the placement of saline intrusion control walls along the wetlands significantly reduced the composition and relative numbers of fish, (including barramundi) in areas impacted by control works. Such a reduction has the potential to impact on the growth rate and ultimate survival of juvenile barramundi. The placement of spillways within the walls was found to negate the negative effects of the control walls, facilitating access for both juvenile barramundi and other species.

Between 2002 and 2004, research effort

concentrated on quantifying the survival rates and physiological effects of angler catch-and-release on barramundi in a freshwater habitat. The results showed that the post-release survival rate of barramundi in a freshwater environment was about 90%, and that the action of hooking and landing barramundi elicited a physiological (plasma cortisol) and metabolic (plasma lactate) stress response. Post-release survival rates also varied significantly throughout the year. Those fish sampled in summer demonstrating elevated physiological and metabolic variables, while recording a lower post-release survival rate of 80%.

As an adjunct to this project, the effects of fish handling techniques, including landing nets, was also investigated. A significant difference was identified in the extent of skin abrasions and fin damage between different types of landing nets. The use of 'environmentally friendly' knotless nets is recommended to minimise injuries and increase the chance of post-release survival.

Incorporation into Management

Monitoring of barramundi stocks in the Mary River during 1986 and 1987 provided vital information supporting major changes to the management of commercial and recreational sectors.

Research in the Mary River wetlands identified the beneficial effects of spillways within saline intrusion control walls. The findings of this research have been incorporated into the future planning of saline intrusion control works.

Data from creel surveys and population monitoring in the Mary River has made significant contributions to adjustment of fishing controls in the region, including the size limit and banning the use of live bait and treble hooks at the Shady Camp Barrage.

The long-term monitoring of the barramundi population at Corroboree Billabong has led to a greatly improved understanding of reasons behind fluctuations in the population, and informs responses to concerns about reported and perceived declines in fishing success.

The results from the post-release survival study strongly support the use of catch-and-release as both a management tool and conservation practice for barramundi in a freshwater environment. The effect of season on both the stress response and post-release survival of barramundi is significant and will be used as a guide for future management strategies.

Current Research

On-going research projects include the annual assessment of recruitment levels and populations in the Mary River, further development of stock assessment models for barramundi, and continued on-board monitoring of the commercial Barramundi Fishery.

In 2005, NT Fisheries hosted the National Barramundi Workshop which attracted 30 participants from Australia and overseas. The objectives of the workshop were to provide;

- an overview of the research and management of barramundi stocks in northern Australia over the last 15 years;
- examine the current and future issues and or concerns in the Barramundi Fishery; and
- develop a northern Australian Barramundi Model.

MANAGEMENT/GOVERNANCE

Management

Objective

Objectives, performance criteria and trigger points for the Barramundi Fishery will be defined as a result of the current review of the *Barramundi Fishery Management Plan*. The proposed objectives for the fishery are listed in Table 1. These objectives will be incorporated as an appendix to the revised *Barramundi Fishery Management Plan*. Such measures will assist in the long-term sustainability of the fishery.

History

Conservative management, focussing on the containment of commercial fishing effort, protection of breeding stocks through seasonal closures and a minimum size limit reducing fishing pressure on juvenile fish, has been adopted to protect the barramundi resource. The fishery has been actively managed since the 1960s and controlled under the *Barramundi Fishery Management Plan* since 1991.

Recreational anglers pay no licence fees, but gear restrictions apply and seasonal area closures are in place on the Mary and Daly Rivers. A specific possession limit of two barramundi applies to the Mary River Fish Management Zone with a limit of five applicable elsewhere in the Northern Territory. A minimum length of 55 cm for both the commercial and recreational sectors applies throughout the Northern Territory.

Current issues

The issues currently facing the management of barramundi stocks in the Northern Territory relate mainly to resource allocation, i.e. which sector or group is granted access to the existing barramundi resource. The Adelaide River was closed to commercial barramundi fishing in 2004 and one full ten-unit licence was bought back by Government so that fishing effort was not displaced into other areas of the fishery. In addition to the buy out of a single licence in 2004, further buy-backs are planned in the future.

There is a specific need to resolve questions concerning the impact of recreational catches on barramundi stocks in heavily utilised areas, increased targeting of mature female barramundi, and access to pastoral leases, Aboriginal land and Kakadu as well as localised habitat issues (e.g. saltwater intrusion in the Mary River catchment).

Most of these issues will be canvassed in the review of the *Barramundi Fishery Management Plan*.

Future plans

During 2005, key fishery stakeholder representatives drafted a ten-year vision and five-year plan for the Barramundi Fishery. This Strategic Plan will document the strategic direction that key stakeholders believe the fishery should take within the next decade in order to provide certainty for industry and future expansion of the recreational fishery.

The *Barramundi Fishery Management Plan* is scheduled for review in 2006. A discussion paper has been drafted on all issues affecting the Barramundi Fishery, and will be made available to the general public and key stakeholders for comment.

The current log books used in the commercial Barramundi Fishery require modification to enhance the definition of species caught and finer spatial information regarding areas fished.

Results of the 2000 National Recreational Indigenous Fishing Survey gave an insight into the recreational sectors catch and effort, and these results have been incorporated into modelling and stock assessments to further define the state of the fishery. As revised stock assessments become available, management arrangements may need to be reviewed.

Compliance

Monitoring, compliance and enforcement activities are undertaken by the NT Police Marine and Fisheries Enforcement Section (MFES). The MFES has 17 officers who are responsible for providing compliance and education on all fisheries managed by the Northern Territory.

Major issues of concern with respect to compliance in the commercial sector are the use of excess gill net, fishing in closed waters and the inadequate marking of gear. Recreational fishing issues include retaining undersize barramundi, fishing in seasonally closed areas and non-compliance within the Mary River Management Zone.

Consultation, Communication and Education

Consultation with key Barramundi Fishery stakeholder groups is undertaken as and when required. Key stakeholders will be extensively consulted throughout the review of the *Barramundi Fishery Management Plan*.

A series of Aboriginal Consultative Committees have been formed to provide NT Fisheries with the opportunity to consult with coastal Aboriginal communities on fishing and related matters.

Prior to commencing fishing operations, all new entrants to the commercial fishery must attend an interview with the Aquatic Resource Manager responsible for the fishery. These interviews are aimed at providing the fisher with an understanding of the legislation, status of the fishery, research, management and compliance issues.

An information package is available for recreational fishers on all aspects of barramundi fishing in the Northern Territory. It includes information on fishing methods, locations of boat ramps, catch and release practices as well as a copy of the recreational fishing controls booklet, outlining regulations applying to the recreational sector.

Presentations on best practice handling techniques and issues affecting sustainability of the resource are given to schools, community groups and fishing clubs.

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Table 1. Management Objectives and Performance Indicators from the proposed revised *Barramundi Fishery Management Plan*

Species/ Group	Management Objectives	Performance Indicators	Trigger Reference Points	Management response to be taken
Barramundi	To maintain the sustainability of the barramundi resource.	Significant decline in the annual catch or a significant increase in fishing effort.	If catch or effort by any sector, or the fishery as a whole, increases or decreases by 20% for each year for two consecutive years.	Stakeholders to make recommendations to the Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.
Barramundi	Each sector (FTO, recreational, commercial, Indigenous) to optimise the monetary value of their catch.	That all sectors are achieving the maximum worth from their catch.	If the monetary value of fishing by a fishery sector changes by more than 20% for each year for two consecutive years.	Stakeholders to make recommendations to the Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.
Barramundi	Maintain and enhance quality fishing experiences for recreational fishers into the future.	If a significant number of recreational fishers or FTO clients do not enjoy their barramundi fishing experience	If more than 20% of participants in stakeholder fishing surveys or FTO clients state that they are unsatisfied with their barramundi fishing experience.	Stakeholders to make recommendations to the Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.
By-product species				Stakeholders to make recommendations to the Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.
Bycatch species	Ensure ecological sustainability of bycatch species.	Onboard monitoring of commercial barramundi vessels.	If bycatch species increase by more than 50% in any year for two consecutive years.	Stakeholders to make recommendations to the Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.
Endangered, threatened or protected species and/or communities	Ensure the continued protection of species and communities listed under EPBC Act (1999), and as listed under the Territory Parks and Wildlife Conservation Act (2001).	Endangered, threatened or protected species and or communities are identified in NT waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC listed species or communities.	Stakeholders to make recommendations to the Director of Fisheries regarding the implementation of a threat abatement plan, if required. Amended arrangements to be implemented within 12 months of trigger being reached.
Ecosystem components	Minimise effects on ecosystem components.	Identification of threatening processes.	Identification of significant negative interaction with components of the natural ecosystem.	Stakeholders to make recommendations to the Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.

Coastal Line Fishery Status Report 2005

INTRODUCTION

Coastal ecosystems are dynamic and diverse resources of great ecological, social and economic significance. They contain some of the most diverse ranges of fish stocks inhabiting the waters of the Northern Territory. Four major sectors utilise coastal fish stocks namely, commercial, recreational and Indigenous fishers, as well as fishing tour operators. With proper stewardship, the NT's coastal finfish resources should continue to meet the differing sector needs without compromising ecological integrity or biological diversity.

The commercial Coastal Line Fishery commenced largely as a lifestyle fishery, but has developed into a professional, expanding industry. Commercial harvests have continued to grow over the last five years, reaching a new high in 2004 of 311 tonnes. Conservative estimates suggest that the recreational harvest of coastal fish species is at least double the commercial take.

Historically, the Coastal Line Fishery has operated as a multi-species line fishery, targeting reef associated species such as snappers, emperors, cod and various pelagic species. Recent changes in the catch composition indicate the Coastal Line Fishery catch is now dominated by one species, black jewfish (*Protonibea diacanthus*).

PROFILE OF THE FISHERY

Commercial Sector

Area

The Coastal Line Fishery extends from the high water mark to 15 nautical miles from the low water mark across the entire Northern Territory coast. Some finer scale access restrictions apply due to the presence of Aboriginal sacred sites and protected area reserves.

Fishing method

Coastal Line Fishery licensees are permitted to use a variety of fishing gear including vertical line, drop line, fish traps, cast net, scoop net and gaff. A maximum of five fish traps per licence may be used in the area seaward of two nautical miles from the low water mark. However little trap fishing had been reported prior to 1992. Similarly, the use of drop lines is also permitted only seaward of the two nautical mile mark.

The use of different fishing gear was reported for the first time in 2002, with drop lines and traps adopted by a small number of commercial fishers. However, line fishing remains the most common method for the coastal fishery.

Commercial fishers are permitted to use up to five hooks per vertical line, but fishers most commonly choose to use two hooks per line. Commercial fishers may use up to 40 hooks per drop line, while the actual number of hooks utilised ranges between 4 and 20.

Catch

The reported catch for the Coastal Line Fishery reached 284 tonnes in 2005, which is lower than the total catch of 311 tonnes in 2004 which was the largest yet reported for this fishery (Figure 1). In the period 1990 to 1998, the catch fluctuated between 60 tonnes and 138 tonnes. Since 1998, a strong trend of increasing catch has been observed until 2005. The total catch decreased in 2005 mainly due to a drop in market demand.

Analysis of the Coastal Line Fishery data reveals significant changes in the fishery's catch composition. For the period 1990 - 1998 a mix of reef fish dominated the catch. Since 1999 a clear trend of increasing black jewfish catch is evident. Interestingly the two different gears now used in this fishery appear to target different species. Black jewfish comprise 86% of the handline total catch, but only 22% of the dropline catch for 2005.

Golden snapper catch has declined from an average of around 16% of the total catch for the period 1990 to 1999 to 4% in 2005.

The target species for the Coastal Line fishery is black jewfish.

The catch of byproduct species in the Coastal Line Fishery is minimal given the targeted nature of the fishery and the use of line tackle.

Effort

In 2005, there were 26 licences active in the Coastal Line Fishery. Fishing effort is recorded as hookday, which equates to the total number of hooks used per day over the entire fishery. Figure 2 displays the catch and effort for the line-only component of the coastal line catch. The dropline and trap components of the fishery have not been displayed as data comes from less than 5 licensees involved in this activity. For the handline-only component of this fishery, fishing effort reached a peak of 28,970 hookdays in 1992 and then declined to an all time low in 1998. Since 1998, effort has increased slightly each year reaching 7,133 hookdays in 2004 and then reduced to 5,649 hookdays in 2005, again mainly due to a drop in market demand.

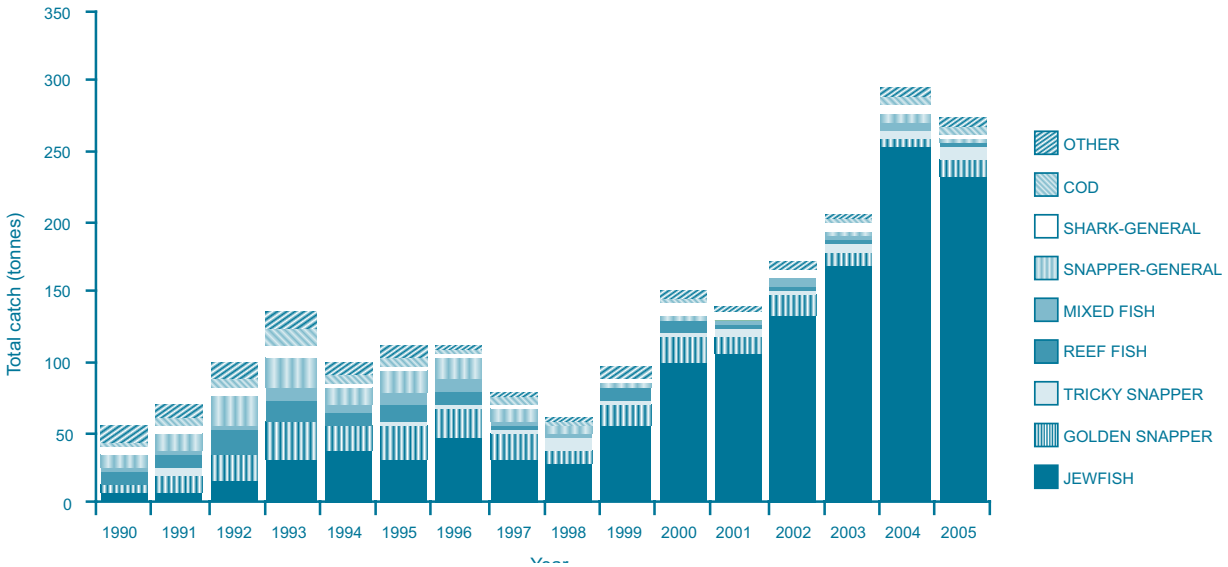

Figure 1. Catch composition for the NT Coastal Line Fishery, 1990-2005 for handline only

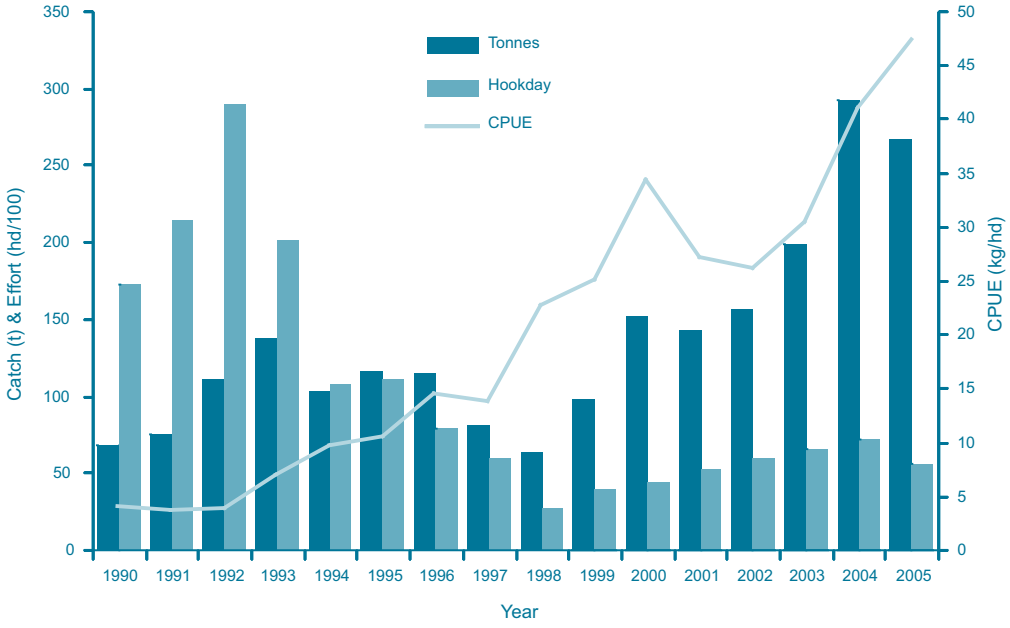

Figure 2. Catch, effort and CPUE for the Coastal Line Fishery, 1990-2005

Catch rates

Until 2000, handline-only catch rates increased steadily as the fishery developed (Figure 2). In 2000, the catch rates for the handline-only component of the coastal line fishery peaked at 34 kg/hookday. In 2005, the catch rate further increased to 47.3kg/hookday.

Marketing

Most fish are sold fresh on ice, usually gilled and gutted, filleted or trunked. Sales have generally been to local markets close to the port of landing, with a small quantity sold to southern markets. Industry representatives report an influx of imported fish reduced interstate demand for black jewfish during 2005.

Recreational Sector

Area

Recreational fishing for coastal species occurs throughout the coastal waters of the Territory. The most important areas are close to the larger coastal population densities – the coastal strip between the Adelaide and Daly Rivers and the Nhulunbuy area. The Darwin area supplies 31% of the total recreational fishing catch in the Northern Territory.

Fishing method

A variety of fishing gear is utilised by the recreational sector. Most of the fishing effort is by line (84%), with this effort shared almost equally between the use of lures and bait. Fishing from a boat is more common than shore fishing, with over 75% of all fishing effort occurring from a boat.

Catch

The National Recreational Fishing Survey conducted in 2000 indicated that of the over 600,000 individual fish harvested by recreational fishers in the Northern Territory (the harvest is those fish caught and kept), the most important species group of finfish were snappers (23% of the total harvest). Within the snapper group, golden snapper and Spanish flag (stripeys) accounted for the largest portion of the harvest, with an estimated 68,000 and 22,000 individuals respectively.

Jewfish (approximately 18,000 individuals) and emperors (approximately 12,000 individuals) were also significant components of the harvest. Conservative estimates suggest the recreational harvest of snappers, jewfish and emperors alone is double the total commercial take for the Coastal Line Fishery.

Effort

In terms of recreational fishing effort, the Coastal Line Fishery is an important fishery, accounting for approximately 30% of the fishing effort in 1995 and 2000. The fishery not only accounts for dedicated reef fishing but also a large amount of fishing with no specific target species.

In 1995, most of the fishing effort for reef fish and 'non-specific target' fishing occurred within the Darwin Harbour area.

In 2000, the Darwin Harbour area was still the most important fishing area, accounting for 39% of the coastal line fishing effort.

Fishing Tour Operator Sector

Area

Fishing Tour Operator (FTO) charters are mostly conducted around Darwin, Fenton Patches, Bynoe Harbour, Fog Bay to Point Blaze and the Peron Islands. A small number of charters operate out of Nhulunbuy, Borroloola and across Arnhem Land.

Fishing method

Fishing guides use the same gear as recreational fishers and mainly fish for reef fish by using lines with bait. FTO clients use bait for 95% of the hours spent fishing for reef species.

Catch

FTO logbook return data for 2005 shows that the most prolific species caught by clients, apart from barramundi, were predominantly reef dwelling species such as golden snapper (20,413), Spanish flag (16,953), tricky snapper (16,633), and trevally (11,942).

Effort

Targeting reef fish was the second most prevalent fishing activity reported by FTOs in 2005. This type of fishing activity accounted for 69,310 hours fished by FTO clients, an increase of 38% since 2004. This large increase can be attributed to an increase in licence activity of 33% since 2004 and an increase in client numbers of 27% since 2004. The overall increase in reef fishing hours has been relatively steady, with line hours almost five times the amount recorded in 1995.

Reef fishing has become an increasingly important component of the FTO industry. The number of trips targeting reef fish has more than doubled since 1995.

Indigenous Sector

Area

A large number of Indigenous communities and outstations are found along the Northern Territory coastline. Most fishing activity occurs in relatively close proximity to the place of residence and is predominantly shore-based.

Fishing method

The National Recreational Fishing Survey conducted during 2000 revealed that over 90% of all Indigenous fishing in the Northern Territory is shore based, commonly conducted using lines with bait (50% of all fishing events).

Catch

Mullet and snappers are the main groups of fish harvested by Indigenous fishers. The Indigenous component of the National Recreational Fishing Survey (NFRS) recorded the harvest of 83,000 individual mullet by Indigenous subsistence fishers in the Northern Territory.

The NRFS provides details on the catch of several other fish, some of which are important to both Indigenous fishers and those operating in the Coastal Line fishery. Other species caught include catfish (60,000), snapper (27,500), shark and rays (12,000), salmon (8,500) and trevally (8,000).

Non-retained Species (Bycatch)

While the Coastal Line Fishery harvest has become increasingly centred on black jewfish and snappers, over 40 different species have been retained in recent years. Fisheries Regulations prohibit Coastal Line licensees from taking barramundi, threadfin salmon, Spanish mackerel or mud crab. Coastal Line licensees have also agreed, at the request of the Offshore Net and Line Fishery Licensee Committee, to shark limits being introduced to their license conditions.

During targeted reef fishing, recreational fishers catch a wide variety of species. The popular table species such as snappers, emperors and jewfish have retention rates of up to 76%. Species such as sharks, rays and catfish have a retention rate of less than 5%. The number of reef fish released by Indigenous fishers is negligible, with fishing being essentially a subsistence activity.

Threatened species interaction

In 2005, there were no reported interactions with threatened species. The targeted nature of the coastal line fishery minimises the risk of interactions with threatened species.

Ecosystem Impact

Presently, there is a deficit of information on the wider impact of coastal line fishing activities conducted in the Northern Territory. Therefore, it is not possible to accurately assess the impact on coastal ecosystems and the aquatic environment as a whole.

An increase in sound information will be necessary to assess the impact of the increasing catch levels and the recent changes in species composition and fishing practices.

Social Impact

In 2005, there were 26 active coastal line licenses which provided both direct and indirect local employment opportunities. A large proportion of the Northern Territory wild harvest seafood is dedicated to domestic consumption, with the commercial seafood industry supplying products to major Australian seafood markets. Subsistence fishing and recreational fishing continue to form an important component in the lifestyles and culture of a large proportion of people residing in the Northern Territory.

Economic Impact

At the point of first sale in 2005, the catch value of the commercial coastal line fishery was $0.75 million ($0.97 million in 2004). The jewfish component was $0.60 million (2004 - $0. 75 million) and golden snapper was $29,060 (2004 - $18 729).

The recreational fishing sector also contributes to the NT economy, particularly to the service and tackle industries.

STOCK ASSESSMENT

Monitoring

The Fisheries Research and Development Corporation (FRDC) project “Implications of Target Fishing Black Jewfish aggregations” commenced in July 2004. One of the project aims is to collect biological information that will help explain the drivers of black jewfish aggregation behaviour.

Catch and effort trends in the commercial fishery data, provided by licensees on a monthly basis, are monitored.

Stock Assessment Methods and Reliability

A major workshop was held in 1996 to provide advice on the status of fish stocks in the Northern Territory. The review found that although not heavily utilised, there were signs of sequential, localised depletion of coastal fish stocks, particularly around major population centres.

Using the limited data available (commercial coastal line catch and effort data and preliminary biological information), an annual catch estimate of 100 - 1000 tonnes was derived. Since then,

estimates of recreational catch have been released. The total coastal line catch, including the Indigenous fishing component, is moving toward the upper estimate of the original stock assessment.

Current Harvest Status

The current research study "Implications of Target Fishing Black Jewfish aggregations" is reviewing the current harvest status and reports of localised depletions, around major population centres.

Future Assessment Needs

There is a lack of definitive information on the biological characteristics of the various coastal species, the size of and relationships between the coastal fish stocks, and the level of catch that may be harvested in a sustainable manner. NT Fisheries is seeking to rectify this deficit and has recently re-commenced research in this area. Information gained by the project "Implications of Target Fishing Black Jewfish aggregations" will contribute to future assessment needs.

RESEARCH

Summary to Date

Concerns about the sustainability of this fishery, raised by key stakeholders in 1995, resulted in the commencement of the coastal research project.

The project aimed to collect important fisheries information on age and growth of key coastal species and incorporate this information into the sustainable management of the fishery. A total of 160 field and data collection surveys were conducted during the four years that the project was active.

Important preliminary results from this work indicate that:

- Black jewfish have a fast growth rate, reaching sexual maturity at around 97 cm in total length and 4 years of age.
- Golden snapper are a long-lived and late maturing fish. Fifty percent of females reach sexual maturity at 63 cm (8 to 10 years old). Males reach maturity at a smaller size, with 50% mature at 47 cm. The oldest golden snapper sampled was 23 years of age with a fork length of 82 cm.
- Tricky snapper undergoes a sex change, beginning life as a female and developing into a functional male at around 37 cm and 6 years of age.

Results of the project "Implications of Target Fishing Black Jewfish Aggregations" will be available in 2007.

Incorporation into Management

Growth and age data collected as a result of this program has resulted in the implementation of two recreational fish possession limits with recreational fishers now restricted to a 5 fish possession limit for black jewfish and golden snapper, included within a general reef fish possession limit of 30 fish.

Current Research

Two linked research projects have been funded by the NT Government and the Fisheries Research and Development Corporation. The research is to be a collaborative three-year project involving the NT Fisheries, Tasmanian Aquaculture and Fisheries Institute, and the Australian Institute of Marine Science.

The projects will bring together standard fisheries science for the collection and analyses of age, growth and reproduction information and innovative technology. A key element of the planned research is to have acoustic tags implanted into 80 jewfish and individual movement between key aggregation sites will be tracked via acoustic receivers located on the ocean floor. In addition, key aggregation sites habitat will be mapped using sophisticated underwater video technology and oceanographic equipment.

The four objectives of the proposed project include:

1. determining the temporal, spatial and biological nature of the aggregations;
2. identifying key sites of black jewfish aggregations and monitor fishing activity at these sites;
3. determining the degree of movement between two known aggregation sites; and
4. reviewing and adjusting management arrangements as appropriate.

MANAGEMENT/GOVERNANCE

Management

Objective

In consultation with stakeholders, NT Fisheries aims to manage the Coastal Line Fishery in a manner that is equitable, in line with nationally agreed ecologically sustainable development principles, and which optimises the benefit to the community now, and into the future.

History

Prior to the introduction of the Fisheries Regulations in 1993, the number of coastal line licences (formerly inshore reef licences) peaked at around 160 non-transferable licences.

The number of licences was reduced to 65 in the early 1990s through a moratorium on the renewal of inactive licences and the issuing of new licences. In the mid-1990s, an additional 26 coastal line licences were granted as a result of negotiations to extend the fishery area.

In 1995, significant amendments to the Regulations came into force to allow the seaward extension of the fishery area, and to introduce the transferability of commercial licences in a two for one licence reduction program. This program was introduced to allow for the transfer of Coastal Line licenses while removing excess fishing capacity. Currently there are 56 coastal line licences. However, the outcome of the licence reduction program may result in there being a maximum of 45 fully transferable licences.

The re-alignment of the Coastal Line Fishery was undertaken to enhance the economic viability and productivity of the fishery, while increasing the opportunity for the sustainable management of coastal resources. The need for the licence reduction program was highlighted during the FRDC-funded workshop conducted in 1996. Uncertainties in stock size estimates, excessive amounts of latent effort and increasing recreational fishing effort, were identified as the major issues for this fishery.

Current issues

While the total catch of the recreational fishery probably exceeds the commercial catch, new possession limits introduced in 2002 will help limit the impact of this sector. Recreational fishers may now take no more than five black jewfish and five golden snapper (as part of the general possession limit of 30 fish per person).

The new limits were introduced to help manage the growing demands placed on the coastal fish stocks, and focus on the two species warranting special management attention. Golden snapper are believed to be vulnerable to overfishing because they are long-lived and late maturing fish.

Black jewfish form large spatially and temporally predictable aggregations. An extensive body of evidence derived from stocks throughout the tropics indicates that target fishing of aggregations can rapidly deplete fishery stocks.

Future plans

The maintenance of the two for one licence reduction program will continue to contribute to the removal of excess fishing capacity in the commercial fishery. Ensuring that the harvest of coastal fish by all sectors is sustainable remains a primary management objective.

Compliance

The NT Police Marine and Fisheries Enforcement Section undertake compliance-related activities for all fisheries managed by the Northern Territory including the Coastal Line Fishery.

The *Fishwatch* toll-free number has become an increasingly popular mechanism for the public to provide Police with information on suspicious fishing activity. However there have been few reported problems with compliance in this fishery. The major area of concern is the potential for the black market sale of fish by unlicensed fishers.

Consultation, Communication and Education

The Aquatic Resource User Group Forum is the peak advisory body to the Director of Fisheries for this fishery. It comprises representatives from various user groups and Government. The NTSC, Coastal Line Fishermen's Association and AFANT take an active role in the formulation of management policy for this fishery. Additionally, there are a series of regional coastal consultative committees, which provide formal advice from Aboriginal constituents on all aspects of fishing, including coastal species.

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Coastal Net Fishery Status Report 2005

INTRODUCTION

The inshore waters of the Northern Territory host a wealth of fish and shark species. The Coastal Net Fishery, using small mesh nets, harvests coastal species within three nautical miles of the coastline. While over 40 species are utilised, the major commercial species are blue salmon, mullet, queenfish, and shark. Commercial licence holders are not permitted to retain barramundi, threadfin salmon, Spanish mackerel or mud crab. To facilitate the release of any bycatch, coastal net licence operators are required to clear coastal nets and gill nets in not less than 30 cm of water.

Commercial fishing effort in the Coastal Net Fishery is comparatively low, and the number of licences is limited. There are only 14 coastal net licences and further entry to the fishery is closed. Development Fishery coastal net licences may be issued to allow commercial fishing outside of the area designated for the Coastal Net Fishery. Presently, there are two Development Fishery coastal net licences.

Recreational and Indigenous subsistence fishers utilise some of the same species and areas as commercial fishers. There is also a rapidly expanding fishing tourism industry encouraging many people to the Northern Territory each year for the purposes of experiencing our high quality recreational fishing. In areas significant to recreational fishing, such as the Darwin or the Borroloola regions, there has been increased competition for coastal resources.

In May 2000, the former Government announced that the Darwin Harbour and Shoal Bay area would be closed to the Coastal Net Fishery. This proposal was cancelled in December 2002 due to a lack of funds for the buy back of licences and the view that a negotiated restructure would achieve a satisfactory outcome for all stakeholders. Consequently, NT Fisheries is currently reviewing the management arrangements governing the Coastal Net Fishery.

PROFILE OF THE FISHERY

Commercial Sector

Area

The Coastal Net Fishery extends from the highwater mark to three nautical miles from the low water mark. The Coastal Net Fishery is regionalised, with licensees able to fish only the one region nominated on their licence. The Coastal Net Fishery area encompasses:

- the Darwin region (from Cape Hotham to Native Point and Cape Ford to Cape Dooley);
- the Gove region (between Cape Arnhem to Cape Wilberforce);
- the Borroloola region (from Bing Bong Creek to Pelican Spit); and
- other areas approved by the Director of Fisheries.

Development Fishery coastal net licences have been issued for areas near Numayanga and Galiwinku. Some further access restrictions apply due to the presence of Aboriginal sacred sites and protected area reserves.

Fishing method

Coastal Net Fishery licensees are permitted to use a coastal net of no greater than 300 m in length, with a maximum drop of 5 m, and mesh not exceeding 65 mm. Licensees are also permitted to use a cast net with a diameter not greater than 6 m, and mesh not exceeding 25 mm.

Three Coastal Net Fishery licensees are permitted (on the grounds of historical use) to use nets of the same dimensions as coastal nets, but made of mesh up to 100 mm (gill nets).

Catch

The Coastal Net Fishery has averaged 35 tonnes per year since 1997, usually fluctuating between 27 and 32 tonnes per year with a peak of 53.9 tonnes in 2001 (Figure 1). The catch for 2005 was 34.4 tonnes, an increase from the 14.9 tonnes recorded in the previous year. The 2004 catch for the fishery was considered poor and attributed to market influences reducing effort in the fishery.

Over 40 species are utilised in the commercial fishery, with the major target species being blue salmon, mullet, queenfish and shark. Other common species include garfish, snappers, and whiting. As mentioned earlier, commercial licence holders are not permitted to retain barramundi, threadfin salmon, Spanish mackerel or mud crab.

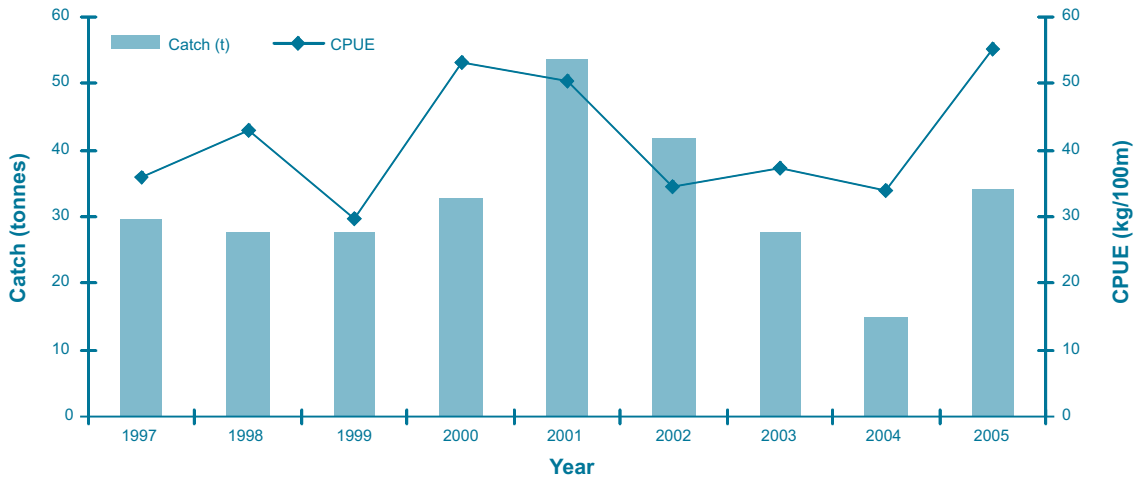

Figure 1. Catch and catch rates for the Coastal Net Fishery, 1997-2005

Effort

In 2005, there were 14 non-transferable fishing licences in the commercial fishery. Only five licenses were active.

Effort is measured as days fished or '100 m net days' (hmnd). One hmnd equals 100 m of net used for one day.

Since 1997, fishing effort in the Coastal Net Fishery has been around 400 days of fishing effort per year and 800 hmnd. The amount of fishing effort in 2005 was 621 hmnd, an increase from the 435 hmnd recorded in 2004. This was due mainly to one active licensee significantly increasing effort since 2004.

Catch rates

The catch rate in the Coastal Net Fishery has averaged 40.1 kg/hmnd since 1997 (Figure 1). The catch rate for 2005 was 55.3 kg/hmnd, a large increase from the 34 kg/hmnd recorded in 2004. As there are few operators in the fishery, the catch rate is highly variable and is affected by the characteristics of the individual fishers operating in the fishery.

Marketing

The majority of fish is sold fresh on ice as fillets, whole or gilled and gutted. Most sales are to local markets close to the port of landing, however there is increasing interest from southern markets.

Recreational Sector

Area

Historically, recreational fishing effort has been centred near Darwin, Gove and Borroloola.

Fishing method

The use of amateur drag nets is popular among some recreational fishers to target small fish and prawns for bait or human consumption.

It is illegal for an amateur drag net to be longer than 16 m in length, have a maximum drop of more than 2 m, or have a mesh size exceeding 28 mm. Additionally, restrictions are placed on the method of use of these nets (e.g. only hand hauling is allowed) and where such nets can be used (e.g. only seaward of the coastline). However, a licence is not required to use such nets for recreational purposes. The NT component of the *National Recreational Fishing Survey*, undertaken in 2000, estimated that recreational fishers spent close to 10,000 hours per year using nets in the Northern Territory.

Catch

Many of the key taxa harvested by the Coastal Net Fishery also form an important component of the recreational fishery of the Northern Territory.

A survey of recreational anglers undertaken in 2000 revealed the importance of snapper (approximately 160,000 individual fish harvested), mullet (approximately 85,000), threadfin salmon (approximately 37,000), and jewfish (approximately 18,000) to the recreational fishing sector. Recreational fishers also harvested an estimated 8,000 sharks and rays.

It is not clear what proportion of this catch was utilised as bait. However the survey indicated that almost half of the recreational line fishing effort in the Northern Territory uses bait.

Fishing Tour Operator Sector

Area

In 2005, FTOs operated throughout the Top End of the Northern Territory but mostly from and around Darwin.

Fishing method

Under the Northern Territory's *Fisheries Regulations*, people conducting fishing tours are required to observe the same rules and regulations as recreational fishers. The level of use of amateur drag nets by this sector is presently negligible.

Catch

The FTO catch by drag net is considered to be negligible.

Indigenous Sector

Area

A large number of Indigenous communities and outstations are scattered along the length of the Northern Territory coastline. Fishing effort is likely to be greatest close to the large Indigenous communities such as those on the Tiwi Islands, Maningrida, Port Keats and Borroloola.

Fishing method

Aboriginal subsistence fishers in the Northern Territory utilise drag nets, cast nets and spears to harvest inshore fish and shark species. Indigenous people in the NT are largely exempt from catch restrictions in regards to the utilisation of aquatic resources when they are harvested for the purpose of traditional or subsistence use.

Catch

It appears that significant overlap occurs among the primary taxa harvested by the Coastal Net Fishery and the Indigenous fishing sector. Based on catch return data submitted by the commercial fishers, and the results of a survey of Indigenous fishing activities conducted in 2000, it was found that mullet are the primary grouping of fish harvested by both sectors. The survey of Indigenous activities identified an annual harvest of 83,000 individual mullet by subsistence fishers in the Northern Territory. The survey provides numbers for several other fish of importance to both fisheries including catfish (60,000), snapper (27,500), shark (12,000 including rays), salmon (8,500) and trevally (8,000).

Non-retained Species (Bycatch)

While the Coastal Net Fishery continues to be centred on the harvest of blue salmon and mullet, increasingly other coastal species are being retained as byproduct. In recent years over 40 different species have been retained.

As mentioned earlier, the *Fisheries Regulations* prohibit coastal net licensees from taking barramundi, threadfin salmon, Spanish mackerel or mud crab under the Coastal Net Licence. As a result, coastal net licence operators are required to clear coastal nets and gill nets in not less than 30 cm of water to facilitate the release of any bycatch.

Threatened species interaction

The *Fisheries Regulations* prohibit the take of aquatic life listed as a protected species under the *Territory Parks and Wildlife Conservation Act 1976*. Listed species inhabiting the waters of the Coastal Net Fishery include dugong, turtles, and crocodiles. The risk of interaction with protected species is managed through the requirement of all coastal net licence operators to remain in attendance of nets set in the water. Operators of coastal nets may only use such gear as a haul or surrounding net, and gill net operators are required to remain within 500 m of the net in use. In 2005, there were no reported interactions with threatened species.

Ecosystem Impact

Small pelagic fish occupy a fundamental niche in aquatic food webs. While there is a lack of information regarding any specific ecosystem impact of the coastal net fishing activities conducted in the Northern Territory, the commercial fishery is likely to have little impact on coastal ecosystems due to the inherent low level of effort. Further, the fishing methods used in the Coastal Net Fishery have negligible physical impact on the benthic environment in which the fishery operates.

Social Impact

Five coastal net licences were active in 2005 presenting nominal employment opportunities. A large proportion of the Northern Territory wild harvest is dedicated to domestic consumption, with the commercial seafood industry supplying products to every major Australian seafood market. Subsistence fishing and recreational fishing continue to form an important component in the lifestyles and culture of a large proportion of people residing in the Northern Territory.

Economic Impact

At the point of first sale in 2005, the catch value from the commercial Coastal Net Fishery was $124,000, up from $50,000 in 2004. The mullet component was $52,000 up from $10,700 recorded in 2004.

While relatively small in overall value, the production from the commercial fishery provides a valuable input to the local fresh food market.

STOCK ASSESSMENT

Monitoring

Under the *Fisheries Act*, Coastal Net Fishery licensees are required to submit monthly records of their catch to NT Fisheries. Fishery dependent monitoring trips were conducted in the initial phases of the fishery when the use of haul nets was still being developed under Special Purpose Permit. Irregular observer trips are conducted and complement data gained from fishery independent studies conducted by NT Fisheries Research.

Stock Assessment Methods and Reliability

No stock assessment has been undertaken on this fishery.

Current Harvest Status

The level of fishing effort in this fishery is low. It is considered that the harvest rate of all sectors is less than the estimated sustainable catch levels for this fishery.

Future Assessment Needs

Further monitoring of the Coastal Net Fishery for species composition and other factors is required.

RESEARCH

Summary to Date

In the initial phases of the fishery, several gear trials were conducted to examine the suitability of various netting methods. Fishery dependent monitoring trips were also conducted in this early stage. More recently a desk-top study on the fishery was completed in 1997.

A Fisheries Research and Development Corporation (FRDC) funded study in the Mud Crab Fishery produced a habitat map of the inshore environment and coastal waters of the entire Northern Territory coastline of relevance to this fishery.

Incorporation into Management

The gear trials provided important information on the different net methods available. In the initial years of the fishery, several changes in the fishing method, such as mesh size and anchoring conditions, were implemented.

Current Research

Currently there is no research underway in the Northern Territory that is directly related to this fishery. The research focusing on barramundi and demersal netting will be of benefit.

MANAGEMENT/GOVERNANCE

Management

Objective

In consultation with stakeholders, the objective is to manage the harvest of aquatic resources by the Coastal Net Fishery in a manner that is sustainable, in line with nationally agreed principles of ecologically sustainable development, and which optimises the benefit to the Territory community.

History

Four experimental special purpose (haul net) licences were issued in 1986. The original intention of these licences was to permit the taking of mullet and blue salmon by haul netting. The number of species harvested, and the fishing methods permitted, progressively expanded in subsequent years. The inception of the Coastal Net Fishery licence came about in 1993 with the introduction of the *Fisheries Regulations*.

In 1992, Coastal Net Fishery licences were made available only to persons who held an existing special purpose (haul net) fishery licence, or a bait fishery licence. At that time, there were four special purpose (haul net) fishery licences (three remain current as Coastal Net Fishery licences), and almost 60 Bait Net Fishery licences (11 remain current as Coastal Net Fishery licences and two as Bait Net Fishery licences).

Following a review of the Coastal Net Fishery undertaken between 1997-1999, the former Government announced in May 2000 that the Darwin Harbour and Shoal Bay area would be closed to the Coastal Net Fishery, and that a commensurate number of licences would be bought back. NT Fisheries are currently reviewing the management arrangements governing the Coastal Net Fishery. The Coastal Net Licensee Committee and the Northern Territory Seafood Council continue to be closely involved in this process.

Current issues

The former proposal to close Darwin Harbour and Shoal Bay to the Coastal Net Fishery was intended to alleviate increasing demands placed upon coastal fish stocks by the various fishing sectors.

This and several other issues identified prior to this proposal, require further examination. These issues centre on the ability of the fishery to operate efficiently while maintaining equitable and sustainable access to fish stocks.

NT Fisheries have responded to industry concerns that the uncertainty regarding the future of the fishery has impeded investment in equipment and market development.

The management needs of the Coastal Net Fishery are currently being reviewed. This review is occurring concurrent with similar reviews of the Bait Net Fishery and Aboriginal coastal licences.

Future plans

It is anticipated the results of the consultation process with the fishery stakeholders regarding the future direction of the fishery will be finalised in 2006.

Compliance

Enforcement activities centred on the fishery are undertaken by the NT Police Marine and Fisheries Enforcement Section.

The Unit has 17 officers who are responsible for providing compliance and education on all fisheries managed by the Northern Territory. Compliance activities include targeting the illegal use of nets by commercial and recreational fishers.

There have been few reported problems with compliance in this fishery. However, as with all small mesh net fisheries, there is an ongoing concern regarding the taking of juvenile fish of managed species such as barramundi and threadfin salmon.

Consultation, Communication and Education

Since the inception of the fishery, NT Fisheries has maintained regular dialogue with the Coastal Net Licensee Committee and the NTSC. Such dialogue is ongoing, and will be central to the review of the fishery, incorporating all stakeholder groups with an interest in the coastal fish stocks and fishery area.

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Demersal Fishery Status Report 2005

INTRODUCTION

The Demersal Fishery is a multi-species dropline and trap fishery operating in waters 15 nautical miles from shore to the outer limit of the Australian Fishing Zone (AFZ). It is managed under the Northern Territory *Fisheries Act 1988*.

The Demersal Fishery targets goldband snapper (*Pristipomoides multidens)*, but also catches significant quantities of red snappers (*Lutjanus malabaricus, L. erythropterus)*, red emperor (*Lutjanus sebae*) and cods (Family Serranidae*)*. The catch is kept on ice and the majority is transported as whole fish to Sydney and Brisbane markets.

Red snappers and red emperors are also taken by the recreational sector. However these are from inshore areas.

Initially, operators in this fishery targeted red snappers, but prices for these species were not high enough to make this fishery economically attractive. In recent years many Timor Reef fishers (who also hold demersal licences) have begun exploring grounds immediately adjacent to the Timor Reef fishery area for goldband snapper. This has led to an expansion of fishing effort in the demersal fishery since 2001 onwards, with the focus on goldband snapper as the target species.

The management arrangements relating to the Demersal Fishery have been assessed by the Australian Government Department of Environment and Heritage against the *Guidelines for the Ecologically Sustainable Management of Fisheries* under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (the EPBC Act). In 2004, the Demersal Fishery received the highest level of export accreditation and as a result is exempt from export regulations under the Act for a period of five years.

Commercial Sector

Area

The Demersal Fishery operates in waters from 15 nautical miles from the coastal baseline to the outer limit of the AFZ, excluding the area of the Timor Reef Fishery (Figure 1).

Within the Demersal Fishery, the majority of fishing effort occurs in areas adjacent to the Timor Reef Fishery.

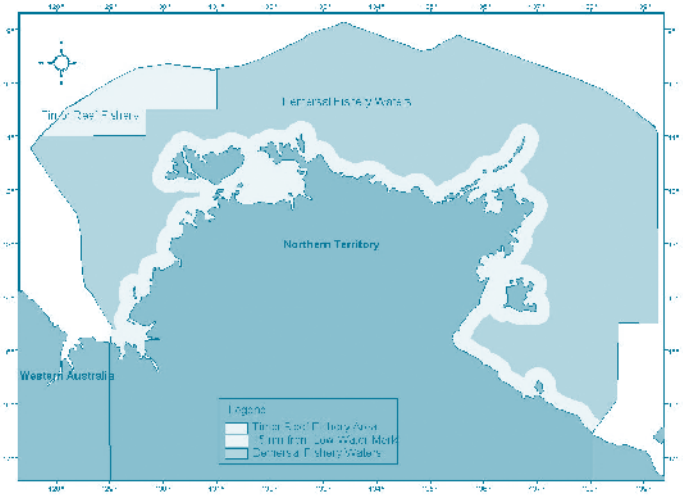

Figure 1. Location of the commercial Demersal Fishery area in 2005

Fishing method

Methods in this fishery are identical to those of the Timor Reef Fishery where operators use either traps or droplines to target goldband snapper. Presently most operators use droplines.

Catch

The principal target species of the Demersal Fishery is goldband snapper, which comprises the three species, *Pristipomoides multidens, P. typus* and *P. filamentosus.* Together these species comprise 67% of the total catch, with *P. multidens* being the most common of the three *Pristipomoides* species. Other major target groups are saddletail snapper (*Lutjanus malabaricus*), red snapper (*L. erythropterus*), red emperor (*Lutjanus sebae*), and cod (Family Serranidae) (Figure 2).

In 2005, the total catch from the Demersal Fishery was 79 tonnes, with the goldband snapper component being 53 tonnes.

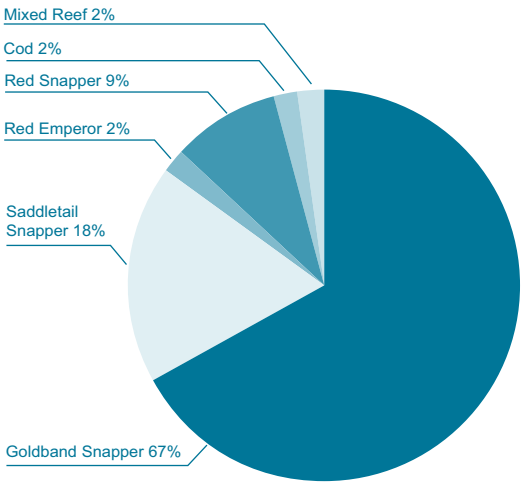

Figure 2. Catch composition of the Demersal Fishery for 2005

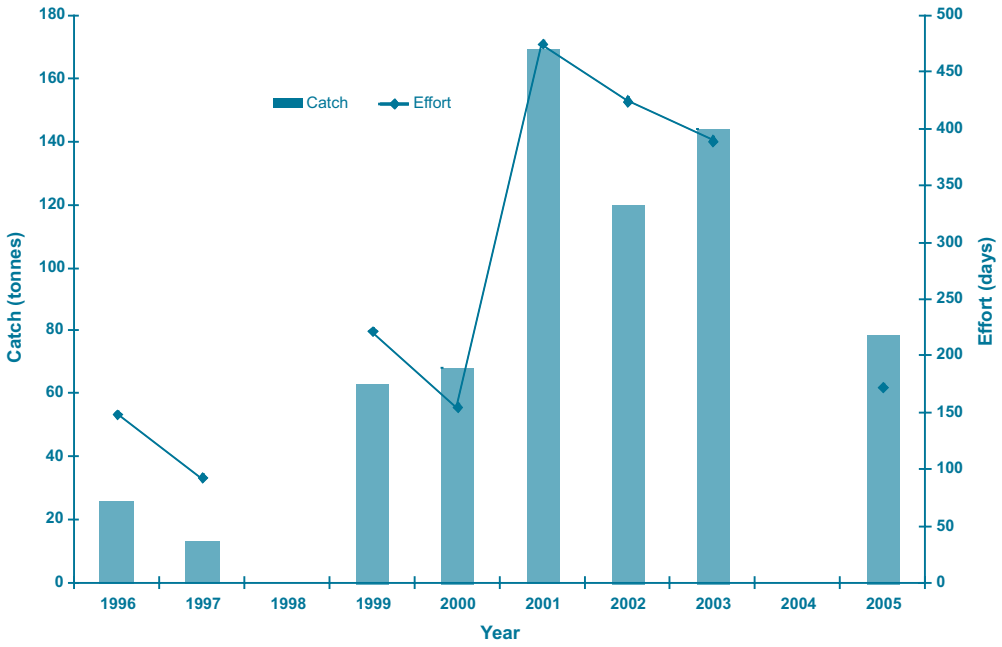

Figure 3. Catch and effort for the commercial Demersal Fishery, 1996 to 2005*

*Note: Due to confidentiality constraints (ie. fewer than five operators working in a single fishery) data collected in 1998 and 2004 has not been published.

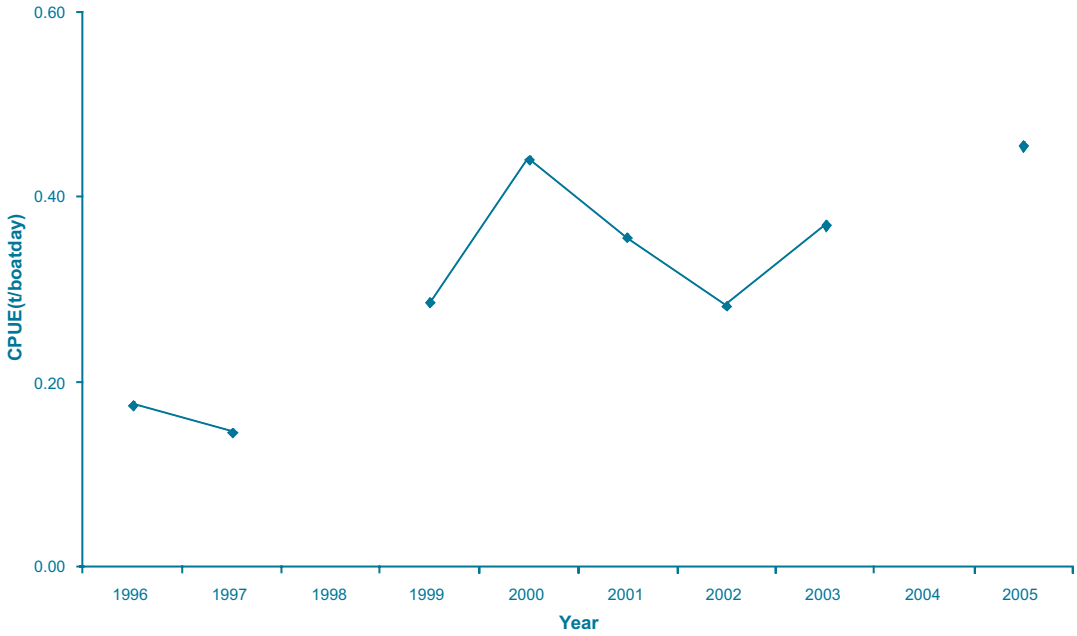

Figure 4. Total CPUE for the commercial Demersal Fishery, 1996 to 2005*

*Note: Due to confidentiality constraints (ie. fewer than five operators working in a single fishery) data collected in 1998 and 2004 has not been published.

Byproduct species

Byproduct catch (mixed reef, cod and red emperor) is well below the 10% trigger value required for a review of management arrangements for the protection of byproduct species.

Effort

During 2005, five operators fished a total of 173 days, which is considerably less than the 390 boat days recorded in 2003.

Catch rates

Catch per unit effort (CPUE) has fluctuated considerably over the history of this fishery. However, this is probably a reflection of the small number of operators and small amount of fishing activity rather than changes in abundance.

Marketing

Currently all fish landed within the line and trap fisheries are sold “fresh on ice” as whole fish, with only a small amount sold as fillets. Due to the small local Darwin market most product is forwarded to interstate markets, principally Brisbane and Sydney. Increasingly, operators are developing marketing arrangements outside the wholesale central interstate marketing systems.

Recreational Sector

Recreational fishers catch some of the same species, particularly red snappers and red emperor, from inshore waters. However, the overall impact on the offshore commercial fishery is considered negligible.

Fishing Tour Operator Sector

Very few Fishing Tour Operators (FTOs) are active in the offshore Demersal Fishery areas, and therefore their activities are not considered to impact on the commercial fishery catch.

Non-retained Species

No monitoring trips were conducted in the Demersal Fishery during 2005, however, due to it’s similarity to the Timor Reef Fishery, the same assumptions have been made about the levels of non-retained species, i.e. levels of <7%.

Non-retained species include chinaman fish (*Symphorus nematophorus*), red sea bass (*Lutjanus bohar*), big eye trevally (*Caranx sexfasciatus)*, and starry triggerfish (*Abalistes stellatus).*

Bycatch in this fishery is well below the 10% trigger value.

Threatened species interaction

In 2005, there was no recorded interaction with threatened species in the Demersal Fishery. The method of fishing and the location of the fishery generally prevent the interaction with these species.

Ecosystem Impact

The management arrangements for the fishery allow operators to use passive vertical lines and traps. The effect of setting and hauling traps on substrate and bottom fauna is unknown. Anchoring is usually limited to overnight stand down of fishing activity.

The impact of “ghost fishing”, i.e. the continued fishing of lost traps, is not considered to be significant in terms of either its impact or occurrence. Underwater video observation of traps during commercial fishing operations throughout northern Australia has shown the entry and exit of fish from the traps used in the Demersal Fishery.

Social Impact

The commercial fishery directly employs fewer than 20 people as crew on boats, and numerous people through other Industries, e.g. transport, boat repairs etc. However recreational fishing targets some of these demersal species and forms an important component in the lifestyles and culture of a large proportion of people residing in the Northern Territory.

Economic Impact

In 2005 there were five active operators in this fishery. It is the policy of the NT Fisheries that information obtained from a fishery with fewer than five active operators will not be released without prior consent from the licensee(s). As a result, the 1998 and 2004 catch value for the fishery remains confidential. The 2005 catch value was $0.49 million.

STOCK ASSESSMENT

Monitoring

This fishery is monitored primarily through logbooks, which operators are required to fill out on a daily basis during fishing operations. These logs provide detailed catch and effort information, as well as information on the spatial distribution of the fishery. Logbooks are submitted with monthly marketing information by the 28th day of the following month.

No monitoring trips were conducted in the Demersal Fishery during 2005, as there was insufficient room on the commercial boats to accommodate a Fisheries officer. However due to the similarity of methods, fishing grounds and catch composition of this fishery with the Timor Reef Fishery, it is felt that observer information from the Timor Reef Fishery adequately covers the Demersal Fishery, especially given the low level of fishing activity.

Stock Assessment Methods and Reliability

Stock assessment for goldband snapper has been combined for both the Demersal and Timor Reef fisheries. This is because 95% of fishing effort undertaken in the Demersal Fishery occurs on grounds adjacent to the Timor Reef Fishery, which encompass the same goldband snapper stocks.

Current Harvest Status

Most recent stock assessments of tropical snappers in relation to sustainable harvest levels indicate that current catch levels in the Australian sector of the Arafura Sea are below triggers set for a review of management arrangements.

Future Assessment Needs

Future assessment needs to concentrate on the degree of movement of both goldband and red snappers between Australia and Indonesia, the identification of juvenile snapper habitats and, obtaining more accurate growth parameters from the capture of juvenile snapper.

RESEARCH

Summary to Date

The stock structure of goldband snapper (*P. multidens*) has been determined through a number of externally funded projects.

The FRDC funded projects 1996/131; 1998/154, were collaborative efforts between NT DPIFM, WA Department of Fisheries and QDPI. These studies used mitochondrial DNA and otolith microchemistry techniques to determine the stock structure of *P. multidens* resources between the Northern Territory and Western Australia. Opportunistic samples were obtained from Kupang (Indonesia). Both studies used fish from the same sites.

The genetic study showed no differences between Australian sampling sites in the Timor and Arafura Seas, but a significant difference in the Timor Sea between Kupang (West Timor) and the north-west Australian site less than 200 nautical miles on either side of the Timor Trench. Otolith microchemistry revealed distinct populations for all sites sampled, indicating that substantial movement of adults between sites is unlikely (Newman et al., 2000).

Growth and reproductive studies were undertaken on *P. multidens,* as part of the collaborative ACIAR funded project between Australia and Indonesia (FIS/1997/165). This study provided updated stock assessment parameters which were incorporated into stock assessment models for the current assessment.

Incorporation into Management

The recent research findings have confirmed the validity of present management arrangements for this fishery between the Northern Territory, Queensland and Indonesia.

Current Research

Current research is focused on developing a holistic approach to fisheries management using Geospatial statistics and fuzzy logic rule-based modelling. This work, funded by FRDC (project 2005/047), explores new ways of incorporating the very diverse forms of physical and environmental data (often on different spatial scales), with catch and effort data from the Timor Reef Fishery. The project will enable us to analyse the many components that may affect fish abundance and catchability in a geo-referenced framework. The fuzzy rule-based modeling allows the uncertainties of human knowledge to be captured as hard data. This work is expected to be completed in 2007.

MANAGEMENT/GOVERNANCE

Management

Objective

Management arrangements for the Demersal Fishery seek to maintain catches of goldband snapper and red snappers by all sectors within acceptable ranges. Red snappers are also a target species of the Finfish Trawl Fishery. Should landings of goldband snapper from the Timor and Arafura Seas rise above sustainable yield estimates, a review of the management arrangements will commence. Similarly, a significant decline in catch rates would prompt a review of the management measures for this fishery (see Table 1).

History

With the passage of the revised jurisdictional arrangements contained in the Offshore Constitutional Settlement (OCS) of 1988, management responsibility for line fishing and trapping in waters adjacent to the Northern Territory passed to the Northern Territory Government from the Commonwealth.

In 1993, the area of the Timor Reef Fishery was annexed from the demersal fishery and the inshore boundary was altered to separate the Demersal Fishery from the inshore coastal line fishery. All operators who had previously held a fishing entitlement to this area were issued a demersal licence if they did not already hold such an entitlement.

A further revision of the jurisdictional arrangements occurred in 1995. At that time, management responsibility for the Demersal Fishery was passed to the Northern Territory Fisheries Joint Authority (NTFJA).

The NTFJA provided for the Commonwealth and the Northern Territory to jointly manage the fishery given the likelihood of shared resources with adjacent national and international jurisdictions.

Under this arrangement, NT Fisheries undertakes day to day management of the Timor Reef, on behalf of the NTFJA.

Current issues

Encouraging further development of this under-utilised fishery and encouraging operators to undertake fishing throughout the entire fishery area continue to be the key objectives for industry and government.

The impacts of Illegal, Unreported and Unregulated (IUU) fishing in northern Australian waters, primarily by foreign fishers are poorly understood. The NT government continues to lobby the Federal Government to ensure adequate resources are allocated by the Australian Government (governing body is the Australian Fisheries Management Authority) to mitigate IUU impacts on the sustainability of red snapper stocks.

While it is accepted that most IUU fishers are primarily targeting sharks, apprehended vessels holding significant quantities of red snapper are becoming more prevalent. Research to determine the probable impact this illegal foreign presence is having on domestic shark and snapper stocks is continuing with AFMA funding a number of projects attempting to determine the species and volumes of sharks and snappers being harvested. It is not yet possible to determine the potential effect IUU fishing is having on the tightly regulated domestic Demersal Fishery.

Future plans

NT Fisheries, in consultation with industry has held a series of workshops to develop a sectorial development plan for offshore snappers. The levels of permitted gear (hand and drop lines) will be incorporated into discussions with industry over the development plan for the combined offshore snapper fisheries.

Fishers in the Demersal Fishery share the same offshore snapper stocks with the Finfish Trawl Fishery and operators from both fisheries are involved in discussions to develop the shared resource. Discussions held so far have indicated a conservative development plan for the offshore snapper resource. Fisheries sharing the offshore snapper resource in the Arafura Sea have sought to introduce an additional finfish trawl licence to increase resource utilisation, particularly in the more remote regions.

Other issues discussed by industry have been long term protection of the deepwater goldband snapper habitat areas from potential finfish trawl gear damage and the re-allocation of potential red snapper catch from the Demersal Fishery to the Finfish Trawl Fishery to avoid any potential for future catch conflicts to ensure the on-going sustainability of red snappers.

The management arrangements relating to the Demersal Fishery have been assessed against the *Guidelines for the Ecologically Sustainable Management of Fisheries* under the EPBC Act.

The fishery has received the highest level of accreditation and thus declared exempt from export regulations under the EPBC Act for five years.

The NT and Australian Governments are working closely with the Indonesian Government to develop a bilateral Management Plan for red snapper shared stocks in the Arafura Sea.

Compliance

Compliance with the Demersal Fishery management arrangements are undertaken by the Police, Marine and Fisheries Enforcement Section (PMFES) of the NT Police and Fire and Emergency Services, under the Northern Territory *Fisheries Act 1988.*

The PMFES effectively monitors and enforces the demersal fishery management arrangements through the inspection of vessel arrivals and departures through the single port of Darwin. This includes verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product). The PMFES has the power, if necessary, to investigate the records of wholesalers and licensees if necessary.

In 2005, there were no recorded compliance issues for the domestic fishery.

Consultation, Communication and Education

Regular consultation occurs between NT Fisheries, the NT Demersal Fishermen's Association and the NTSC. In addition, NT Fisheries staff make regular visits to the wharf to speak informally with fishers.

The low levels of participation in the Demersal Fishery allow all stakeholders to be directly involved in discussions on any proposed management arrangements. A framework for a Demersal Fishery Management Advisory Committee has been developed to formally represent the interests of all stakeholders and provide a forum for any proposed amendments to the management regime.

Conservation groups and non-government organisations are advised and consulted on topical fisheries issues, including the Demersal Fishery, through monthly advisory meetings with senior fisheries officers and the Executive Director of Fisheries. Members of the public, including community and environmental / conservation groups, are also invited to provide their views to NT Fisheries through the release of public discussion papers and other consultative processes.

NT Fisheries also puts out publications in the form of Fisheries reports and newsletters to inform and educate stakeholders.

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Table - Management objectives, performance indicators, trigger points and management actions used in the Demersal Fishery

Species or Group	Management objectives	Performance indicator	Trigger reference point	Management response to be taken
Goldband snappers	Ensure inter-generational equity by maintaining ecologically sustainable annual catches in all sectors. Optimal sustainable yield estimates.	Optimal sustainable yield estimates.	Catch levels increase to 90% of estimated sustainable annual yield.	DFMAC to review fishery and make recommendations to the Director of Fisheries regarding appropriate measures to ensure annual catches do not exceed estimated sustainable yields and onboard monitoring if not already in place, to commence at earliest practical opportunity.
Red snappers				
Red emperor		Significant change in catch composition on demersal fishery grounds.	Annual catch increase in proportion of the total catch by greater than 10% above the 5 year average.	DFMAC to review fishery and make recommendations to the Director of Fisheries and onboard monitoring to commence at earliest practical opportunity.
Cods				
Byproduct species	Ensure sustainability of byproduct species taken in the demersal fishery.	Monitoring of commercial logbook returns.	Annual catch increase in proportion of the total catch by greater than 10% above the 5 year average.	
Bycatch species	Ensure sustainability of bycatch species taken in the demersal fishery.	Onboard monitoring of Timor Reef fishery.	Total bycatch within the demersal fishery increases to 10% of total catch or a decline in a species relative numbers without a corresponding change in fishing area or fishing technique.	DFMAC to make recommendations to Director of Fisheries regarding appropriate remedial action and onboard monitoring to commence at earliest practical opportunity.
Endangered, threatened or protected species and/or communities	Maintain present level of interaction between demersal fishing operations and species and communities listed under the *EPBC Act 1999*.	Endangered, threatened or protected species and or communities are identified in Northern Territory waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC listed species or communities.	DFMAC to make recommendations to Director of Fisheries regarding appropriate threat abatement plan implemented and onboard monitoring to commence at earliest practical opportunity.
Ecosystem components	Minimise effects on ecosystem components.	Identification of threatening processes.	Identification of significant negative interaction with components of the natural ecosystem present on demersal fishing grounds.	DFMAC to make recommendations to Director of Fisheries regarding appropriate remedial action.

Development Fisheries Status Report 2005

INTRODUCTION

The commercial fishing industry is characterised by constantly evolving technologies and changing market opportunities. To conduct trials of new fishing gear, or to encourage sustainable harvest of aquatic resources not utilised by existing fisheries, commercial fishers may be issued with development permits or licences. Such trials are termed Development Fisheries.

Fishers who wish to conduct trials are required to lodge written applications providing detailed information about their proposed activities. The Northern Territory Fisheries Development Opportunities Committee (NTFDOC) reviews all applications.

Approved applications are issued with a development permit valid for the licensing year commencing in July. Performance criteria are assigned to each permit so that the feasibility of a potential commercial fishery may be demonstrated. Permit holders who have satisfied all aspects of the performance criteria may apply for a development licence.

Development licences may be issued to approved applicants for up to one licensing year and may be renewed a maximum of four times. Applicants must meet all performance criteria within the term of each licensing year if they wish the NTFDOC to consider recommending the upgrade of a development fishery to a managed fishery. Administration of the development fisheries is guided by the *Policy for the Appraisal and Administration of Northern Territory Development Fishery Applications.*

PROFILE OF THE FISHERY

Commercial Sector

Area

A development permit or licence may be issued to a fisher to conduct fishing trials targeting a resource not already targeted by a managed fishery or a resource outside the boundary of an existing fishery. Within the area of an existing fishery, a development permit or licence may be issued for the purpose of trialling new fishing gear or methods. Fishers are required to declare the proposed fishing area in their application, and this is incorporated into the conditions of the permit or licence.

Development trials may be permitted to occur only in specific areas requested, as in the case of previous skimmer net trials, or may be granted widespread access to Northern Territory waters, as in the case of the squid and bait fish permits. Generally, the boundaries of a development fishery will replicate relevant existing fisheries, and will also incorporate restrictions where Aboriginal sacred sites and protected area reserves exist.

Fishing method

In 2005, a number of different development permits were issued. These included blue swimmer crabs, tropical rock lobster, sponge, sea urchins, octopus, trepang, squid, and skimmer net.

Two permits were issued to trial the use of deepwater longlines in part of the Demersal Fishery. A deepwater longline is a line anchored to the seabed at both ends, with branch lines set at intervals to which hooks or sets of hooks are attached.

Five permits were issued to trial the harvest of rock lobsters, sea urchins or sponges using scuba or hookah gear and hand held implements. Two permits were also issued to trial the use of crab pots to harvest blue swimmer crabs or deep water crabs.

One permit was issued to trial the harvest of octopus using traps in either single or multiple configurations. An octopus trap has a single opening, and must be constructed of material that can not entangle aquatic life.

Two permits were issued to trial the harvest of trepang in areas outside of the current Trepang Fishery. The gear permitted was the same as that for the Trepang Fishery (eg. hookah and handheld implements).

Two permits were approved to trial the harvest of squid and bait fish using a lift net. A lift net is a horizontal net that is lowered to the bottom, left, and then lifted rapidly to the surface. One permit was also issued to trial the use of a small purse-seine net for harvest of the same resources. The purse-seine method of fishing involves surrounding a school of fish with a wall of net and then pulling the bottom together to form a purse or pouch around the fish. This differs from a skimmer net, or a push net, that is attached to the bow of a small manoeuvrable vessel and is used to fish the upper metre of the water column. One permit was issued to harvest either sergestid shrimp of the genus Acetes or aquarium fish species.

Catch

Due to the low number of operators in each development fishery, confidentiality constraints prohibit the release of catch information. This is because NT Fisheries has a policy precluding the release of catch information from those individual fisheries with fewer than five active operators, without the consent of all licensees and/or permit holders.

Effort

See above.

Catch rates

See above.

Marketing

Development permits are issued to assess both the sustainability and economic feasibility of new commercial fishing activity. During the initial trials, the market acceptance and potential is investigated. Only if it can be demonstrated that the product of the development fishery is commercially viable, will a trial progress to the next stage.

Recreational Sector

It appears that there is negligible overlap of the aquatic resources currently utilised by the Development Fisheries and the recreational fishing sector. Recreational catch data gathered during the National Recreational Fishing Survey conducted during 2000-2001, revealed no significant conflict between the two sectors.

Fishing Tour Operator Sector

There is little overlap in terms of the resources utilised by the Development Fisheries and the Fishing Tour Operators (FTOs). It is possible that FTOs may occasionally utilise squid and bait fish stocks, however it is unlikely that present catch levels in the development fishery will impact on their operations.

Indigenous Sector

There is little overlap in terms of the resources utilised by the Development Fisheries and the Indigenous subsistence fishing sector. The National Indigenous Fishing Survey – Northern Territory conducted during 2000 and 2001, indicated that there is little conflict between the Indigenous fishing sector and the current development fisheries.

Non-retained Species (Bycatch)

Development permit and licences holders were not required to record details of non-retained species in 2005. Based on additional information provided by the permit holders, and on the reports of the observers, it appears the skimmer net presents little risk to bycatch, while the squid operation retention of byproduct species is to be refined.

Threatened species interaction

In 2005, there were no reported interactions with threatened species.

Ecosystem Impact

A major consideration in the assessment of new applications for a development permit or licence is the impact of the development activity on the ecosystem. All applications are considered on the premise of the precautionary principle to provide the greatest care to the environment in which the trials are conducted.

The appropriateness of the equipment and methods are governed by the conditions of the permit or licence. These may include restrictions on the type of gear permitted, the time and place in which trials may occur, and limits on the target and bycatch species. Formal performance criteria are applied to all development permits and licences, and these must be achieved for the trials to continue.

Social Impact

The social impact of the Development Fishery is incorporated into the assessment of new applications and progress of current permits and licences. If a development permit application is considered to present a significant impact on other user groups, the application will be forwarded to the relevant representative bodies for advice. If a development licence is deemed to present potential for conflict with other stakeholders, an information paper may be circulated to the relevant representative bodies.

Economic Impact

Development permits and licences provide the means for fishers to trial more efficient gear or new market opportunities. The economic potential or impact of the Development Fishery is incorporated into the assessment of new applications and progress of current permits

and licences. The value of these fisheries is confidential. As indicated earlier, information from less than five active operators within a fishery will not be released without seeking prior consent of all licensees/permit holders.

STOCK ASSESSMENT

Monitoring

Permit and licence holders are required to provide records of the daily catch, and may be required to accommodate observers on board their vessel to assess the development fishery. The NTFDOC annually reviews the logbook returns and observer reports for each of the development fisheries.

Stock Assessment Methods and Reliability

At any stage, if the NTFDOC requires more information about the proposed fishery in order to make a decision, the NTFDOC may seek a report on the resource. NT Fisheries may then coordinate research and provide a report to the NTFDOC for their consideration at the next scheduled meeting. Alternatively, the applicant may be requested to supply or resource an appropriate report. No stock assessments have been conducted to date.

Current Harvest Status

Catches in the Development Fisheries in 2005 were below the maximum harvest levels specified in the permit conditions. A precautionary approach was applied to the setting of the maximum harvest levels of the developing fisheries. The initial yields are set at a low level of harvest rate so as not to present adverse impacts on the environment in which the Development Fishery operates. The total allowable catch may be increased as more information on the sustainability of the fishing activity is gained.

Future Assessment Needs

If the NTFDOC deems it necessary to complete research whilst the fishery is in its development stage, the cost of the research will be divided equally amongst applicants of that Development Fishery to a maximum of $1,000 per applicant per licensing year.

If further research is required before the NTFDOC will make a decision on the transformation of a Development Fishery to a managed fishery, generally the cost shall be borne entirely and equally by the applicants of that Development Fishery.

RESEARCH

Summary to Date

The establishment of a managed fishery requires informed decision-making based on advice on the status of target stocks and the impact on the aquatic ecosystem as a whole. Information of this nature has been gained through the reports of independent observers. Such reports have been produced on the skimmer net trials and squid harvesting activities. There are no other studies underway in the Northern Territory that are related to the current Development Fisheries.

Incorporation into Management

Development trials will only progress to the next stage where the development permit or licence holder is able to demonstrate that the trials are both ecologically and economically viable.

Current Research

At the request of the NTFDOC, NT Fisheries has conducted a desktop study of the development options for harvesting squid and bait fish. The results of this study form the basis of the current review of this development fishery.

MANAGEMENT/GOVERNANCE

Management

Objective

The *Policy for the Appraisal and Administration of Northern Territory Development Fishery Applications* aims to encourage the development of new fisheries and new fishing gear through ecologically sustainable development, ensuring that aquatic resources are properly utilised now and preserved for the future.

History

The NTFDOC (formerly the Ministerial Committee on Northern Territory Fisheries Development Opportunities) was founded in September 1998. The NTFDOC was formed to streamline the

assessment of applications for development trials. The NTFDOC is required to provide informed, impartial recommendations to the Executive Director of Fisheries and the Minister for Primary Industry, Fisheries and Mines about the issuance of development permits or licences.

The NTFDOC comprises an independent chair, a commercial fishing representative, a recreational fishing representative and a member of NT Fisheries. The NTFDOC Charter dictates the principles governing the NTFDOC.

In 2001, the *Policy for the Appraisal and Administration of Northern Territory Development Fishery Applications* was released. Within this document, details are provided of the policies endorsed by the NTFDOC following the assessment of previous applications. Applications reviewed have focused on pelagic fish, jellyfish, squid, octopus, crabs, crayfish, prawns, mussels, corals and shells. Harvest methods assessed have included a variety of nets, pots and lines.

The NTFDOC meets annually in February so that development permits and licences may be issued in the new licensing year commencing in July. Sections 11 and 17 of the Northern Territory *Fisheries Act 1988* provide for the issue of development permits and licences. The granting of a development permit or licence does not guarantee access to a resource or fishing method that advances to a managed fishery. However, history accumulated in the development fishery will be taken into account when determining access.

Current issues

The 2005 annual meeting of the Northern Territory Fisheries Development Opportunities Committee (NTFDOC) highlighted the need for:

- a review of the issues pertaining to the harvest of tropical rock lobster resources in the Northern Territory; and
- a review of observer cost recovery in Development Fishery trials.

Future plans

The NTFDOC undertakes regular reviews of the *Policy for the Appraisal and Administration of Northern Territory Development Fishery Applications*, with the last comprehensive review undertaken in 2004. Further, it is required to provide advice on amendments to the Northern Territory *Fisheries Act 1988* or the *Fisheries Regulations* 1993.

Compliance

Compliance and enforcement activities are undertaken by the NT Police Marine and Fisheries Enforcement Section. The Section has 17 officers who are responsible for providing compliance and education on all fisheries managed by the Northern Territory.

While the novel technologies of Development Fisheries continue to draw the attention of the general public, there have been no reported problems with compliance in any of the Development Fisheries operating in 2005.

Consultation, Communication and Education

NT Fisheries provide an Executive Officer to the NTFDOC. It is the role of this position to facilitate the application and assessment process, and coordinate the daily administration of the development fisheries. The Executive Officer, together with the Northern Territory Seafood Council, is available to provide assistance to fishers in regards to their applications and development activities.

Development permit and licence applicants are invited to attend the annual meeting of the NTFDOC, providing the opportunity to present additional details of a particular development project. Regular dialogue with permit and licence holders is maintained, and all permit holders are required to submit a progress report six months from the issuance of the permit.

Prepared by

Patti Kuhl – Aquatic Resource Manager

Finfish Trawl Fishery Status Report 2005

INTRODUCTION

The trawl fishery was intensively fished by Thai and Taiwanese pair trawlers during the 1970s. Foreign fleets continued fishing, under licence agreements, following the ratification of the Australian Fishing Zone (AFZ) in November 1979. Taiwanese pair trawlers (1979-1990), Thai - Australian stern trawlers (1985-90) and Chinese pair trawlers (1989) operated in AFZ waters adjacent to the Northern Territory. In 1983, overall catches peaked at around 10,000 tonnes from the Arafura Sea.

Today the Finfish Trawl Fishery is comprised of a single finfish trawl operator fishing in offshore waters east of Darwin and includes the northern region of the Gulf of Carpentaria. The fishery is co-managed under the legislative framework of the Northern Territory *Fisheries Act 1988*.

The principal species landed are red *snappers (Lutjanus malabaricus* and *L.erythropterus*). Around 70% of the landed catch is sold in interstate markets.

The Finfish Trawl Fishery has received the highest level of export accreditation against the *Guidelines for the Sustainable Management of Fisheries* under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (the EPBC Act). The Finfish Trawl Fishery is exempt from export regulations for five years in recognition of the Australian Government finding the fishery to be operating in a sustainable manner.

PROFILE OF THE FISHERY

Commercial Sector

Area

The Finfish Trawl Fishery operates in waters east of Darwin to the outer limit of the AFZ, excluding the area of the Timor Reef Fishery (Figure 1).

Within this overall area, only a relatively small portion is currently fished due to the single operator targeting the higher yield red snapper fishing grounds. Although legally able, the Finfish Trawl operator does not presently fish the same grounds as the Demersal Fishery licensees.

Fishing method

This fishery has been limited to a single trawl operator. Fishing operations are conducted using a semi-pelagic demersal trawl. This trawl net was developed cooperatively by industry and NT Fisheries to minimise habitat disturbance whilst ensuring commercial catch rates were maintained. The quality of the retained catch was also improved by the reduction in the number of sponges and other unwanted species associated with the operations of traditional demersal trawls.

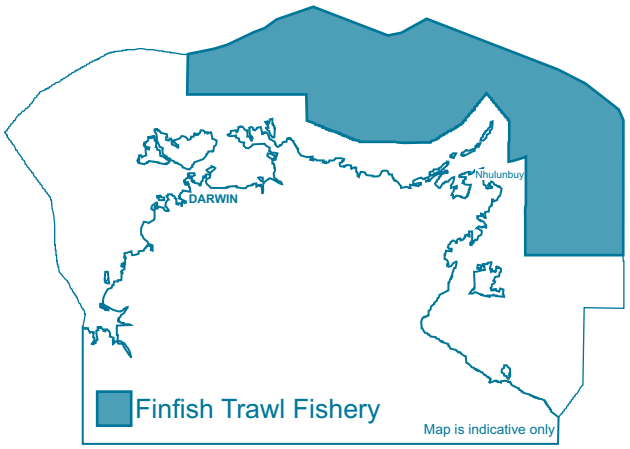

Figure 1. Fishing area available to the commercial Finfish Trawl Fishery

Catch

Target species saddletail snapper (*Lutjanus malabaricus*) and red snapper (*Lutjanus erythropterus*) are the target species of the Finfish Trawl Fishery, comprising 82% of the total catch (Figure 2).

Since 1995, catches have increased steadily, peaking in 2001 (Figure 3). In 2005, the catch was 814.4 tonnes. As there is only one operator in this fishery, care must be taken in interpreting catch trends as they may reflect business decisions rather than fishery trends.

In 2005, byproduct species was 150.4 tonnes. These species include primarily goldband snappers (*Pristipomoides multidens* and *P. typus*), red spot (*L. lentjan*), and painted sweetlip (*Diagramma pictum*).

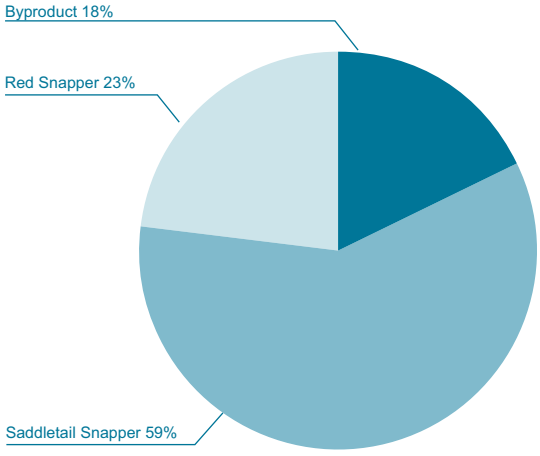

Figure 2. Catch composition for the Finfish Trawl Fishery, 2005

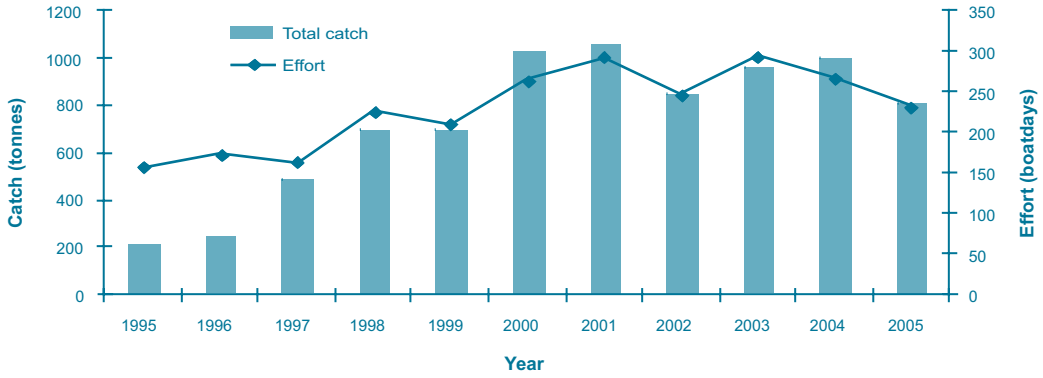

Figure 3. Total catch and effort within the Finfish Trawl Fishery, 1995-2005

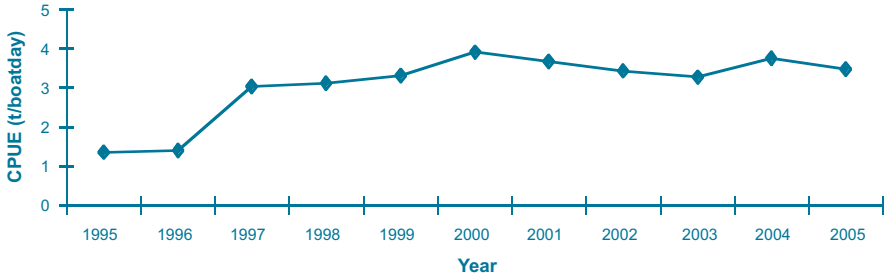

Figure 4. CPUE for the Finfish Trawl Fishery, 1995-2005

Effort

Effort has increased steadily from 158 boatdays in 1995 to 292 boatdays in 2001. During 2005 effort was 233 boatdays (Figure 3). However as there is only one operator, care should be used in interpreting any trends in this fishery based on effort, as there are many reasons for any changes in fishing effort.

Catch rates

Since 1997 the CPUE has shown little change, ranging from 3.0 to 3.9 tonnes per boat day (Figure 4). CPUE for 2005 was 3.5 tonnes/boat day.

Marketing

As 90% of product is sold in Australia, it is transported from Darwin as fresh fish in refrigerated trucks. A small portion is sold in Darwin. About 10% is sold to export markets (5% frozen to Asia and 5% fresh to the US).

Recreational Sector

Recreational fishers take some of these species, particularly saddletail snapper, red snapper and red emperor from inshore waters, however their impact on the offshore commercial fishery is considered negligible.

Fishing Tour Operator Sector

The majority of FTO activity is in inshore waters where some of the same species are taken.

Non-retained Species (Bycatch)

For the commercial Finfish Trawl Fishery, only 19% of the total catch is discarded. High proportions of discarded species (by weight) are sharks and rays (as there is a 'no-take' regulation in place with regard to these species). To assist in vastly reducing release mortality the operator has developed a system comprising grids and rails on the fish hopper to enable sharks and rays to be returned to the water via a chute alive and in a timely manner. This system is being evaluated by other trawl fisheries interstate with the intention of incorporating its use as standard operating practice.

Threatened species interaction

In 2005, there was no recorded interaction with threatened species in the Finfish Trawl Fishery. The method of fishing and the location of the fishery generally prevents the interaction with these species.

Ecosystem Impact

NT Fisheries has encouraged fishing practices that cause minimal ecosystem impact. The development, in conjunction with industry, of a semi-pelagic demersal trawl net that minimises sea bed disturbance and reduces the amount of bycatch was important in reducing the environmental impact of this fishery.

Social Impact

This fishery directly employs fewer than 10 people. However, there are flow-on benefits from the fishery for other industries (eg. freight haulage and vessel repairs). Recreational fishers also target some of these species (within coastal waters) and recreational fishing forms an important component of the lifestyles and culture of a large proportion of people residing in the Northern Territory.

Economic Impact

The value of this particular fishery (one operator only) is confidential. It is the policy of NT Fisheries that information obtained from a fishery with fewer than five active operators will not be released without prior consent from the licensee(s).

STOCK ASSESSMENT

Monitoring

Due to resource constraints in 2005, only one monitoring trip was conducted in the calendar year. While on-board, observers document vessel and gear information, location and depth fished, fishing practices, catch composition, and measure landed species.

Stock Assessment Methods and Reliability

Stock assessments for the Finfish Trawl Fishery were undertaken in 1996 and 2004. The initial assessment used a Stock Reduction Analysis model developed by Prof Carl Walters (1996). The more recent assessment, Yield per Recruit and Biomass Dynamics models, incorporated updated biological parameters.

An absolute figure cannot be placed on sustainable harvest, because key parameters (Indonesian catch and effort, and level of interchange of fish and recruits, and the important productivity parameters for red snapper) are not known. However for the Australian sector of this fishery, the biomass of red snappers has been estimated from a fishery independent survey in 1990 to be 24,000 tonnes. It has been agreed that a trigger point be implemented for management purposes if harvest levels exceed 10 % of the estimated biomass.

Genetic studies undertaken as part of an ACIAR project (FIS/1997/165) indicate that red snapper (*L. erythropterus*) and saddletail snapper (*L. malabaricus*) stocks are shared with Indonesia in the Arafura Sea (Salini et al. submitted).

Current Harvest Status

The high level of Indonesian trawl fishing in the Arafura Sea adjacent to the AFZ does not necessarily imply that the Australian sector is unsustainable. The question of sustainability of the Australian sector of this fishery depends on where recruitment occurs and the level of movement of fish between the two countries. If movement rates of red snapper between Indonesia and Australia are low, and there is good recruitment to the Australian fishery from nursery areas within Australia, then the effect of large scale Indonesian fishing may be small. However if recruitment was primarily from Indonesia and movement rates between sectors high, then the effect would be more significant.

In the past five years CPUE has remained relatively constant (Figure 4) and harvest levels in the Australian sector of the Arafura Sea are below current reference points.

Future Assessment Needs

Future assessment needs to concentrate on the degree of movement of red snappers between Australia and Indonesia to resolve whether Australia is acting as a donor of red snappers to Indonesia. Identification of juvenile habitats and where recruitment occurs is also important.

Previous stock assessment models have used the 1990 trawl survey biomass estimates as a base. This estimate is now 15 years old and an upgraded stock assessment which incorporates current biomass estimates is required.

Modelling needs to be undertaken to investigate different scenarios (using alternative spatial dynamics) for the fishery, as well as exploring the use of alternative management responses.

RESEARCH

Summary to Date

A joint project between NT Fisheries, CSIRO and Indonesia (funded by ACIAR) has investigated the biology, life history and sustainability of the target species for this fishery (*Lutjanus malabaricus, L. erythropterus*) which account for 82% of the Finfish Trawl Fishery catch. Findings from this project are outlined in the final report of ACIAR project FIS/1997/165 (available on the ACIAR website, http://www.aciar.gov.au).

Incorporation into Management

Stock assessment findings have been incorporated into management plans, ensuring that trigger points are set within sustainable limits for the Australian sector of these stocks.

Current Research

Research is presently being undertaken to identify juvenile red snapper grounds.

MANAGEMENT/GOVERNANCE

Management

Objective

Management of the Finfish Trawl Fishery seeks to ensure the ecological sustainability of target, byproduct and bycatch species. The objectives aim to ensure that overall landings of these species are maintained within acceptable levels.

Trigger points and management actions for the Finfish Trawl Fishery are listed in Table 1. An appropriate management response would be made in consultation with stakeholder groups should a trigger point be reached. Amended arrangements are to be implemented within 12 months of a trigger being activated.

History

With the passage of the revised jurisdictional arrangements contained in the Offshore Constitutional Settlement (OCS) of 1995, management of the trawl, shark and line fishing and trapping in waters adjacent to the Northern Territory passed to the Northern Territory Fisheries Joint Authority (NTFJA).

The NTFJA provides for the Commonwealth and the Northern Territory to jointly manage the fishery given the likelihood of shared resources with adjacent national and international jurisdictions. NT Fisheries on behalf of the NTFJA undertakes the day-to-day management of the fishery.

Current issues

The Finfish Trawl Fishery has been assessed against the Australian Government *Guidelines for the Sustainable Management of Fisheries* under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act). The fishery received the highest level of accreditation and has been added to the list of fisheries exempt from export regulations for five years.

The impacts of Illegal, Unreported and Unregulated (IUU) fishing in northern Australian waters, primarily by foreign fishers are poorly understood. The NT Government continues to lobby the Commonwealth to ensure adequate resources are allocated by the Australian Government (governing body is the Australian Fisheries Management Authority (AFMA)) to mitigate IUU impacts on the sustainability of red snapper stocks.

While it is accepted that most IUU fishers are primarily targeting sharks, apprehended vessels holding significant quantities of red snapper are becoming more prevalent. Research to determine the probable impact this illegal foreign presence is having on domestic shark and snapper stocks is continuing with AFMA funding a number of projects attempting to determine the species and volumes of sharks and snappers being harvested. It is not yet possible to determine the potential effect IUU fishing is having on the tightly regulated domestic Finfish Trawl Fishery.

Future plans

NT Fisheries, in consultation with industry has held a series of workshops to develop a sectorial development plan for offshore snappers.

Fishers in the Demersal Fishery share the same offshore snapper stocks with the Finfish Trawl Fishery and operators from both fisheries are involved in discussions to develop the shared resource. Discussions held so far have indicated a conservative development plan for the offshore snapper resource. Fisheries sharing the offshore snapper resource in the Arafura Sea have sought to introduce an additional finfish trawl licence to increase resource utilisation, particularly in the more remote regions.

Other issues discussed by industry have been long term protection of the deepwater, goldband snapper habitat areas from finfish trawling and

the re-allocation of potential red snapper catch from the demersal fishery to the Finfish Trawl Fishery to avoid any potential for future catch conflicts to ensure the on-going sustainability of red snappers.

NT Fisheries will continue to monitor the fishery to ensure catches are maintained within agreed ranges.

Compliance

Compliance with the Northern Territory Finfish Trawl Fishery management arrangements are undertaken by the Police, Marine and Fisheries Enforcement Section (PMFES) of the NT Police and Fire and Emergency Services, under the NT *Fisheries Act 1988.*

The PMFES effectively monitors and enforces the Finfish Trawl Fishery management arrangements through the inspection of vessel arrival and departures through the port of Darwin. This includes verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product). The PMFES has the power, if necessary, to investigate the records of wholesalers and licensees if necessary. In 2005 there were no recorded compliance issues with this fishery.

The compliance operations for the Finfish Trawl Fishery are appropriate to the size of the fishery (i.e. one operator). A compliance risk assessment was undertaken for the fishery in 2004, with no major domestic fishery issues identified.

Consultation, Communication and Education

Joint industry/government forums are used to consult with the single finfish trawler. NT Fisheries also put out publications such as Fisheries Reports and newsletters to inform and educate stakeholders.

Prepared by

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Julie Lloyd– Senior Research Scientist

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Salini, J. P.; Ovenden, J. R.; Street, R.; Pendrey, R.; Haryanti, and Ngurah. (Submitted) Genetic population structure of red snappers (*Lutjanus malabricus* Bloch & Schneider, 1801 and *L. erythropterus* Bloch, 1790) in central and eastern Indonesia and northern Australia.

Table 1. Management Objectives, Performance Indicators, Trigger Points and Management Actions used in the Finfish Trawl Fishery

Species/Group	Management objectives	Performance indicator	Trigger reference point	Management response to be taken
Red snappers	Ensure intergenerational equity by maintaining ecologically sustainable annual catches in all sectors	Sustainable yield estimates for nominated regions (Table 2)	Combined Finfish Trawl and Demersal fishery catch levels increase to 2500 t over the next calendar year. Catch levels decline by 30% over the next calendar year (Finfish Trawl only).	Stakeholders to review fishery and make recommendations to the Executive Director of Fisheries regarding appropriate measures to ensure annual catches do not exceed estimated sustainable yields. Amended arrangements to be implemented within 12 months of trigger being released.
Byproduct species	Ensure ecological sustainability of byproduct species taken in the Finfish Trawl Fishery	Monitoring of commercial logbook returns	Annual catch increase in proportion of the total catch by greater than 35%	Stakeholders to review fishery and make recommendations to the Executive Director of Fisheries. Amended arrangements to be implemented within 12 months of trigger being released.
Bycatch species	Ensure ecological sustainability of bycatch species taken in the Finfish Trawl Fishery	Onboard monitoring of Finfish Trawl Fishery	Total bycatch within the Finfish Trawl Fishery increases to 35% of total catch or a decline in a species relative numbers without a corresponding change in fishing area or fishing technique	Stakeholders to make recommendations to Executive Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being released.
Endangered, threatened or protected species and/or communities	Ensure the continued protection of species and communities listed under the EPBC Act 1999 and the Territory Wildlife and Conservation Act 2000	Endangered, threatened or protected species and or communities are identified in NT waters	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC listed species or communities	Stakeholders to make recommendations to Executive Director of Fisheries regarding the implementation of a threat abatement plan, if required. Amended arrangements to be implemented within 12 months of trigger being released.
Ecosystem components	Minimise effects on ecosystem components	Identification of threatening processes	Identification of significant negative interaction with components of the natural ecosystem present on Finfish Trawl fishing grounds	Stakeholders to make recommendations to Executive Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being released.

Mud Crab Fishery Status Report 2005

INTRODUCTION

The Mud Crab Fishery is one of the key Northern Territory managed wild harvest fisheries. In 2005, the commercial wild-harvest sector caught 304 tonnes which was valued at more than $5.41 million.

The mud crab resource is also significant to the recreational and Indigenous fishing sectors. In 2000, 82,000 and 86,500 crabs respectively were harvested by each sector, with a combined catch, equating to approximately 135 tonnes.

Four species of mud crab have been identified from the Indo-West Pacific region, with two species found in Northern Territory waters. *Scylla serrata* accounts for 99% of the catch from all sectors while *S. olivacea* accounts for the remainder. There is little byproduct/bycatch in this fishery due to highly selective gear utilised to target large mud crabs.

The Mud Crab Fishery has been assessed by the Australian Government Department of Environment and Heritage for compliance with the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and has received full export accreditation.

PROFILE OF THE FISHERY

Commercial Sector

Area

The Mud Crab Fishery operates in tidal waters between the Queensland and Western Australian borders. Crabbing operations are confined to coastal and estuarine areas, predominantly on mud flats. Fishing activity is not permitted in Darwin Harbour, most creeks adjoining Shoal Bay, Leaders Creek and the waterways of Kakadu National Park.

The majority of crabbing activity occurs in the Gulf of Carpentaria. However in 2005, the fishery has continued to utilise new areas with fishers operating on the North Arnhem coast, Van Diemen Gulf, Chambers Bay, and the west coast down to the Victoria River region.

Bait nets may be used under a restricted bait net entitlement to harvest fish for bait in crabbing operations. Bait nets may only be set in the open sea within three nautical miles of the coast and the fisher must be in attendance of the net at all times. The use of bait nets is prohibited between Bing Bong and the Queensland border and a number of other areas around the coast. Increasingly, commercial fishers are purchasing bait rather than harvesting using bait nets.

Fishing method

Most commercial crabbing operations work from remote, rudimentary land-based camps although a small proportion of the industry are now accessing remote waters through the use of motherships or permanently moored pontoons. Crabbers may travel in excess of 100 km to set their pots and then often stay in the vicinity for a number of days before returning to their base to unload the catch.

Mud crabs are harvested using baited pots, and a commercial mud crab licence holder is entitled to use 60 pots. A float, with the licence number inscribed, identifies each pot. Commercial crab pots can be a maximum of 0.5 cubic metres in volume and may not exceed one metre in length.

Crab pots are baited with fresh meat or fish and set in estuarine and coastal waters. Pots are generally checked on each daylight high tide. Less frequently, if tides and other conditions are favourable, they may be checked again at night.

Pots are hand-hauled into dinghies and all crabs are checked to see if they are berried (have eggs attached), exceed the minimum size and are commercially suitable for harvest. Commercial suitability was an industry initiative to ensure no empty (low meat content) mud crabs are harvested. This measure helps maintain the reputation and high market value of NT crabs and reduces mortality during transport.

Catch

In 2005, 304 tonnes of mud crabs were harvested in the commercial fishery (Figure 1). Five years prior, the commercial mud crab catch exceeded 1,000 tonnes per annum. It is believed that these exceptional catches were a product of high recruitment during favourable environmental conditions.

Both male and female mud crabs may be taken from Northern Territory waters and hence minimum size limits are applied to both sexes. In the commercial fishery in 2005, females had to be at least 14 cm across the widest part of the carapace (*increased to 15 cm in 2006*) and males had to be at least 13 cm (*increased to 14 cm in 2006*).

Cod species and catfish are the main byproduct of crabbing operations. Cod and catfish are often used as bait in subsequent pots. In 2005, information from commercial crabber's logbooks reported the harvest of 272 kg of cod and 120 kg of catfish. No bycatch was reported in the logbook returns.

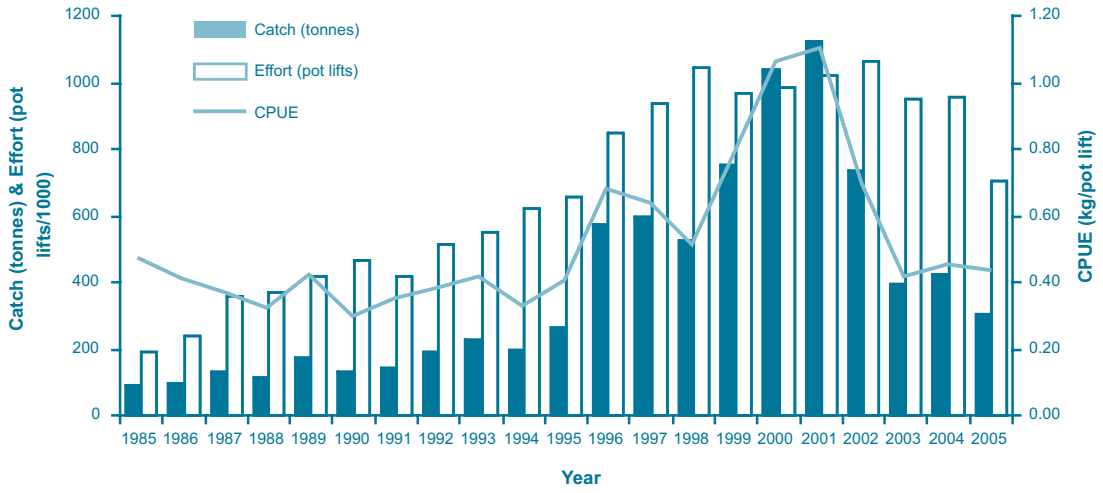

Figure 1. Catch and effort for the commercial mud crab fishery, 1985 to 2005. Please note the harvest of 'soft crabs' was prohibited in 2001 and explains some of the change in the catch and CPUE

Effort

The commercial Mud Crab Fishery is restricted to 49 transferable licenses. Generally, each operator utilises the maximum entitlement of 60 pots per licence.

Total effort reported in 2005 was 704,370 potlifts (Figure 1). As crabbers may check their pots numerous times per day, fishing effort for this fishery is measured by the number of potlifts that take place. Pots are often pulled twice a day.

Crabbing operations are most productive in the months from May to November, when most regional areas are accessible. Also, during December through to April, mature female mud crabs are generally absent from the fishery when they move offshore to spawn.

Catch rates

CPUE equated to 0.43 kg per potlift in 2005 (Figure 1). During the first decade of the fishery, catch rates remained relatively stable with an average of 0.35 kg per potlift. In 1996, the catch rate increased to 0.65 kg per potlift, eventually peaking in 2001 at over 1 kg per potlift. The catch rate has remained stable over the last three years.

Marketing

Mud crabs are a premium seafood, with strong demand for live product from the Sydney and Melbourne markets. Live mud crabs are transported to Darwin from areas around the Territory coast (at least weekly by truck), cleaned, sorted by size, sex and condition and then air freighted to southern markets. In previous years, Northern Territory mud crabs have also been exported to Singapore, China and the United States of America.

Recreational Sector

Area

Recreational fishers may crab in all waters of tidal influence except in Kakadu National Park where pots are not permitted. Crabbing is often undertaken in conjunction with other fishing activities in coastal and estuarine regions.

Surveys undertaken of recreational anglers in 1995 and 2000 found that the majority of crabbing activity occurred in the Darwin Harbour area, McArthur River and Roper River.

Fishing method

The recreational harvest of mud crabs uses pots similar to the commercial fishery, with the same gear controls. Dillies may also be used which consist of a panel of mesh on a steel frame that is baited and set on substrate. Dillies must not be constructed in any way that would cause entanglement of mud crabs or other aquatic life. A gear restriction of five pots per person applies with a maximum of 10 pots per vessel.

Mud crabs may also be harvested by a hand spear, hand-held hook, hook and line, hand net, cast net, or drag net.

Catch

Minimum size limits of 14 cm across the widest part of the carapace for females and 13cm for males apply to the recreational sector. Berried mud crabs must also be released at the point of capture.

There are no restrictions on the take of commercially unsuitable mud crabs, or those that are not full of meat. However recreational fishers are encouraged to test the fullness of a crab and release any that are not full of meat.

In 2000, recreational fishers harvested over 82,000 mud crabs and this was equivalent to around 65 tonnes. Darwin Harbour and Shoal Bay accounted for 74% of the catch (over 61,000 individuals) with only 5% of the harvest taken from the McArthur River.

Effort

Recreational crabbing is often an adjunct to other recreational fishing or boating activities. A large number of recreational fishers set the crab pots before a day's fishing expedition and haul their pots at the end of the day, or at high tide.

In 2000, recreational fishing for 'non fish' species totalled 303,033 hours and accounted for 17% of the total recreational fishing effort. However, this includes activities such as prawning and hand gathering. Over 50% of the total fishing effort for 'non-fish' species occurred in the Darwin Harbour area.

Catch rates

Targeted recreational fishing effort for mud crab was not recorded in 2000. However the catch rate during fishing for species 'other than fish' (thus including mud crabs) was 0.42 individuals per hour.

Fishing Tour Operator Sector

Area

Fishing Tour Operators (FTOS) are subject to the same controls as recreational fishers. They are restricted to crab in waters of tidal influence and not within waters of Kakadu National Park.

Fishing method

FTOs employ the same methods of mud crab harvest as recreational fishers. The same pot and possession limits apply as for the recreational sector. Over 94% of all crabbing by FTO clients use pots.

Catch

In 2005, the FTO sector landed 2,625 mud crabs, of which 1,623 were retained (62%). This is an increase from the 1,567 mud crabs landed and 973 retained (62%) during 2004.The harvest rate of mud crabs has remained relatively stable since 1995, fluctuating between 65% and 79% of the catch.

Effort

In 2005, FTO clients spent 6,550 hours of fishing effort targeting mud crabs. This represents the maximum level of mud crab effort since 1999 and a 100% increase since 2003 when 3,014 hours were expended.

Despite the increase, mud crabbing accounts for little of the total FTO effort. Since 1995, 3% or less of all fishing trips reported annually have targeted mud crabs as part of their trip, and mud crabbing accounts for 3% or less of all fishing hours.

Catch rates

The 2005 catch rate by FTO clients has decreased slightly to 0.4 mud crabs per hour, from the average since 1995 of between 0.5 and 0.8 crabs per hour. The harvest rate of crabs has also decreased from the average of between 0.3 and 0.4 crabs per hour to 0.25 mud crabs per hour in 2005.

Indigenous Sector

Area

Most fishing effort is localised, and centred close to communities or outstations.

Fishing method

Although Indigenous fishers are entitled to use the same fishing gear as recreational fishers, spearing and hand harvesting are the most popular methods.

Catch

Mud crabs are a significant and favourite food source for coastal Indigenous Australians. The catch by Indigenous fishers is mostly consumed and therefore only minimal catch is released.

The Indigenous harvest in 2000 was 86,000 crabs or approximately 69 tonnes. There are now a number of licences owned by Indigenous groups as a means of providing employment and income as well as fresh food for local communities.

Non-retained Species

Crab pots are highly selective towards large mud crabs due to the large mesh size used in their construction and as such the catch of non-target species is minimal. The aggressive nature of mud crabs is also likely to deter other animals from entering the pot.

Bycatch is made up of unmarketable mud crabs, cod, catfish and the occasional blue swimmer crab, the majority of which are released alive. Finfish species may be used as bait in the commercial fishery or discarded alive by the recreational sector.

Indigenous fishers target the same crab species as recreational fishers, however harvesting by hand or spear eliminates the incidental capture of bycatch.

Threatened Species Interaction

In 2005, there were no reported interactions with threatened species in the Mud Crab Fishery.

Ecosystem Impact

The Mud Crab Fishery has minimal impact on the ecosystem due to passive fishing methods that effectively target large mud crabs.

The Australian Government Department of Environment and Heritage has reviewed the impacts of the fishery on the ecosystem and has determined that crocodiles, turtles and sharks may feed on mud crabs. However, the current level of mud crab harvest is unlikely to significantly impact on these species.

The research program "Methods for monitoring the abundance and habitat of the Northern Australian Mud crab *Scylla serrata*" mapped mud crab habitat and provided density estimates. This information gives an indication of abundance of mud crabs in different environments which would be required if an impact on the ecosystem was observed.

Social Impact

Commercial mud crab fishing operations and processing provide direct employment and support a service industry which supplies gear and consumables to crab fishers, services their equipment and provides freight services.

Crabbing operations may also affect landholders, as crabbers camps may incur access or permit costs and camping fees.

Mud crabbing is also a popular recreational pastime as there is good access to the resource close to population centres. While difficult to quantify, money spent by recreational fishermen in the pursuit of mud crabs would contribute to employment in the FTO, tackle and hospitality sectors.

Economic Impact

In 2005, the Northern Territory commercial mud crab catch was 304 tonnes and was valued at approximately $5.41 million.

The recreational sector also contributes to the Northern Territory economy, especially to the service and tackle industry. However, such expenditure cannot be attributed solely to the mud crab fishery.

STOCK ASSESSMENT

Monitoring

A mud crab monitoring program has been in place since the early 1990s. Mud crabs from the Roper River, Blue Mud Bay, Adelaide River and the Borroloola region are monitored. Between 100 and 200 crabs are sampled from each region on a monthly basis. Important information, such as carapace width, weight, sex, and mating success are collected.

Time series analysis of carapace width data reveals a small decline in the mean size for both male and female crabs harvested in most regions. Declines in the mean size are often observed in harvested stocks. Hence, minimum size limits are set to ensure a sufficient proportion of the stock has the opportunity to reproduce.

Stock Assessment Methods and Reliability

Various stock assessment methods have been applied to the Mud Crab Fishery. Stock assessment workshops have been held in 1996, 1999, 2000 and 2004.

The first assessment (Walters et al. 1997) revealed exploitation rates in fished areas were as high as 70-90% of the available stock, leading Walters *et al.* (1997) to conclude the fishery may be described as fully developed from a management perspective.

The latest assessment (Haddon *et al.* 2005) revealed catch-rates in 2004 were the same as pre-1996. However, the assessment concluded effort had spread across a wider temporal and spatial scale, creating a greater dependence upon new recruits to the fishery.

Current Harvest Status

Recent assessments indicate that the Mud Crab Fishery is fully developed. In 2005, details of future management options were presented to the Minister for Fisheries.

Future Assessment

The next assessment of the Mud Crab Fishery will occur during 2007. The assessment will re-examine the status of the fishery and will also examine the effect of recent changes to the Mud Crab Fishery management arrangements.

RESEARCH

Summary to Date

The NT Mud Crab Research Program commenced in 1990 and has collected a large body of information on the population dynamics of the mud crab. This work has been published in various reports; the most recent of which include the 2004 stock assessment (Haddon *et al.* 2004), and completion of the study into critical mud crab habitat and abundance estimation techniques (Hay *et al.* 2005).

Incorporation into Management

NT Fisheries review results of all research programs annually. If research determines that significant changes are required in any aspect of the fishery, particularly with respect to catch and effort, a review of the management arrangements will be undertaken.

Any pertinent issues identified by research will be discussed by the Mud Crab Fishery Advisory Committee (MCFAC). Pending discussions with key stakeholders, changes to the regulatory controls in the Mud Crab Fishery Management Plan for one or all fishing sectors, may be required.

The outcomes of the 2004 Stock Assessment Workshop have been considered by the MCFAC and recommendations on revised management controls for the commercial fishery have been considered by the Minister for Fisheries.

Current Research

In 1999, NT Fisheries hosted a workshop to develop a 'National Strategy for Research on Mud Crabs'. The workshop was attended by fisheries managers, researchers and industry representatives. The workshop developed a national strategy to guide future mud crab research undertaken in Australia.

The three phases recommended in the strategy are:

1. Estimate relative productivity of mud crab habitat based on satellite imagery and abundance estimation techniques.
2. Utilise validated commercial catch and effort data as index of stock abundance.
3. Develop a fishery independent index of stock abundance based on juvenile pre-recruit index.

In 2000, the Fisheries Research and Development Corporation granted funding to implement Phase 1 of the National Strategy. The three-year project coordinated by NT Fisheries was completed in 2004. The project quantified the area of critical mud crab habitat in the Northern Territory, and developed methods to estimate the size of the mud crab stocks in northern Australia.

Subsequent to the completion of Phase 1 of the National Strategy, several projects consistent with Phase 2 have been completed in northern Australia. For example, catch and effort data were employed as an index of stock abundance during the 2004 assessment workshop which reviewed the status of the NT fishery.

Phase 3 of the national strategy remains outstanding and NT Fisheries is currently seeking funding to implement a project.

MANAGEMENT/GOVERNANCE

Management

Objective

A range of fishery objectives with performance indicators were agreed by the Mud Crab Fishery Advisory Committee (MCFAC) to ensure that the sustainability of the fishery is maintained. Triggers against the performance indicators are presented in Table 1.

History

Conservative management, focusing on containing fishing effort and protection of breeding stocks through size limits has been adopted in the Mud Crab Fishery. Since 1991 the fishery has been controlled under the MCFMP. Amendments to the Plan were made in 1993 relating to non-retention of berried females and again in 1995 relating to a 10 mm increase in the minimum size limit for females to protect breeding stocks. An "in possession" limit of a maximum of 10 mud crabs per person applies with a vessel limit of 30 mud crabs if there are three or more people on the vessel.

Current issues

The main trigger points of this fishery relate to pronounced changes in catch, effort or mean size of crabs. If catch increases by 50% in a single year or declines by 10%, effort increases by 10% or average carapace width decreases by 5 mm for two or more consecutive years, the management arrangements will be reviewed. Should any such changes occur, then the MCFAC will review the situation and provide advice to the Director of Fisheries.

Several trigger points were met in 2003 and 2004. As a result, NT Fisheries undertook a stock assessment of the fishery in 2004. Expert stock assessment scientists were commissioned to assist NT Fisheries research team with the analysis. The report *Mud crab (Scylla serrata) Assessment Workshop, Fishery Report Number 79* provides a summary of the workshop proceedings and outcomes.

After extensive stakeholder consultation a revised management plan was Gazetted for public comment in November 2005. The proposed plan incorporates a range of management actions to increase compliance and ensure the continued sustainability of the mud crab fishery. It is envisaged that the revised plan will receive Ministerial approval and become effective during 2006.

Future plans

The results of previous surveys of recreational and Indigenous fishing activities provide an insight to the targeting of mud crabs by the recreational sector. The results from future surveys will be incorporated into modelling and stock assessments to further define the state of exploitation of the fishery.

The restricted bait net entitlement will be reviewed during 2006/2007 to determine its necessity and appropriateness given the amount of conflict between user groups, particularly in the Gulf of Carpentaria region. A risk assessment of the removal of mud crab from the ecosystem will also be undertaken and any outcomes will be incorporated into the fishery's management arrangements. These reviews meet the conditions of export certification awarded to the fishery by the Australian Government Department of Environment and Heritage.

Compliance

The NT Police Marine and Fisheries Enforcement Section undertakes monitoring and enforcement activities with respect to the Mud Crab Fishery. The Section has 17 officers who are responsible for providing compliance and education on all fisheries managed by the Northern Territory.

In 2005 there were 5 successful prosecutions in the mud crab fishery.

Major issues of concern with respect to compliance are illegal use of excess or unmarked pots.

Consultation, Communication and Education

The Mud Crab Fishery Advisory Committee (MCFAC) is the peak advisory body to the Executive Director of Fisheries and the Minister for Primary Industry and Fisheries. It comprises representatives from various user groups and Government. As well as MCFAC, a series of regional coastal consultative committees have been formed. These provide formal advice from Aboriginal constituents in coastal regions on all aspects of fishing, including mud crab. The Northern Territory Crab Fishermen's Association and the Amateur Fishermen's Association of the Northern Territory have also taken an active role in formulating management policy for this Fishery.

Prior to commencing fishing operations, all new entrants to the commercial fishery must undergo an interview with the Aquatic Resource Manager responsible for the fishery. These interviews may utilise the services of an interpreter and are aimed at providing the fisher with an understanding of the legislation, status of the fishery, research, management and compliance issues.

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Table 1. Management Objectives and Performance Indicators for the Mud Crab Fishery

Species	Management Objectives	Performance Indicator	Trigger Reference Point	Management response to be taken
Mud crabs	Ensure the intergenerational equity by maintaining ecologically sustainable annual catches in all sectors.	Significant decline in the annual catch.	Commercial catch decreases by 10% per annum for two or more consecutive years or decreases by 50% in any one year.	MCFAC to review fishery and make recommendations to the Director of Fisheries to ensure that the mud crab resource is harvested in an ecologically sustainable manner. Advice provided to the Director within 12 months of trigger being reached.
		Significant increase in fishing effort.	Commercial fishing effort increases by 10% per annum for two or more consecutive years.	
		Significant decrease in the median size of mud crabs.	Median size of mud crabs decreases by 5 mm per annum for two or more consecutive years.	
Byproduct species	Ensure ecological sustainability of byproduct species.	Monitoring of commercial logbook returns.	Byproduct increases by more than 0.5 t in any one-year period.	MCFAC to review fishery and make recommendations to the Director of Fisheries regarding appropriate remedial action. Advice provided to the Director within 12 months of trigger being reached.
Bycatch species	Ensure ecological sustainability of bycatch species.	Monitoring of commercial crabbing operations.	Bycatch abundance increases by more than 50% in any one-year or more than 100% in any three-year period.	MCFAC to review fishery and make recommendations to the Director of Fisheries regarding appropriate remedial action. Advice provided to the Director within 12 months of trigger being reached.
Endangered, threatened or protected species and/or communities	Maintain present level of interaction between mud crab fishing operations and species and communities listed under the EPBC Act 1999.	Endangered, threatened or protected species and/or communities are identified in Northern Territory waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC listed species or communities.	MCFAC to make recommendations to the Director of Fisheries regarding the implementation of a threat abatement plan, if required. Advice provided to the Director within 12 months of trigger being reached.
Ecosystem components	Minimise effects on ecosystem components.	Identification of threatening processes.	Identification of significant negative interaction with components of the natural ecosystem present on mud crab fishing grounds.	MCFAC to make recommendations to the Director of Fisheries regarding appropriate remedial action. Advice provided to the Director within 12 months of trigger being reached.

Offshore Net and Line Fishery Status Report 2005

INTRODUCTION

Target species for the commercial Offshore Net and Line Fishery (formally known as the Shark Fishery) are the blacktip sharks (*Carcharhinus tilstoni* and *C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*), with a variety of other sharks and pelagic finfish also landed. A conservative approach has been adopted in managing the northern Offshore Net and Line Fishery, given the well-documented low productivity of many shark species.

A joint authority between the Northern Territory and the Commonwealth established under an Offshore Constitutional Settlement (OCS) arrangement manages the Offshore Net and Line Fishery. This provides for the Territory to manage the day to day operations of the fishery on behalf of the Northern Territory Fishery Joint Authority (NTFJA). The number of commercial participants has been reduced considerably through a three for one licence reduction scheme.

Cooperative research efforts are under way with adjacent jurisdictions, with the Northern Territory actively contributing to the implementation of an Operational Plan for the Sustainable Use of Northern Australian Shark Resources (OPSUNASR).

The Offshore Net and Line Fishery has received a Wildlife Trade Operations level of export accreditation against the Australian Government Guidelines for the Sustainable Management of Fisheries under the Environment Protection and Biodiversity Conservation Act (the EPBC Act). The management arrangements of the fishery are recognised by the Australian Government to be operating in a sustainable manner, and the fishery is exempt from export regulation for three years.

Sharks are also taken as limited byproduct in a range of fisheries targeting other species. The incidental take of sharks is around 5% of the total combined fisheries shark catch. The dedicated Offshore Net and Line Fishery accounts for 95% of the total shark catch.

PROFILE OF THE FISHERY

Commercial Sector

Area

Operators are authorised to fish in Northern Territory waters from high water to the Australian Fishing Zone (AFZ) boundary, with spatial restrictions placed on the use of certain gear. However, the majority of the fishing is undertaken within the coastal zone (within 12 nm of the coast or baseline) and immediately offshore in the Gulf of Carpentaria. Little fishing was undertaken in the offshore component of the fishery during 2005.

Fishing method

Operators may use either longlines or pelagic nets, but the use of bottom set gillnets is prohibited.

Most shark fishing is undertaken by pelagic gill net. Nets are generally 1000 to 2000 m in length with a mesh size of 160 mm to 185 mm. Most nets are constructed of monofilament nylon, with a drop of 50 to a maximum 100 meshes. The nets are weighted and have a buoyed headline.

Catch

As described above, operations in the Offshore Net and Line Fishery are such that there are two separate target species groups: sharks, principally the blacktip sharks, and grey mackerel.

The total catch of all species for the fishery in 2005, as determined from logbook records, was 1398 tonnes, a slight decrease (10.3%) on the 2004 total of 1559 tonnes. The 2005 total shark catch of 831 tonnes was a substantial decrease of 23.7 % from the 1089 tonnes caught 2004 (Figure 1). The decrease corresponded very closely to a similar decrease in fishing effort, in response to measures introduced to contain effort in the Fishery (Figure 1). Blacktip shark catches showed a relatively small decrease (13.8%), from 440 tonnes in 2004 to 379 tonnes in 2005. In 2005, blacktips were 27% of the catch (Figure 2), as in 2004. In contrast, grey mackerel catches increased, from 481 tonnes (30% of the catch), in 2004, to 526 tonnes, 38%, in 2005 (Figure 2).

The previously strong increasing trend in catches evident since 1999 came to an end in 2005. Although grey mackerel remained the principal single target species in the fishery, operators report that market forces may be among the principal drivers of variation with grey mackerel. Catch variations largely result from variations in

targeting. However, it has not been possible to deduce from recorded catches and effort whether, in any fishing operation, the target was any particular species or species group, or just the suite of species typical of the fishery.

Byproduct Species

The catches of sharks other than blacktips decreased from 649 tonnes (40%) of the fishery catch in 2004 to 452 tonnes (32%) in 2005 (Figure 2). These were principally other whalers, several species of Family Carcharhinidae, mostly *Carcharhinus* spp. and *Rhizoprionodon* spp., and hammerhead sharks (*Eusphyra blocchii* and *Sphyrna* spp.)

There were 21 tonnes of mackerels other than grey mackerel landed (1.6% of the total catch), all declared to be narrow-barred Spanish mackerel, *Scomberomorus commerson*. Small quantities of other fish species landed were tunas, mainly *Thunnus tonggol*, (14.1 tonnes) and blue salmon, queenfish and trevallies, each comprising less than 500 kg of landings.

Sharks were also landed as an incidental catch in a range of commercial fisheries targeting other species. Catches with the Restricted Bait Net entitlement held by these fisheries were 31.6 tonnes. The Coastal Line Fishery additionally landed 4.2 tonnes, while there were small shark yields from the Coastal Net Fishery, at 7.6 tonnes, and the Barramundi Fishery (10.5 tonnes). The total catch of 54 tonnes of shark landed by fisheries other than the Offshore Net and Line Fishery in 2005 was a slight increase on the 44 tonnes landed by these fisheries in 2004. Shark landings from fisheries other than the Offshore Net and Line Fishery have fluctuated between 32 and 79 tonnes since 1994.

Effort

Effort fluctuations have largely driven the highly variable trends in catches of sharks and mackerel in this fishery. Recorded effort prior to 1 July 2005 did not indicate target species, as a result only effort directed at the fishery as a whole can be reported. This constraint has been addressed through recently-introduced logbook amendments.

After initial low effort in the early 1980s, effort in the Offshore Net and Line Fishery was stable at around 900-1000 boat days through the late 1980s and early 1990s. (Figure 1; the mean for 1985-1991 was 932.6 boat days). The 1990s was a period of particular variability. After a low point of 490 boat days in 1994, effort generally increased, deviating from this pattern with a sharp increase in 1997 (to 1127 boat days) but declining again over the next two years, to 892 boat days and 573 boat days in 1998 and 1999 respectively. Effort then steadily increased in following years to the series peak of 1800 boat days in 2003. Measures introduced to contain effort resulted in a decline to 1538 boat days in 2004 then to 1176 boat days in 2005.

Catch rates

Catch rates for shark (Figure 3) have shown a relatively flat trend over the last two decades, excepting high points during the mid-1990s and 2004. Catch rates for total shark in the Offshore Net and Line Fishery, for most years between 1983 and 2005, have been between 300 and 500 kg/day fished, but reached 626 kg/day in 1995, and exceeded 700 kg/day in 2004. Catch rates for blacktip sharks have shown a similar pattern, varying in the range 244-398 kg/day between 1997 and 2003. However, with catch rates of 286 kg/day in 2004 and 322 kg/day in 2005, they did not show the increase in catch rate shown by sharks in total. Grey mackerel catch rates resumed the pattern of a steady and marked increase from the early 1990s, achieving an average catch rate of 448 kg/ day in 2005.

Marketing

Grey mackerel is marketed domestically as fillet, trunks and whole fish. Shark is marketed in trunk, fillet and whole forms, both as fresh and frozen product. Fin is a valuable product but must be landed with a prescribed proportion of shark meat. This measure is designed to contain wasteful practices in which only the fins are retained and the shark body is returned to the water. While some shark product is retained for local processing and consumption, most is sent interstate, with over 20% of total shark catch earmarked for direct export overseas.

Recreational Sector

Area

The significant areas for recreational shark catches are the Darwin Harbour, McArthur River and the Cobourg Peninsula areas.

Fishing method

Most sharks are taken during reef fishing and general fishing (fishing with no specific target). These types of fishing generally use baited lines.

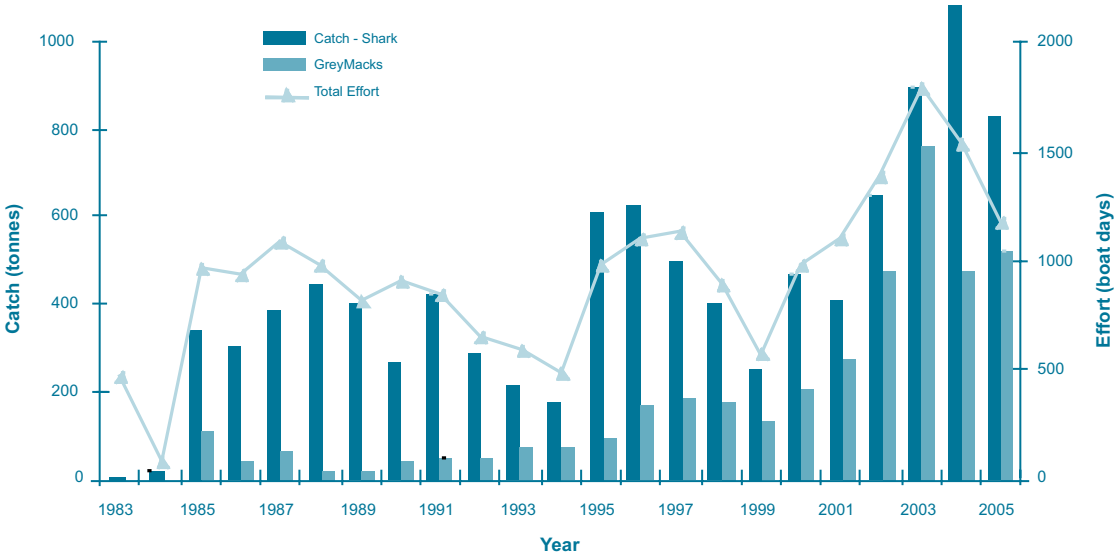

Figure 1. Catches and effort for the commercial Offshore Net and Line Fishery, 1983-2005

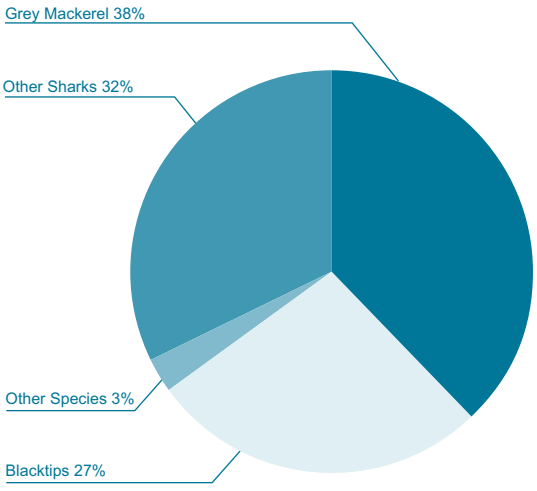

Figure 2. Composition of the commercial Offshore Net and Line Fishery catch, 2005

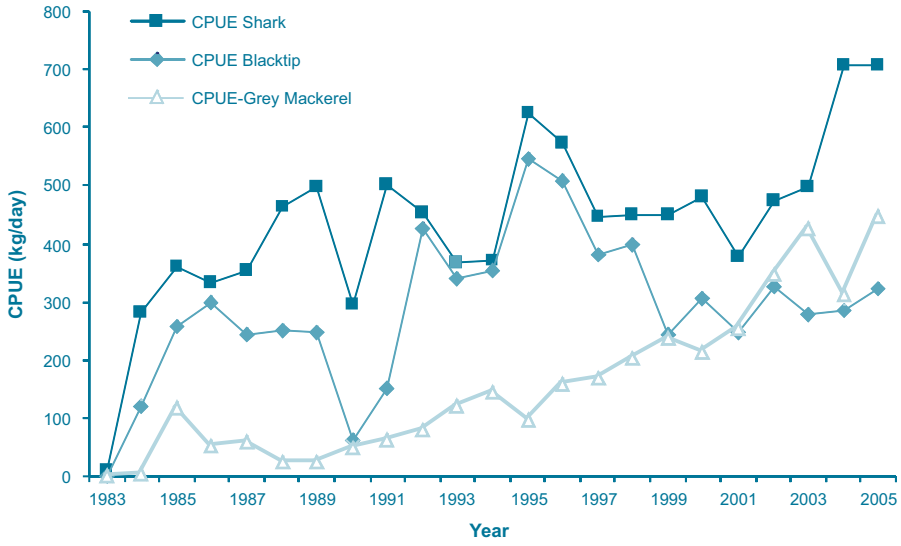

Figure 3. Catches and effort for the commercial Offshore Net and Line Fishery, 1983-2005

Catch

Sharks are not specifically targeted by recreational fishers, but are caught during other targeted fishing activities. In 1995, over 80,000 individuals were caught, but only 18% were retained, giving a harvest of 15,000. Reef fishing and non-target fishing accounted for 74% and 18% of the total shark catch respectively. The proportion of shark harvested depends on the type of fishing undertaken. During non-target fishing 34% of sharks caught are harvested, whilst reef fishers only harvest 12%.

In 2000, a survey of recreational fishers found that over 76,000 sharks were caught, with 8,000 harvested and the remainder released. This indicates a 47% reduction in harvest rate since 1995. Barramundi fishing, reef fishing and non-target fishing accounted for 14%, 26% and 52% of the total shark catch respectively. The mortality rate of released sharks is not known.

Fishing Tour Operator Sector

Area

Sharks are not specifically targeted by Fishing Tour Operators (FTOs), but are landed during other targeted fishing activities.

Catch

In 2005, 7,588 sharks were caught by FTOs. Of these, an estimated 7,312, or 96%, were released, representing a 17% increase in sharks caught by FTO clients over 2004 figures. The species of sharks caught and harvested were not recorded and the mortality rate of released sharks is not known.

The number of sharks caught by FTO clients has more than doubled since 1995, when fewer than 3,000 sharks were caught. However, the proportion of sharks harvested has declined. In 1995, 60% of sharks captured were harvested; this figure decreased rapidly to only 10% in 1997 and has declined further to around 4% in 2005.

The proportion of captured sharks that are harvested by FTO clients is about the same as the general recreational fisher community.

Indigenous Sector

Area

Most Indigenous fishing activities occurs in the close vicinity of communities and outstations, inland or near coastal waters.

Catch

Sharks and rays were one of the more important groups of fish caught by Indigenous people in the coastal areas of the NT. In 2000, a survey of Indigenous fishing activities found that over 12,000 sharks and rays were harvested, comprising just over 3% of the total finfish harvest. The species of sharks and rays caught and harvested were not identified.

Non-retained Species (All sectors - Bycatch)

Sharks are generally seen as a non-targeted or incidental catch for the recreational sector. A low proportion of sharks caught are harvested, although this does depend on the type of fishing and the fishing location. Besides various mackerel species, the majority of other species caught by the recreational sector during targeted game fishing activities are trevally and queenfish (Family Carangidae). Most of these fish are retained, with a harvest rate of over 83%. Other minor species caught also have a high retention rate of 78%.

Although gill nets are often regarded as non-selective fishing gear, when used by a skilled operator they are very effective at taking the target catch. Nevertheless, the amount of bycatch depends strongly on location and season. Most shark species are now retained apart from the Tawny Shark, *Nebrius ferrigineus*. Rays are an uncommon bycatch in the surface set nets. Not retained, they are usually released alive. Some finfish with poor market acceptability (for example some trevally and queenfish) are retained rarely.

Threatened species interaction

In the Offshore Net and Line Fishery, operators reported interactions with a single dolphin (not identified to species), and several turtles (9 were unidentified but 5 were recorded as Green turtles and one as a Hawksbill). The dolphin interaction was also recorded by fishery observers who additionally recorded one turtle capture. No speartooth or northern river sharks (*Glyphis* spp.) were recorded during 2005.

Ecosystem Impact

There are studies under way which examine the relative impact of harvesting sharks and grey mackerel.

Little is known about the large scale stock structure of the principal shark species harvested, particularly

the extent to which Indonesia, Western Australia, Queensland and the Northern Territory share fishery resources. However, this problem is under investigation in an Australian Centre for International Agricultural Research (ACIAR)-supported project. Led by the CSIRO, the project *Artisanal shark and ray fisheries in eastern Indonesia: their socioeconomic and fisheries characteristics and relationship with Australian Resources* is a collaborative effort between several Australian and Indonesian agencies. The project also acquires biological information, examines stock status and describes socio-economic attributes of the fisheries. Although, as an aid project, it is principally designed for the benefit of fisheries management in Indonesia, the project will also be of value for the management of Australian fisheries, and as many of the species are common and stocks may be shared, will contribute to ecosystem understanding at a regional scale.

The Fisheries Research and Development Corporation (FRDC) Project, *Northern Australian Sharks and Rays: the Sustainability of Target and Bycatch Species, Phase 2* (Salini et al. 2006) is nearing completion (Salini et al. 2006). The project seeks to obtain comprehensive data on species composition and biological characteristics of sharks and rays taken in northern Australia fisheries, including those fisheries for which the sharks and rays are bycatch. The major output of the project is to be a risk analysis which provides prioritization for research and management direction. Both the ACIAR and FRDC-funded projects provide genetic and other information that adds to the understanding of the spatial relationships of northern shark stocks.

The catch composition information provided by these projects forms a baseline against which the Offshore Net and Line Fishery can be monitored for biodiversity change in the future, and is considered of particular importance in assessing the potential ecological impact of foreign illegal fishing on Australian shark stocks.

In 2005, NT Fisheries observers undertook three observer cruises on shark fishery vessels, and examined shark bycatch of three barramundi fishing operations. A FRDC-funded research project (representing further collaboration among the northern research agencies) is examining the spatial stock structure of grey mackerel. The project began during 2005 and will continue into 2007.

Controls on fishing gear have been introduced to minimise any physical impact on the seabed, other than anchoring. A prohibition on the use of bottom set gill nets was introduced following interactions with turtles.

Social Impact

In 2005, there were a total of 17 licences operating in the Offshore Net and Line Fishery. Most vessels employ a skipper and have two or three crew members.

Economic Impact

At the point of first sale in 2005, the overall catch value of the commercial shark fishery was just over $6.2 million ($8.55 million 2004). The black tip shark component was valued at $0.66 million (2004 - $1.18 million), $2.2 million for other sharks (2004 - $5.08 million) and $ 3.14 million for grey mackerel (2004 - $2.12 million).

STOCK ASSESSMENT

Monitoring

The basic monitoring information from the Offshore Net and Line Fishery comes from compulsory catch and effort logbooks. Monthly summary returns for the commercial fishery form a time series from 1983. A transition from monthly summary returns to recording each gear set has been managed since the late 1990s, and from July 2005 the target species have been recorded. This reflects a policy of improving the quality and utility of logbook information collected.

Observer cruises add information on species composition and provide other biological and ecological data. Three observer cruises on commercial shark boats were undertaken during 2005, as well as the examination of the shark bycatch of three Barramundi Fishery operations. These provided data on species composition of both harvest and bycatch (retained and non-retained catch). Research has been initiated for the development of a tagging protocol for monitoring of harvest rates of the principal target shark species, as well as indicator species. This project, led by the Charles Darwin University with collaboration of the fishing industry, NT Fisheries and the Australian Institute of Marine Science (AIMS), has supporting funding under the Australian Research Council (ARC) Linkage program, and the NT Fishing Industry research and Development Fund. The project will

entail extensive evaluation of monitoring and management combinations, and experimentation to ensure that managers have an informed choice of management options.

Stock Assessment Methods and Reliability

The Offshore Net and Line Fishery has a history of continual assessment. In the 1980s, a joint assessment was conducted between the then NT Department of Primary Industries and Fisheries, CSIRO, and the Australian Fisheries Service. The *Pelagic Fish Stock Assessment Program* estimated that, in waters adjacent to the Northern Territory, the maximum sustainable yield for the black tip sharks, *C. tilstoni* and *C. sorrah,* was 3,400 tonnes annually. This consisted of 1,900 tonnes in the Arafura and Gulf of Carpentaria (GoC) zones and 1,500 tonnes in the Northern Territory zone.

Although CSIRO studies indicated that blacktip sharks form a single large genetic stock throughout northern Australia, mark-recapture studies showed that movement rates both along-shore and offshore are relatively restricted between the northern Australia Arafura Sea, the GoC and the Bonaparte Gulf. Mixing is sufficient to ensure a genetically homogeneous population but, at the same time, interactions are sufficiently restricted that segments of the population could be fished down without impacting on production throughout the population as a whole (Stevens et al. 2000).

Assessment in the mid-1990s (Walters and Buckworth 1997) suggested a potential yield estimate for Western Australia, the Northern Territory and Queensland of at least 2,000 tonnes per year. The optimum annual harvest rate is 6-7% per year of the component of the stock vulnerable to gill net fishing. This age-structure modelling (Walters and Buckworth 1997) indicated that the overall stock should have been increasing, at a rate of between 5% and 10% per year since the mid 1980s, when Taiwanese catches were greatly reduced.

However, CPUE data from the Northern Territory gill net fishery to 1995, on which this assessment was based, suggested a decline in relative abundance since the mid 1980s, for which several potential, unquantified sources were identified. These sources included losses to other fisheries, across the northern border or undeclared within other Australian fisheries which, it was calculated, could account for up to 1500 tonnes of catches, as well as localized depletion effects. However, the unreliability of the assessment, particularly due to its reliance on CPUE statistics, was emphasised. Over the longer course of the fishery to 2005, there has been a small, long-term increase in the mean catch rate trend for black tip sharks (which averages around 4% annually). A recent update of the age structured model by the Northern Assessment Group (consisting of researchers and managers from the management agencies responsible for the northern shark fisheries) nevertheless remained uncertain. Although the model incorporated the additional eight years of CPUE data available since Walters and Buckworth (1997), the data as a whole remained informative. The dominant characteristic of the CPUE data is strong variation, particularly the large peaks of 1995 and 1996.

The basic problem with CPUE as an index of abundance is that it may reflect factors, such as the behaviour of fishers, in response to markets of cost structures, much more than it does the abundance of the fish. This is illustrated by apparent targeted fishing within the Fishery. The very strong and persistent increasing trend in the catch rate of grey mackerel suggests that this species has been increasingly targeted. The downturn of 2004 probably reflected general targeting of sharks during that year, in response to market pressures, while the resumption of the trend in 2005 was again probably an artefact of target fishing of grey mackerel. The catch rate variations among the total sharks, blacktip sharks and grey mackerel (Figure 3) are substantially in counterpoint i.e. those years in which catch rates of grey mackerel peaked, shark catch rates declined, and vice versa. Existing logbook effort data could not be allocated among the target groups, but the inference from these observations is that catch rate trends presented for sharks and mackerel in this Fishery are unlikely to capture all but the strongest trends in abundance. The slight variations evident for black tip shark catch rates in Figure 3 may simply reflect diversion of effort by operators to whichever fishing target they predicted would have the greatest nett value at any time.

Current Harvest Status

Exploitation by the FTO and recreational sectors is considered to be quite low. The harvest by the commercial sector is below most estimates of sustainable yield. Logbooks do not indicate target species. Given the very strong increasing trend in grey mackerel catches and catch rates,

variations and trends in CPUE could result from increased direction of fishing in response contrasting market demands for mackerel or shark. However, given the high degree of uncertainty in stock estimates and declining trend since the mid-1990s of CPUE adjusted for the amount of gear deployed, conservative management precludes any significant increase in harvest rates. The Offshore Net and Line Fishery is thus considered to be fully fished.

Future Assessment Needs

There is clearly a need for continued updated assessment of the Offshore Net and Line Fishery. It is planned that target species in the fishery will be re-assessed at least every three years. However the information on fishery status that can be provided by logbook catch and effort data alone is limited, and new assessments are unlikely to be more informative. A key recommendation from previous assessments has been to establish sources of information on harvest rates or abundance levels of the NT shark stocks, independent of logbook data. Consequently, research to develop mark-recapture (tagging) to provide on-going index of harvest levels for the NT shark fishery has been instituted. Further, there should be a concerted effort to obtain black-tip catch statistics from the foreign fisheries currently operating in the Arafura Sea, north of the AFZ. Constraints on resources have meant that these recommendations are yet to be implemented.

There is little information as yet available on the magnitude and impact on northern Australian shark and finfish stocks of Illegal, Unreported and Unregulated (IUU) fishing by foreign vessels in northern Australia waters. The consequences of this fishing for the Australian fishery are difficult to predict. This is firstly because we do not know the magnitude of that illegal fishing. Secondly, movement rates and life history linkages between inshore (where most Australian fishery effort is directed) and offshore (most IUU fishing) are poorly known for most species. Thirdly, we do not know the ecological effects that may arise by fishing down many of the top predatory fish from the offshore area. Thus broader ecosystem effects of fishing, and the effect of high levels of IUU effort, need to be addressed in future assessments.

Given the significance of the grey mackerel catch in this fishery, it is planned that initial assessment for this species will be addressed during 2006.

RESEARCH

Summary to Date

In the mid 1980s, the Northern Territory Shark Fishery was the subject of a major joint Commonwealth/ NT/ Qld/ WA/ Pelagic Fish Stock Assessment Program, sampling extensively around the Northern Territory coastline, to establish species and size composition and provide basic biological information. Sharks were tagged to provide growth and movement information. The project provided substantial information, including extensive and long-term information on movements and growth from the mark-recapture work (Stevens et al. 2000). The most recent tag recovery from this program was as recent as 2004. Outcomes from this research were discussed above. Research during the 1990s was limited to monitoring of trends in the commercial fishery data and stock assessment using all available data (Walters and Buckworth 1997). However, the recognised need for more information on the broad suite of sharks species taken in northern Australia prompted the development of the FRDC-funded projects, *Northern Australian Sharks and Rays: the Sustainability of Target and Bycatch Species, Phase 1* and *Phase 2* (see below).

Incorporation into Management

Results of research have allowed informed and conservative management regimes to be implemented for the Offshore Net and Line Fishery.

Current Research

A series of projects on the sustainability of sharks and rays in northern Australia have been undertaken since the late 1990s (Stobutzki et al. 2003; Rose et al. 2003; Salini et al. 2006). These projects have included substantial information on species composition and biology of sharks and rays in the Offshore Net and Line Fishery, as well as various other northern Australia fisheries. This provides information to management and also indicates those species for which particular mitigative management responses may be needed. Observer information on catch composition is considered an important basis for monitoring biodiversity. Although the blacktip species are well-known biologically, this has not been true of many of the species that are less-frequent catch components. Thus the biological information accumulated and communicated (e.g.

Beatty and Crofts 2004) from these projects is valuable for the future management of the fishery. These are national projects, with collaboration between the northern states and NT as well as Victoria and the CSIRO. Development of a collaborative tagging program with commercial fishers is also under way, as described above.

Given the value of the grey mackerel in the fishery, there is also a need for further information on this species. An initial FishNote was prepared to increase stakeholder information on grey mackerel (Crofts and de Lestang 2004). Information on stock structure, movements and age structure of the population will be provided by current research in FRDC project 2005/010, *Determination of Management Units for Grey Mackerel Fisheries in Queensland and the Northern Territory,* initiated during 2005.

MANAGEMENT/GOVERNANCE

Management

Management of the Offshore Net and Line Fishery seeks to maintain shark and grey mackerel catches within appropriate ranges, dictated by scientific understanding of sustainable harvest levels and the underlying value of the fishery in providing food and economic value. This is achieved through a range of input and output controls and containment of fishing capacity through a "three for one" licence reduction program. This licence reduction program requires new entrants to acquire and transfer three restricted Offshore Net and Line Fishery licences to the Territory for the issuance of an unrestricted Offshore Net and Line Fishery licence. Overall capacity has been reduced from 38 licences to 17 licences in 2005.

Finning ratio licence conditions were imposed on Offshore Net and Line licensees in late 2003 and seek to prevent the targeting of large shark for their fins alone. The fin ratios are reviewed periodically and have resulted in a general ratio reduction of 17%.

The current ratios are 6.5% fresh or frozen fin as a proportion of trunk weight, 13% fresh or frozen fin as a proportion of fillet weight and 3% fresh or frozen fin as a proportion of whole weight. Licensees must have an appropriate amount of meat for every fin in their possession. The ratio is designed to factor in operational circumstances such as unintentional loss of useable product through machinery malfunctions, chiller breakdowns, predator and sea-lice attack.

Catch restrictions apply to Spanish mackerel. This byproduct limit seeks to link landings of Spanish mackerel to grey mackerel catches. Such a measure was agreed to address concerns by other sectors about pelagic net fishers targeting Spanish mackerel.

A review of the incidental capture of sharks, including finning, in other fisheries targeting non-shark species concluded in 2003. A prohibition on the possession of sharks and shark product was also agreed for the Timor Reef, Demersal, Finfish Trawl and Spanish Mackerel fisheries. In 2003, agreement was reached with the Barramundi, Coastal Net and Coastal Line fisheries on levels of incidental catches of sharks. The fin to meat ratios are also applicable to these fisheries, with the current ratios being imposed.

In 2004, the Offshore Net and Line Fishery underwent an ecological assessment under the Commonwealth Government's *Environmental Protection and Biodiversity Conservation Act.* The management arrangements of the fishery were assessed against the Guidelines for Ecological Sustainable Fisheries by the Department of Environment and Heritage (DEH). The Offshore Net and Line Fishery was found to be operating in a sustainable manner and accredited with a Wildlife Trade Operation (WTO) in December 2004 which permits the fishery to continue to export shark products.

NT Fisheries and Industry negotiated with DEH a range of conditions on the fishery to be implemented over the life of the WTO to ensure ongoing sustainability of the fishery. Some of these conditions include:

- An annual cap of 1599 days for pelagic net fishing gear to be shared between all licensees
- An annual cap of 234 days for long-line fishing gear to be shared between all licensees
- 2500 meters pelagic net reduced to 2000 meters maximum with maximum of 100 meshes drop
- A reduction in mesh size range from 150 mm – 250 mm to 160 mm – 185 mm
- 20 nm of long-line reduced to 15 nm with maximum 1000 snoods (hooks), no auto-baiting gear
- Defined restrictions on incidentally taken snappers and Spanish mackerel.

History

A large commercial shark fishery commenced throughout northern Australia in the early 1970s. At that time, a Taiwanese gill net fleet targeted a range of pelagic shark and fish species, with foreign fishing vessels working as close as 12 nautical miles (approximately 22 km) of the coast prior to 1978. Foreign fishing vessels were excluded from the Gulf of Carpentaria in 1979.

With the declaration of the AFZ in 1979, the foreign fishing fleet's exclusion zone adjacent to Arnhem Land and the Wessel Islands increased to between 40 and 50 nautical miles offshore. A bilateral agreement between Australia and Taiwan permitted continued access for 30 gill netters to land up to 7,000 tonnes of shark from northern Australian waters. Further restrictions were introduced in 1986 due to declining catch rates and concerns about the incidental capture of dolphins. These restrictions limited the length of gill nets to not more than 2.5 km, thereby rendering foreign gillnetting uneconomic. Despite the permitted use of baited longlines, foreign fishing operations in northern Australian waters ceased in late 1986.

Direct involvement by dedicated domestic shark fishers in coastal waters began in the early 1980s. At that time, the Northern Territory actively encouraged the development of the inshore component of the fishery. Landings remained low with catches ranging from 100 to 500 tonnes, with shark fillets sold on established food markets throughout southern Australia.

Current issues

The Northern Territory is signatory to a multi-jurisdictional "Operational Plan" for northern Australian shark fisheries to achieve the outcomes of the National Plan of Action for Sharks (NPOA). This Northern Operational Plan was endorsed at a meeting of fisheries officers from all jurisdictions in September 2004 and is the only Operational Plan to address issues raised in the NPOA in Australia at this time.

A review of the impacts of Illegal, Unreported and Unregulated (IUU) fishing in northern Australian waters, primarily by foreign fishers is currently underway. An expected outcome of this review is to ensure adequate resources are allocated by the Australian Government (governing body is the Australian Fisheries Management Authority) to mitigate IUU impacts on the sustainability of shark stocks. This review is expected to conclude in 2005-2006.

The impacts of IUU fishing in northern Australian waters, primarily by foreign fishers are poorly understood. The NT government continues to lobby the Federal Government to ensure adequate resources are allocated by the Australian Government to mitigate IUU impacts on the sustainability of shark stocks.

Most IUU fishers are primarily targeting sharks, and are becoming more prevalent. Research to determine the probable impact this illegal foreign presence is having on domestic shark stocks is continuing with AFMA funding a number of projects attempting to determine the species and volumes of sharks being harvested. It is not yet possible to determine the potential effect IUU fishing is having on the predominately inshore, tightly regulated small domestic Offshore Net and Line Fishery.

The collaborative research project to develop mark-recapture (tagging) protocols to provide on-going monitoring for the NT Offshore Net and Line Fishery will assist in determining movement rates and life history linkages between inshore (where most domestic fishing occurs) and offshore (mostly IUU activity) stocks.

The Offshore Net and Line Licensee Committee of the Northern Territory Seafood Council (formally the Shark Fishermen's Association) implemented a voluntary 'no-take' policy in December 2004 for all sawfish in Northern Territory waters in recognition of the higher risk these species face in the fishery. Logbooks have been amended (mid-2005) to allow for accurate reporting of threatened species and species of scientific interest. This will enable recording of sawfish interactions by species and assist to determine their distribution and status.

A review of the management objectives, performance indicators, and trigger points (see Table 1.) was undertaken in early 2005 to determine if imposed gear and effort reductions are adequate to address trigger reference points being exceeded for grey mackerel and other shark byproduct during 2004. As the new effort reduction strategies were not in place for the whole of 2005, but positive signals were being indicated that the new strategies were having the desired effect, it was decided to extend the review date (to 2006) to enable more data to be gathered.

Future plans

The incidental landings of sharks in fisheries targeting other species are subject to annual review. The finning ratios are to be reviewed periodically to ensure they meet the sustainability criterion. Due to changing fishing methods within the fishery, the fishery was reviewed at the annual Shark Fishery Management Advisory Committee (SharkMAC, now renamed ONLMAC) meeting held in September 2005.

The DEH assessment of the Fishery for ecological sustainability was completed in May 2005, with accreditation of the WTO being extended until November 2007. The implementation of new effort controls into the management arrangements of the Fishery, during 2005, has ensured a significant reduction in shark catches taken by the long-line fishing method. The Offshore Net and Line Fishery is now working toward meeting all DEH recommendations with industry committed to ensure ecological sustainability through a cooperative working relationship with government.

Compliance

Compliance activities for the Offshore Net and Line Fishery management arrangements are undertaken by the Marine and Fisheries Enforcement Section (MFES) of the NT Police, Fire and Emergency Services, under the *NT Fisheries Act 1988.*

The MFES effectively monitors and enforces management arrangements for the Offshore Net and Line Fishery through the inspection of vessel arrivals and departures through the single port of Darwin. This includes verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product). The MFES has the power, if necessary, to investigate the records of wholesalers and licensees.

In 2005, there were not any significant domestic compliance issues recorded for this Fishery.

Consultation, Communication and Education

Regular communication and consultation occurs between stakeholders to discuss matters of concern within the Fishery. Stakeholders involved in such discussions include the Northern Territory Offshore Net and Line Licensee Committee, the Northern Territory Seafood Council, neighboring jurisdictions, other extractive stakeholders and wider interest groups.

Workshops have been convened as required, and these serve as a forum for industry, management and researchers to canvass all issues of interest to the Offshore Net and Line Fishery.

The Offshore Net and Line Fishery Management Advisory Committee (ONLMAC, formally SharkMAC), comprises membership from a wide range of stakeholder interest groups to provide expert advice to the Director of Fisheries. This committee met in September to work through issues to ensure the fishery continues to be sustainably managed in an open and transparent manner.

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Table 1. Management Objectives, Performance Indicators, Trigger points and Management Actions used in the Off Shore Net and Line Fishery

Species/Group	Management objectives	Performance indicator	Trigger reference point	Management response to be taken
Black tip sharks *C.tilstoni* & *C.sorrah*	Ensure inter-generational equity by maintaining ecologically sustainable annual catches in all sectors	Sustainable yield estimates	Catch levels increase to 2000 t over the next calendar year. Catch levels decline by 30% over the previous two calendar years.	Stakeholders to review fishery and make recommendations to the Director of Fisheries regarding appropriate measures to ensure annual catches do not exceed estimated sustainable yields. Any amended arrangements will be implemented within 12 months of trigger being reached.
Grey mackerel		Sustainable yield estimates are developed	Until sustainable yield estimates are determined the trigger will be rise or decline of 30% of the catch from the previous calendar year.	
Byproduct species Combined other shark species	Ensure ecological sustainability of byproduct species taken in the Offshore Net and Line Fishery	Monitoring of commercial logbook returns	Catch increases in proportion of the total catch by greater than 35 % over the next calendar year.	Stakeholders to review fishery and make recommendations to the Director of Fisheries. Any amended arrangements will be implemented within 12 months of trigger being reached.
Combined other species			Catch increases to 10% of the total catch over the next calendar year.	
Bycatch species	Ensure ecological sustainability of bycatch species taken in the Offshore Net and Line Fishery	Onboard monitoring of Offshore Net and Line Fishery	Total bycatch within the shark fishery increases to 10% of total catch in successive calendar years or a decline in a species relative numbers without a corresponding change in fishing area or fishing technique.	Stakeholders to make recommendations to Director of Fisheries regarding appropriate remedial action. Any amended arrangements to be implemented within 12 months of trigger being reached.
Endangered, threatened or protected species and/or communities	Ensure the continued protection of species and communities listed under the *EPBC Act 1999* and the *Territory Wildlife and Conservation Act 2000*	Endangered, threatened or protected species and or communities are identified in NT waters	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC listed species or communities.	Stakeholders to make recommendations to Director of Fisheries regarding implementation of a threat abatement plan, if required. Amended arrangements to be implemented within 12 months of trigger being reached.
Ecosystem components	Minimise effects on ecosystem components	Identification of threatening processes	Identification of significant negative interaction with components of the natural ecosystem present on demersal fishing grounds.	Stakeholders to make recommendations to Executive Director of Fisheries regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.

Spanish Mackerel Fishery Status Report 2005

INTRODUCTION

Spanish mackerel are found throughout tropical and subtropical waters of the Indo-west Pacific, from Africa to Fiji. In Australian waters, they are found from Geographe Bay in Western Australia, throughout northern Australian waters and down the east coast to the south coast of New South Wales.

The NT fishery is based on the capture of the narrow-barred Spanish mackerel (*Scomberomorus commerson*) by way of lures or baited lines. The commercial troll fishery area comprises all waters seaward of the Northern Territory coast extending to the outer limit of the Australian Fishing Zone (AFZ). Spanish mackerel are also landed as an incidental catch during pelagic shark fishing and finfish trawl operations, with catch limits set for these sectors. In 2005 there were 15 active commercial licences operating in the fishery

On 1 January 2005 the Northern Territory Spanish Mackerel Fishery Management Plan came into effect. The Spanish Mackerel Fishery is managed under a catch sharing arrangement with other user groups which include commercial, recreational, fishing tour operator and traditional Indigenous stakeholders. The wider community also has an interest in the way our Spanish mackerel resources are used, conserved and enhanced to ensure the quality of the fishery is preserved for future generations.

Historically, there were significant landings of Spanish mackerel taken by the Taiwanese gillnet fleet off northern Australia between 1974 and 1986, with annual catches perhaps as high as 1,000 tonnes in the late 1970s. Catches by foreign fishing vessels stabilised to between 400 and 500 tonnes through the late 1970s and early 1980s. Since the mid 1990s the fishery has stabilised as a small, tightly controlled Territory-based troll fishery. Possession limits have been implemented for the recreational sector.

In 2003 the Spanish Mackerel Fishery received the highest level of export accreditation against the Australian Government's *Guidelines for the Sustainable Management of Fisheries* under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act). As the management arrangements for this fishery are recognised by the Australian Government to be operating in a sustainable manner, the fishery is therefore exempt from export regulations for a period of five years.

PROFILE OF THE FISHERY

Commercial

Area

Licensees in the Spanish Mackerel Fishery may fish in Northern Territory waters seaward of the coast and river mouths, to the outer limit of the AFZ.

The principal fishing areas include waters near Bathurst Island, New Year Island, northern and western Groote Eylandt, the Gove Peninsula, the Wessel Islands, the Sir Edward Pellew Group and suitable fishing grounds on the western and eastern mainland coasts. Fishing generally takes place in coastal areas around reefs, headlands and shoals.

Fishing method

Fishers may operate from a mother boat with up to two dories and use any number or combination of troll lines, floating handlines and rod and lines. It is common for fishers to troll two to four lines behind a dory and up to eight lines from a mother boat.

Most commercial fishers purchase bait for their fishing operations. However, a small number of operators (less than five) fish for bait under a restricted bait net entitlement. Bait fish, usually garfish, harvested under this entitlement may only be used for the commercial fishing of Spanish mackerel.

Additionally, a small amount of Spanish mackerel are taken by pelagic gillnet, and demersal trawl methods as used respectively in the Offshore Net and Line Fishery (previously the Shark Fishery) and Finfish Trawl Fishery.

Catch

As the name suggests the key target species for the Spanish Mackerel Fishery is the narrow-barred Spanish mackerel, *Scomberomorus commerson*. Small amounts of other *Scomberomorus* species are included in the catch in some years.

The Spanish mackerel catch for the troll fishery in 2005 increased to 390 tonnes, from the 2004 catch level of 297 tonnes (Figure 1), exceeding the previous peak annual catch from the fishery of 373 tonnes (2001). The changes in annual total catches largely reflect effort, which in turn reflect causes as varied as prices, wind strengths and crew availability. The last has been a continuing complaint from operators in this and several other fisheries.

In 2005, *Scomberomorus commerson* were 99.91% of the landed catch. There were very small catches of other mackerel species in 2005:

just 25 kg of Australian spotted mackerel (*S. munroi*); 65 kg of Queensland school mackerel (*S. queenslandicus*); and 9 kg of grey mackerel (S. *semifasciatus*) were taken.

The other byproduct species in the troll fishery in 2005 were wahoo (*Acanthocybium solandri*), with a landing of 182 kg, and 65 kg of goldband snapper (*Pristipomoides* spp.) In previous years, landings have included small amounts of trevallies (Family Carangidae) and cods (Family Serranidae, including coral trouts, *Plectropomus* spp.). The capture method in this fishery (usually heavy troll lines) means that other species that are not retained for sale are usually returned to the water alive.

In 2005, 20.6 tonnes of Spanish mackerel were landed in the Offshore Line and Net Fishery, down from 26 tonnes in 2004. The 1,032 kg of Spanish mackerel landed from the Finfish Trawl Fishery in 2005 was very close to the 2004 landing of 985 kg.

Effort

Spanish mackerel troll fishery effort in 2005 (1,115 boat days fished) was an increase from the declining trend of the previous few years (Figure 1), approaching the 2001 high value of 1,155 boat days. Although effort levels since 2001 have been higher than the average effort for the late 1990s, the peak value (1,887 days) for the Fishery was recorded in 1990.

Catch rates

The Catch Per unit of Effort (CPUE) for the commercial fishery for Spanish mackerel (Figure 2) has followed a strong increasing trend through the past two decades, with CPUE since 1999 at a level around twice or more of that seen in the 1980s. The catch rate of 2005, 349.8 kg/day, was a slight reduction from the 2004 peak of 359.1 kg/day. The long-term trend may reflect growth in efficiency in fishing operations, as well as recovery of the Spanish mackerel population from historical over-fishing by the licensed Taiwanese-Australia joint venture fishery of the 1970s and 1980s.

Marketing

Spanish mackerel are usually filleted on board the mother vessel soon after capture. Some mackerel are processed as trunks. Trunks (whole fish from which the head, viscera and tail have been removed), are convenient for processing later into cutlets or fillets. The catch is frozen after processing and stored onboard. The catch may be unloaded to barges that service remote ports or delivered directly to the major ports of Darwin and Gove.

Recreational Sector

Area

Highly prized as a sport and table fish, most Spanish mackerel taken by recreational fishers are from waters within easy reach of the major coastal population centres of Darwin, Nhulunbuy and Borroloola. Surveys of recreational anglers in 1995 and 2000 found that most (47%) of the targeted effort for game fish (eg. mackerel) occurred in the Nhulunbuy area.

Fishing method

Fishing gear and methods employed by recreational fishermen targeting Spanish mackerel are similar to those found in the commercial sector. Lures and baits are trolled in the vicinity of reefs, headlands and shoals, or baited lines are used for casting or drifting into mackerel schools. Many recreational anglers use berley, which is diced and continuously tossed from the fishing vessel to entice mackerel. A proportion of the catch is also taken when fishing for other species and these fishing methods can vary.

Catch

FISHCOUNT, a general population survey conducted in 1995, estimated the total recreational catch of all mackerel to be around 24,500 individuals. Almost all of these fish were harvested, giving a harvest of approximately 170 tonnes. The proportion of Spanish mackerel within the recreational mackerel catch was not identified.

In 2000, the National Recreational Fishing Survey found that the annual Northern Territory catch of all mackerel by the recreational sector to be 25,233 individuals, slightly higher than the FISHCOUNT survey conducted in 1995. Over half of the mackerel catch was not identified to species. However, during recent survey work done with recreational fishers, 49% of the mackerel catch was thought to be Spanish mackerel. The survey results also indicated that the average weight of individual Spanish mackerel was estimated to be approximately 5.9 kg, coupled with an estimated release mortality of 54%. This information provided an estimated recreational sector harvest of 62.2 tonnes, which includes the Fishing Tour Operator (FTOs) catch component of 15.1 tonnes.

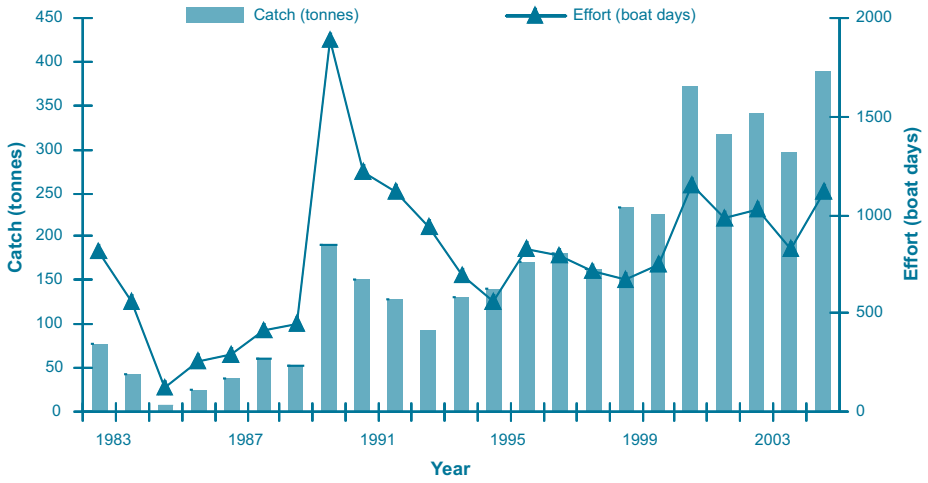

Figure 1. Catch and effort for the commercial Spanish Mackerel Fishery, 1983 - 2005

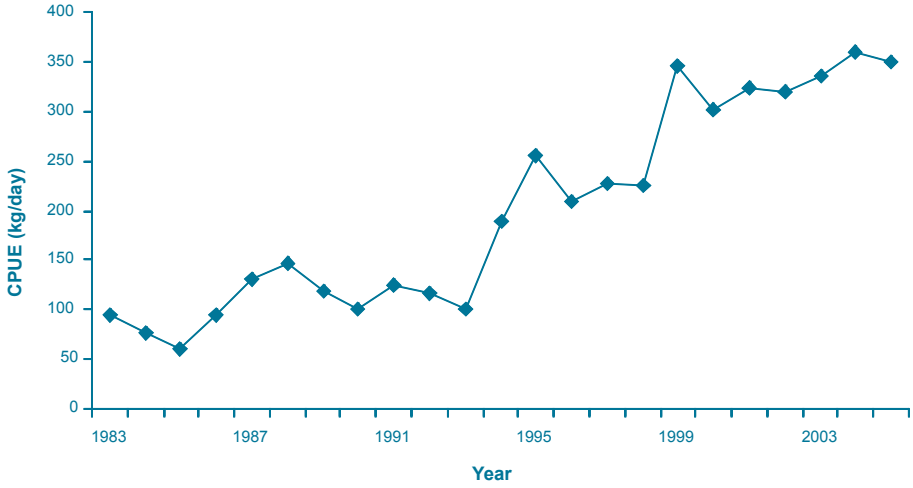

Figure 2. CPUE for the commercial Spanish Mackerel Fishery, 1983-2005

Effort

In 1995, targeted game fishing accounted for only a small amount (2%) of the total recreational fishing effort, over 37,000 hours. In 2000, targeted game fishing increased to nearly 8% of the total recreational fishing effort, over 139,313 hours.

Fishing Tour Operator Sector

Area

Fishing guides can fish in all areas of the fishery.

Fishing method

Fishing gear and methods employed by FTO clients targeting Spanish mackerel are similar to those found in the recreational and commercial sector. Lures and baits are trolled in the vicinity of reefs, headlands and shoals, or baited lines are used for casting or drifting into mackerel schools. Trolling accounts for most of the fishing effort, although casting has been used more frequently since 1998.

Catch

The catch of Spanish mackerel in 2005 has more than trebled since 1994, with 3,744 fish caught and 1,160 (31%) retained in 2005. Total harvest of Spanish mackerel by FTOs in 2005 was 2,555 fish. This figure includes onboard fishing mortality and an estimated release mortality of 54%. In 2005, 2,085 other species of mackerel were caught with 494 of those fish retained (24 %).

Effort

Targeted game fishing by FTOs is a small component of the industry. Just over 1,023 trips targeting game fish were taken by Fishing Tour Operators in 2005. This is over double the number

of game fishing trips undertaken in 1995. Although the total number of trips has increased over this period, the proportion of game fishing trips has remained relatively stable at 13% of all fishing trips

FTO clients expended over 15,072 hours on targeted game fishing activities in 2005 This was more than double the number of hours recorded in 1995. The proportion of targeted game fishing hours has increased slightly to 9% since 1995.

Indigenous Sector

Only a very few (1,400) individual mackerel captures were reported during the 2000 Indigenous Fishing Survey of Northern Australia and specific types of species were not recorded.

Non-retained Species (Bycatch)

The commercial fishery catches very little apart from its primary target and almost all bycatch items are returned alive to the water. Monitoring of the commercial fishery identified very low levels of bycatch which illustrates the highly targeted nature of this fishery. There was one interaction with a protected species, a sea snake (species not recorded), which was released alive. During 2005, bycatch was recorded during four observer trips (31 observer days), in which small numbers of trevally, barracuda, queenfish, and various shark and tuna species were captured. No bycatch at all was observed on nine of the observer days. None of these bycatch species was retained as byproduct, and the majority of the fish were observed to be alive at the time of release.

Besides various mackerel species, the majority of other species caught by the recreational sector during targeted game fishing are trevally and queenfish. Most (over 83%) of these fish are retained. Other minor species caught also have a high retention rate of 78%.

Threatened species interaction

Due to the highly targeted nature of the troll fishing method, interactions with threatened species are highly unlikely. The single sea snake above, not identified to species, was the only protected or threatened species observed or reported during 2005.

Ecosystem Impact

The fishing gear and targeted nature of fishing operations observed in the fishery have minimal impact on the ecosystem.

Social Impact

The social value of the commercial Spanish Mackerel Fishery is mostly derived from the employment and economic activity generated by fishing operations. The fishery has a total of 19 licences. A vessel typically operates with a skipper and two-crew members, and most processing is undertaken on-board (and therefore very limited processing of catch occurs ashore). Although some fish is processed for further sale and consumption locally, most Spanish mackerel is sold interstate.

Spanish mackerel is a highly regarded sport and food fish by the recreational sector and to a lesser extent, the Fishing Tour Operator sectors.

Economic Impact

At the point of first sale in 2005, the value of the catch from the commercial Spanish mackerel Fishery was $2.41 million, up from $1.75 million in 2004. The catch of Spanish mackerel species effectively represented the total catch value for the fishery. While total economic return from the fishery was lower, in line with reduced catches and effort, there was a 10% increase in return per tonne, reflecting improved demand and effective marketing strategies by fishers.

The recreational fishing sector also contributed to the Northern Territory's economy, especially with regards to the service and tackle industries.

STOCK ASSESSMENT

Monitoring

Monitoring of the Spanish Mackerel Fishery comprises two main elements. The first of these is a logbook system which provides catch and effort information. In addition, research staff and fishers regularly monitor catches on board commercial vessels, measuring the fish and obtaining biological information such as sex and maturity. Details of fishing effort and strategy are also recorded. Some fishers also routinely provide length measurements of the fish taken. In 2005 four monitoring trips were undertaken. The Genetag project (see Research section below) has the intention of developing a method for directly monitoring catchability and harvest rates.

Stock Assessment Methods and Reliability

Various stock assessment methods have been applied to the NT Spanish Mackerel Fishery. Age structured models using the available time series of catch and effort have provided the best results but even those assessments are considered to be only moderately reliable.

Stock assessment of Spanish mackerel in the NT has been problematic in that the time series of catch and effort are explained with similar probability by a very wide range of harvest levels. In the absence of more information for alternative assessments, initial management of the fishery used the approximate equilibrium catch of the Taiwanese fleet (450 tonnes per year) as indicative of an optimum sustainable annual yield. Using this as a limit reference point, conservative management (chiefly with measures to contain fishing effort) was adopted, to ensure protection of the resource.

Assessments in 1997 and 2000 (Walters and Buckworth 1997; unpublished) and 2003 (Buckworth, 2004) indicated that the fishery has been recovering from over-fishing by the Taiwan-Australia joint venture fishery of the 1970s and 1980s. Stevens and Davenport (1991) also interpreted declining size and catch rates in that fishery as indicating overfishing, while a decline in genetic diversity (Buckworth et al. 2006) also suggests overfishing by that joint venture fishery.

However, despite a longer time series of catch and effort, as well as age structure information, the real impact of the fishing could not be ascertained without better information on harvest rates or abundance. In addition to stocks being finely divided geographically, it is difficult to estimate Spanish mackerel abundance, as the fish are not amenable to survey by trawling or gill net or even by air, and are difficult to capture uninjured for tagging. As they are strongly schooling fish, catch rates are poor indicators of abundance.

The assessment workshops of 1997 and 2000 (Walters and Buckworth, 1997, unpublished) underlined the need for better information on harvest rates or abundance, but pointed out that the NT stocks of Spanish mackerel may now be close to being fully utilised. This was reiterated at a workshop held in August 2000, where it was suggested that the Spanish Mackerel Fishery is probably below or nearing sustainable catch levels. Analysis of data on catches taken during the Taiwanese fishery (1974-1986), in conjunction with Northern Territory domestic catches, suggested that the lack of older fish in the age structure information resulted from overfishing by the Taiwanese fishery, and that the recovering Northern Territory population of Spanish mackerel may be nearing optimum catch levels. Substantial uncertainty in this and subsequent assessments (Buckworth 2004) may reflect inaccuracies in the catch and effort time series from the Taiwanese fleet. The 2000 assessment also cautioned that while there were strong management measures to contain commercial fisheries, if the NT follows world trends, the room for growth may be taken up by guided and charter fishing. The North American experience has seen explosive growth in this area, as there are no ceilings on the number of participants, with a substantial increase in their share of the catch.

Current Harvest Status

Recent assessments indicate that the Northern Territory Spanish Mackerel Fishery is currently fished below or at the optimum level.

Future Assessment Needs

It has been recognised that assessment based on time series of CPUE as an index of abundance or biomass in schooling species such as Spanish mackerel is unreliable. Assessments based on monitoring of harvest rates through tagging would be much more informative (Buckworth, 2004). Use of tag-based monitoring would overcome the lack of confidence in the accuracy of the early catch data time series.

RESEARCH

Summary to Date

Research programs for the Spanish Mackerel Fishery seek to improve knowledge of stock structure and harvest rates and other information required for fishery assessment and management. Cooperative research with the commercial and recreational sectors, as well as other fisheries research and management agencies, contributes to the success of these projects.

An FRDC funded project initiated in 1992/93 examined the age composition of the commercial Spanish mackerel catch, based on the examination of growth patterns from fish otoliths (ear bones) and length composition of the catch. That study found that Spanish mackerel in the catch varied in age between one and eleven years. Most of the catch was about 100

cm (length to caudal fork) and between three and six years of age indicating that Northern Territory Spanish mackerel are not fully subjected to commercial fishing until they are around five years old. Size at age was quite variable. Females were the largest fish in the catch, and for any given age, the females were usually larger than the males.

A study aimed at describing the geographic structure of the Spanish mackerel stocks across northern Australia was completed in 2002. NT Fisheries, Queensland Department of Primary Industries and Fisheries (QDPIF), Western Australia Department of Fisheries and the University of Queensland collaborated to examine the spatial stock structure of northern and western Australia's Spanish mackerel (Buckworth et al. 2006). The study used three stock discrimination methods: genetics, parasite loadings and otolith chemistry.

This FRDC-funded work showed that Spanish mackerel in the Top End are not highly migratory but are actually divided into a mosaic of separate adult groups. Little interaction between groups is evident from the parasite and otolith isotope results, which demonstrated that these fish do not mix much over distances as short as 100 km. Thus very few fish from Cape Wessel, for example, would mix with fish from Groote Eylandt, or from the Darwin region. However just three distinct genetic stocks were identified: one on the east coast, one across northern and western Australia, and a third distinct stock lying between, in the Torres Strait area. Fish sampled from Kupang (Indonesia) were also found in this study to be distinct from the three Australian stocks, in that movement from Australia was not supported by either parasite or genetic analyses. Movement of fish in the other direction (ie from the vicinity of Kupang to Australian waters) was not discounted. There may be some mixing between these four stock units, but they certainly have distinctive seasonal migration and historical fishing patterns. This means that analysis of catch information and management must take into account or be robust to these fine scales. Several articles are anticipated from this work.

Incorporation into Management

NT Fisheries staff review results of all research programs annually. If research determines significant changes in any aspect of the fishery, a review of the management arrangements is undertaken.

Current Research

A project to develop a new approach for tagging an aggressive predatory fish like Spanish mackerel commenced in 2001, with funding from the Northern Territory Research and Development Trust Fund. Methods have been developed to "tag" Spanish mackerel by DNA fingerprinting techniques without the need to actually catch the fish. A special hook, the "Genetag Hook", has been designed to remove a very small piece of tissue for DNA fingerprinting, causing minimal damage to the fish. Subsequent DNA screening of tissue samples from the catch will reveal those which have been "tagged" before. Using this technique it will be possible to quite accurately determine harvest rates for monitoring the state of the fishery.

Subsequent to the success of the pilot work described above, the project *GENETAG: Genetic mark-recapture for real-time harvest rate monitoring. Pilot studies in northern Australia Spanish mackerel fisheries* was commenced, and supported by the FRDC. This project is a collaboration between the Department of Primary Industry, Fisheries and Mines (DPIFM), QDPIF, and commercial and recreational fishing groups. It aims to refine the tissue sampling method, develop efficient genetic screening methods and implement the genetic tagging approach at the fishery scale. The project has seen the genetic tagging of more than a thousand fish, the implementation of tissue sampling techniques with a 75% success rate, the development of protocols for preservation and storage of samples, as well as DNA extraction, identification and matching protocols. The project has been expanded to include combined conventional/genetic tagging, with a panel of expert anglers tagging more than 400 fish in 2004, and even more in 2005. Around 3% of these conventionally-tagged fish have subsequently been recaptured. The first recapture of a genetagged fish - a fish that was genetagged and subsequently genetagged again 6 weeks later - was detected in genetic screening during 2004. Several more short term recaptures have since been detected from 2004 and 2005. In these cases fish were genetagged more than once within a few days of each tagging, or were detected in the landed catch after having been genetagged at the same location within the previous few days. While these recaptures do not as yet provide a good estimate of harvest rates, they do form "proof of concept" for the Genetag approach.

MANAGEMENT/GOVERNANCE

Management

On 1 January 2005 the Northern Territory Spanish Mackerel Fishery Management Plan came into effect.

Objective

The overall objective is to ensure the long-term sustainability of the fishery by maintaining landings within acceptable ranges. The management framework seeks to maintain all landings of Spanish mackerel at or below 450 tonnes per annum. A review of management arrangements will commence should estimated aggregate landings by all sectors reach 405 tonnes (being 90% of the estimated yield) or total fishery catch declines by 30% over 12 months. Catch shares have been established for all sectors in ensuring the optimal utilisation of Spanish mackerel resources. Should the estimated catch share by a stakeholder group(s) either commercial or recreational, vary by more than 20% over 12 months, a review of the management regime will be commenced (see Table 1).

Current arrangements also seek to ensure the sustainability of byproduct taken in the Spanish Mackerel Fishery by maintaining its contribution to less than 10% of the total catch.

These objectives are achieved by the *Spanish Mackerel Fishery Management Plan*, primarily through reducing commercial participation rates to extremely low levels, further effort reduction programs, the monitoring of catches and through regular reviews of management plans.

History

Until the early 1970s, the holder of a general fishing licence could land and sell fish, including Spanish mackerel. Throughout the 1970s, management arrangements were refined, with the taking of Spanish mackerel restricted to the holder of net and line licences.

A Taiwanese gill net fleet commenced fishing for pelagic species, including Spanish mackerel, in 1974. Overall catches from the AFZ peaked at 10,000 tonnes per year (processed weight), with shark, tuna and mackerel being the main species. The foreign fishing fleet was permitted to fish within 12 nautical miles of the Northern Territory coast until 1978, at which time they were excluded from waters adjacent to Arnhem Land and the Wessel Islands. Foreign fishing vessels were excluded from the Gulf of Carpentaria in the following year. Net lengths were restricted during 1986 in response to declining shark catch rates and concerns about the incidental capture of dolphins. These controls resulted in the conclusion of foreign fishing operations in northern Australian waters, late in that year.

With the passage of fisheries legislation in 1980, the Net and Line licence was superseded and commercial mackerel fishers were issued with a Reef and Mackerel licence. In 1984, the licensing scheme was further refined, with pelagic, inshore reef fish or offshore reef fish fishery endorsements allowing trolling as a permitted fishing method to take Spanish mackerel. Fishers were encouraged to operate under a pelagic fishery endorsement when targeting Spanish mackerel.

The Commonwealth Government managed all fish species in northern Australian waters beyond three nautical miles of the coast, until 1988. The Northern Territory Government assumed responsibility for the management of Spanish mackerel at this time for all waters adjacent to the Northern Territory coast to the outer boundary of the AFZ.

A ceiling on the number of licences in the pelagic fishery was introduced in 1990. A public announcement on 1 April 1991 advised that the landing of Spanish mackerel by other than the holder of a pelagic endorsement might not be recognised in any future allocation of fishing entitlements.

With the declaration of the Spanish Mackerel Fishery in 1991, only those licensees able to demonstrate a reliance on the fishery maintained access. Consequently, the number of licences was reduced to 28. An active licence reduction scheme was introduced in 1993 with new entrants required to either surrender two pre-existing licences or acquire a licence previously issued on the surrender of two licences.

Current issues

In 2005 the aggregate catch of all sectors exceeded 90% of the total allowable catch for the fishery triggering a review of the management arrangements. The review will be undertaken by the Spanish mackerel Fishery Management Advisory Committee to determine whether or not mitigation management measures are required. At this time researchers believe the catches are not sufficiently high to warrant any immediate concern or further management measures.

Incidental landings of Spanish mackerel in the Offshore Net and Line Fishery and Finfish Trawl Fishery continue to be monitored and managed through a byproduct management plan

Future plans

Recommendations from the Spanish Mackerel Fisheries Management Advisory Committee (SMFMAC) were incorporated into a new draft management plan which was released for public comment in mid 2004. The new Spanish Mackerel Management Plan came into effect on 1 January 2005. Catch share allocations for each sector will be reviewed regularly to ensure catches are maintained within agreed parameters (see Table 2).

The Spanish Mackerel Fishery received export exempt accreditation under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. NT Fisheries has committed to: undertaking a compliance risk assessment of the Fishery, report on yearly results of observer surveys conducted, continue to seek out alternative cost effective fishery independent sampling techniques, and undertake risk assessment for byproduct and/or bycatch species should its contribution to the total catch change. NT Fisheries will continue to monitor the size composition of the commercial catch of Spanish mackerel and will introduce additional management measures if the catch composition shifts to immature fish.

During 2005 a desktop study to determine the circumstances leading to the increase in Spanish mackerel catches in the Off Shore Net and Line Fishery was conducted. A number of fishers were discovered to be taking large catches of Spanish mackerel while targeting shark and grey mackerel. Consultation with these fishers has resulted with the incidental catch of Spanish mackerel subsequently decreasing in 2005. The situation will continue to be closely monitored with the trend in declining incidental catch expected to continue.

Compliance

Compliance activities associated with the Spanish mackerel fishery management arrangements are undertaken by the NT Marine and Fisheries Enforcement Section (MFES), under the *NT Fisheries Act 1988.*

In 2005 there were no significant compliance issues for this fishery.

Consultation, Communication and Education

The SMFMAC was formed to provide a collaborative group to make recommendations on the future management of the Spanish Mackerel Fishery.

Notable achievements of SMFMAC to date include formulating management arrangements that led to the initial *Spanish Mackerel Fishery Management Plan* and its subsequent amendment. These measures included the introduction of a Spanish mackerel Total Allowable Catch and sector shares into the fishery, continuation of the licence reduction scheme and recommendations for the reduction of the incidental byproduct of Spanish mackerel in other commercial fisheries.

Regular consultation occurs between NT Fisheries, the Northern Territory Troll Line Fisherman's Association, the Northern Territory Seafood Council, the Amateur Fishermen's Association of the Northern Territory and other extractive stakeholders to discuss matters of concern within the fishery.

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Table 2. Management strategies for the Spanish Mackerel Fishery

Objective	Performance Indicator	Trigger Point	Management Action
Ensure the sustainability of Spanish mackerel stocks	Estimated catch by all sectors does not exceed the estimated sustainable yield of Spanish mackerel	Aggregate landings by all sectors reach 90% of the sustainable yield (by whole weight) and/or total fishery catch declines by 30% over the calendar year (by whole weight)	Management arrangements for the Spanish mackerel fishery will be reviewed by SMFMAC within 12 months of a trigger being reached. Management regime to be implemented to ensure that aggregate landings by all sectors do not exceed estimated sustainable yield
	Genetic studies indicate discrete Spanish mackerel stock(s)	Discrete Spanish mackerel stocks identified	SMFMAC to review and make recommendations on appropriate management response to ensure the sustainability of discrete Spanish mackerel stocks
	Sustainable yield estimates are reviewed annually	Annual review	Continue existing research and review alternative yield estimate methodologies annually
Optimal utilisation of Spanish mackerel	Estimated catch share (as a percentage of total aggregate landings, by whole weight) for all sectors remains unchanged	Estimated catch share by a stakeholder group(s) (commercial or recreational) changes (increase or decrease) over the calendar year by more than 20% (by whole weight)	Undertake a desktop study to determine the circumstances leading to the increase/ decline in catch share arrangements. SMFMAC to make recommendations to the Director of Fisheries on appropriate management arrangements to address any changes in catch shares
Ensure the sustainability of byproduct taken in the Spanish Mackerel Fishery	Byproduct in the Spanish Mackerel Fishery increases significantly	Byproduct in the Spanish Mackerel Fishery increases to 10% of the total catch over the calendar year (whole weight)	SMFMAC to make recommendations to the Director of Fisheries on appropriate management arrangements to address any changes and reduce byproduct levels
Ensure the sustainability of bycatch taken in the Spanish Mackerel Fishery	Bycatch in the Spanish Mackerel Fishery increases significantly	Bycatch in the Spanish Mackerel Fishery increases to 10% of the total catch over the calendar year (whole weight)	SMFMAC to make recommendations to the Director of Fisheries on appropriate management arrangements to address any changes and reduce bycatch levels
Minimise effects of fishing operations on endangered/ threatened/protected species/communities	Endangered/threatened/ protected species/ communities are identified in NT waters	Impacts are observed by commercial fishers or fisheries observers	Threat abatement plan implemented

Timor Reef Fishery Status Report 2005

INTRODUCTION

Commercial operators in the Timor Reef Fishery principally target goldband snapper (*Pristipomoides multidens* and other *Pristipomoides* species) and also land significant quantities of red snappers (*Lutjanus malabaricus, L. erythropterus*), red emperor (*Lutjanus sebae*) and cods (Family Serranidae).

Prior to the declaration of the Australian Fishing Zone (AFZ) in 1975, the area was fished by international fishing vessels. A prohibition on finfish trawling was implemented in the late 1980s. Following exploratory fishing trials under a joint venture arrangement, and marketing trials underwritten by the Northern Territory Government, trapping and droplining by local operators commenced in 1987. Management arrangements were further refined in the early 1990s with the introduction of a precautionary licence reduction scheme. With the passage of revised jurisdictional arrangements in 1995, management of the fishery passed to the Northern Territory Fisheries Joint Authority.

In 2005, there were 12 licences in the fishery, a reduction from 22 licences in 1993. A limit of 45 fish traps for each licence was agreed to in 2002 and implemented as a licence condition in 2004.

The Timor Reef Fishery operates under the highest level of export accreditation as assessed against the *Guidelines for the Sustainable Management of Fisheries* under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act). The management arrangements of the fishery are recognised by the Australian Government Department of Environment and Heritage to be operating in a sustainable manner. The fishery is exempt from export regulations for 5 years.

PROFILE OF THE FISHERY

Commercial Sector

Area

The Timor Reef Fishery operates well offshore out in the Timor Sea, in a remote region extending north-west of Darwin to the Western Australia/Northern Territory border and to the outer limit of the AFZ. The fishery has an area of approximately 8400 nm^2 (Figure 1).

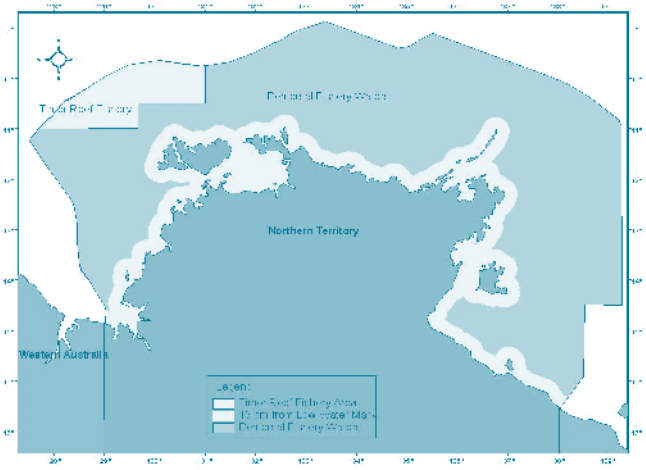

Figure 1. Area of the Timor Reef Fishery

Fishing method

Commercial operators are authorised to use baited traps and vertical lines, including handlines and droplines. Although some operators used traps during the early development phase of the Timor Reef Fishery, most chose to use vertical lines as the fishery developed. However, during 1999 and 2000 there was an industry wide change to trap fishing, and during 2002 only one operator was using droplines, with the remainder having changed to traps. There was a reversal of this trend back to droplines by many operators during 2004, as dropline caught fish are of better quality. Presently, two vessels use traps and the remainder dropline.

Catch

The principal target species of the Timor Reef Fishery are goldband snapper, which comprise the three species *Pristipomoides multidens, P. typus* and *P. filamentosus*. Together these species comprise 70% of the total catch (Figure 2), with *P.*

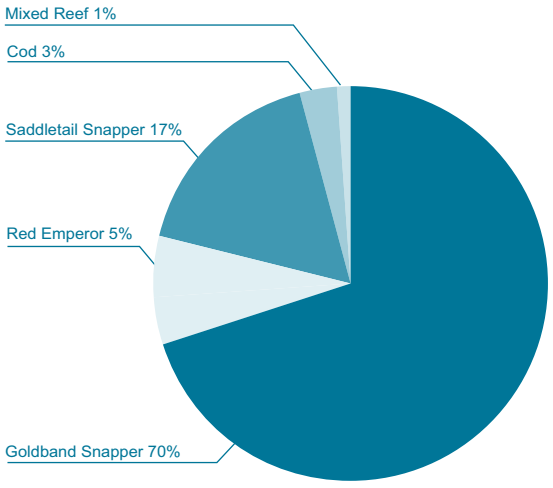

Figure 2. Composition of the catch from the Timor Reef Fishery for 2005

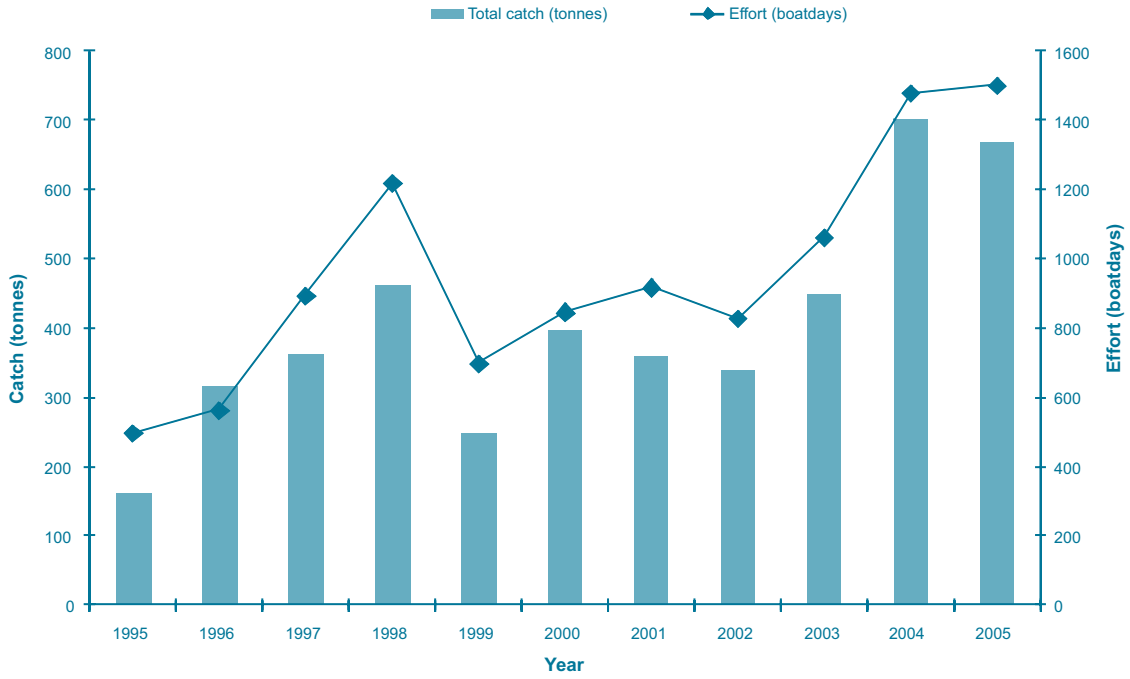

Figure 3. Catch and Effort for the Timor Reef Fishery 1995-2005

Figure 4. Catch rates for the Timor Reef Fishery, 1995-2005

multidens being the most common of the three *Pristipomoides* species. Other key species in this fishery are saddletail snapper (*Lutjanus malabaricus*), red snapper *(L. erythropterus*), red emperor (*L. sebae*) and cods (Family Serranidae).

In 2005, the total catch from the Timor Reef Fishery was 669 tonnes, while the goldband snapper catch component was 453 tonnes. The decrease from a total catch of 703 tonnes in 2004 is largely accounted for by a decrease in goldband snapper landed compared to the 485 tonnes in 2004.

Byproduct species for the Timor Reef Fishery only make up 1% of the overall catch. These include predominantly small snappers such as *Lutjanus vittus, L. russeli*, and emperors such as red spot emperor (*Lethrinus lentjan*) and Robinson's seabream (*Gymnocranius grandoculus*).

The 2005 byproduct level is well below the 10% trigger value required for a review of management arrangements for the protection of byproduct species.

Effort

During 2005, ten operators fished a total of 1503 boat days, which is marginally higher than during 2004 (Figure 3).

In 2005, there were 12 licences operating in the fishery. As mentioned earlier, the number of licences was reduced from 22, through an ongoing two for one licence reduction program.

Catch rates

Catch per unit effort (CPUE) increased in 2000 with the introduction of traps, however there was a decline in CPUE in 2001, but has remained relatively steady in the following years (Figure 4).

Marketing

Due to the lack of consumer familiarity with tropical snappers and emperors during the early developmental phase of the fishery, initial catches were processed and sold as frozen fillets on southern domestic markets.

Trial shipments of whole fresh "gilled and gutted" goldband snapper were well received. Studies on tropical snappers indicated a shelf life of up to 20 days after capture. This led to a marketing break-through for these species.

Currently, almost all snappers landed within the line and trap fisheries are sold as "fresh on ice" whole fish (including gills and stomach), with very small amounts sold as fillets. As the Darwin market is small, most product is forwarded to interstate markets, principally Brisbane and Sydney. Increasingly, operators are developing marketing arrangements outside the traditional central marketing systems, with a local representative of a major seafood wholesaler continuing to co-ordinate consignments to east-coast markets. At least one operator independently markets catch from his two vessels.

Non-retained Species

For the Timor Reef Fishery, the reported and observed level of bycatch (non-retained species) is less than 7% of total catch. The demersal tropical species landed in the fishery are well received throughout existing marketing channels.

Non-retained species include chinaman fish (*Symphorus nematophorus*), red sea bass (*Lutjanus bohar*), big eye trevally (*Caranx sexfasciatus)*, and starry triggerfish (*Abalistes stellatus).*

Bycatch in this fishery is below the 10% trigger value.

Threatened species interaction

In 2005, there were no recorded interactions with threatened species in the Timor Reef fishery. The method of fishing and the location of the fishery generally prevent interactions with threatened species.

Ecosystem Impact

The management arrangements for the fishery allow operators to use passive fishing gear comprising of vertical lines and traps. Interaction with the habitat is limited to the effects of traps and vertical line weights on the substrate and the effect of anchors. Traps are connected individually to an identifying float by a single line, traps are not attached to each other in order to avoid excessive interaction with the substrate upon hauling. Anchoring is usually limited to overnight stand down of fishing activity.

No interaction between the fishing gear and protected species has been observed. Such interactions are not expected with a deep-water trap fishery.

The impact of "ghost fishing", i.e. the continued

fishing of lost traps, is not considered to be significant in terms of either its impact or occurrence. Underwater video observation of traps during commercial fishing operations throughout northern Australia has shown the entry and exit of fish from the traps used in the fishery.

A prohibition on fish trawling within the area of the Timor Reef Fishery was declared in the late 1980s. Such a declaration sought to provide greater protection of the then emerging fishery from the impacts of demersal fish trawling. The Australian Government managed Northern Prawn Fishery allows prawn trawlers to operate year round in offshore waters throughout northern Australia. Prawn and scampi (deepwater shellfish) trawling activity is generally limited to water greater than 200 m deep in areas immediately north of current Timor Reef Fishing grounds.

Social Impact

This fishery directly employs over 42 people as boat crew, packagers, marketers and numerous people in other support industries, e.g. transport, boat repairs etc.

Economic Impact

At the point of first sale in 2005, the overall catch value of the commercial Timor Reef fishery was $4.3 million. The goldband snapper component was $3.3 million (2004 - $3.18 million) and the catch value of saddletail snapper was $0.45 million (2004 - $0.53 million).

STOCK ASSESSMENT

Monitoring

This fishery is monitored primarily through logbooks, which operators are required to fill out on a daily basis during fishing operations. These logs provide detailed catch and effort information, as well as information on the spatial distribution of the fishery. Logbooks are submitted with monthly marketing information by the 28th day of the following month. In addition to logbooks, fisheries officers conduct onboard monitoring of commercial fishing trips. While onboard, observers document vessel and gear information, location, depth, fishing practices, catch composition (including by-catch), and where possible, measure all landed species.

Due to resource constraints two onboard monitoring trips were conducted during 2005.

Stock Assessment Methods and Reliability

A stock assessment of goldband snapper for the Timor Reef Fishery was undertaken in 2003. This analysis also included part of the Demersal Fishery from the boundary of the Timor Reef Fishery to longitude 133° E, as 95% of the Demersal Fishery catch of goldband snapper is within this area. These two sectors encompass the same goldband snapper stocks. The models used in this stock assessment were an extension of those developed by Professor Carl Walters at a workshop in Darwin in 1996 and details can be found in Ramm (1997).

Spatial analysis of catch per unit effort (CPUE) data on a finer scale was undertaken at three locations in the Timor Reef Fishery. The areas chosen were Tassie Shoal, Lyndoch Shoal and Franklin, Flinders, Blackwood and Evans Shoals that were combined into a single group. These areas were chosen as they accounted for 15-30% of the fishery over the period 1995-2003.

Both computer modelling and finer spatial data analysis showed trends that were of concern. While catch rates for the entire fishery (Figure 3) have increased since 1995 and appear to be relatively stable, this masks a contrary trend occurring on a finer spatial scale. However all modelled scenarios suggest a decline in biomass if current levels of fishing effort are maintained. How quickly this occurs depends upon assumptions made about the level of exchange between the two areas, the level of Indonesian fishing effort, and whether Australian fishing effort increases. Finer spatial analysis of this fishery will be undertaken as part of FRDC project 2005/047 which commenced in October 2005.

An absolute figure cannot be placed on sustainable harvest because key parameters (Indonesian catch and effort, the level of interchange of fish and recruits, and the important productivity parameters for goldband snapper) are not known. However, the goldband snapper biomass has been estimated to be between 3,000-20,000 tonnes, with 9,000 tonnes considered the more realistic estimate. It has been recommended that the harvest level of goldband snapper should not exceed 10-15% of estimated biomass.

Genetic analysis using mitochondrial DNA has shown that goldband snapper (*Pristipomoides multidens*) is the same stock in both the Timor and Arafura Seas (Ovenden et al., 2002), but

there are a number of separate stocks throughout Indonesia (Ovenden et al., 2004).

Otolith microchemistry indicates that adult goldband snapper are relatively sedentary and there is unlikely to be substantial movement between Western Australia and the Northern Territory (Newman et al., 2000) therefore it is appropriate that these stocks be managed separately.

Current Status

In the Timor Sea, goldband snappers are targeted by Indonesian long line vessels as well as Australian trap and dropline vessels. These methods target fish above the size of maturity. Harvest levels in the Australian sector of the Timor Sea are below current reference points.

Future Assessment Needs

Future assessment needs to concentrate on the degree of movement of snappers between Australia and Indonesia, the identification of goldband and red snapper juvenile habitats, and obtaining more accurate growth parameters from the capture of juvenile goldband snapper.

RESEARCH

Summary to Date

The stock structure of goldband snapper (*P. multidens*) has been determined through a number of externally funded projects.

The FRDC funded projects 1996/131; 1998/154, were collaborative projects between NT DPIFM, WA Department of Fisheries and Queensland DPI. These studies used mitochondrial DNA (mtDNA) and otolith microchemistry techniques to determine the stock structure of *P. multidens* resources between the Northern Territory and Western Australia. Opportunistic samples were obtained from Kupang (Indonesia). Both studies used fish from the same sites.

The genetic study showed no differences between Australian sampling sites in the Timor and Arafura Seas, but a significant difference in the Timor Sea between Kupang (West Timor) and the north-west Australian site less than 200 nautical miles on either side of the Timor Trench. Otolith microchemistry revealed distinct populations for all sites sampled, indicating that substantial movement of adults between sites is unlikely (Newman et al., 2000).

Growth and reproductive studies were undertaken on *P. multidens,* as part of the collaborative ACIAR funded project between Australia and Indonesia (FIS/1997/165). This study provided updated parameters that were incorporated into stock assessment models for the current assessment.

Incorporation into Management

The recent research findings have confirmed the validity of present management arrangements for this fishery between the Northern Territory, Western Australia and Indonesia.

Current Research

Current research is focused on developing a holistic approach to fisheries management using Geospatial statistics and fuzzy rule-based modelling. This work, funded by FRDC (project 2005/047), explores new ways of incorporating the very diverse forms of physical and environmental data (often on different spatial scales), with catch and effort data from the Timor Reef Fishery. This will enable analysis of the many components that may affect fish abundance and catchability in a geo-referenced framework. The fuzzy rule-based modeling allows the uncertainties of human knowledge to be captured as hard data. This work is expected to be completed in 2007.

MANAGEMENT/GOVERNANCE

Management

Objective

Management objectives for the Timor Reef Fishery are achieved by maintaining target, incidental and non-retained catch levels within acceptable ranges. Should landings of goldband snapper rise above sustainable yield estimates, a review of the management arrangements will commence. Similarly, a significant decline in catch rates would prompt a review of the management measures for this fishery (Table 1).

Existing arrangements also seek to ensure the sustainability of byproduct species taken in the Timor Reef Fishery. Acceptable catch ranges for by-product are not more than 10% of the weight of aggregate landings in the fishery.

Monitoring of the fishery is achieved through analysis of commercial logbook reports and onboard observers.

Controls on the construction and use of fish traps and vertical lines minimise the effects on ecosystem components. Should significant interaction with components be identified, the appointed advisory group will make recommendations regarding appropriate remedial action. No such interactions were identified throughout the reporting period.

History

A joint venture feasibility study between an Australian and Japanese company was undertaken in the early 1980s to investigate the potential for a domestic dropline fishery. Landings from the trial were around 1500 tonnes per annum. It was not until 1987 that commercial droplining by domestic operators commenced. Jurisdictional arrangements were changed in 1995, at which time management responsibility for line fishing and trapping in waters adjacent to the NT passed to the Northern Territory Government.

In responding to concerns that excess fishing capacity may lead to the over-exploitation of goldband snapper stocks, a moratorium on the issue of further entitlements for what is now known as the Timor Reef Fishery was announced in December 1991. Only those fishers active in the fishery or licence holders able to demonstrate a commitment to entering the fishery retained access.

Separate management measures were implemented for the Timor Reef Fishery in 1993 when it was annexed from the Demersal Fishery. Overall fishing capacity within the boundary of the Timor Reef Fishery was reduced from a potential 60 to 22 licences. Limits on the number of operators were implemented in responding to concerns that fishers displaced from interstate fishing restructuring programs may lead to over exploitation of goldband snapper stocks.

A further revision of the jurisdictional arrangements occurred in 1995. At that time management responsibility for the Timor Reef Fishery was passed to the Northern Territory Fisheries Joint Authority (NTFJA). The NTFJA provided for the Commonwealth and the Northern Territory to jointly manage the fishery given the likelihood of shared resources with adjacent national and international jurisdictions. NT Fisheries undertake day-to-day management of the Timor Reef Fishery.

Agreement was reached on a ceiling of 45 fish traps during 2002. The limit was implemented as a precautionary measure and to provide clarity on the amount of fishing gear used under each licence.

Current issues

Anecdotal reports from domestic fishers suggest illegal foreign fishing catches are increasing.

The impacts of Illegal, Unreported and Unregulated (IUU) fishing in northern Australian waters, primarily by foreign fishers are poorly understood. The NT Government continues to lobby the Federal Government to ensure adequate resources are allocated by the Australian Government (governing body is the Australian Fisheries Management Authority) to mitigate IUU impacts on the sustainability of red snapper stocks.

While it is accepted that most IUU fishers are primarily targeting sharks, apprehended vessels holding significant quantities of red snapper are becoming more prevalent. Research to determine the probable impact this illegal foreign presence is having on domestic shark and snapper stocks is continuing with AFMA funding a number of projects attempting to determine the species and volumes of sharks and snappers being harvested. It is not yet possible to determine the potential effect IUU fishing is having on the tightly regulated domestic Timor Reef Fishery.

Future plans

An industry request to review the levels of permitted gear (handlines and droplines) and management arrangements will be undertaken throughout 2006/07 with a view to developing a formal plan of management for the fishery.

Goldband snapper are also landed outside the boundary of the Timor Reef Fishery, but are likely to be part of the same stock. Management triggers recognise this, with the management arrangements under constant review.

Compliance

Compliance with the Timor Reef Fishery management arrangements are undertaken by the Police, Marine and Fisheries Enforcement Section (PMFES) of the NT Police and Fire and Emergency Services, under the NT *Fisheries Act 1988.*

The PMFES effectively monitors compliance and enforces the Timor Reef Fishery management arrangements through the inspection of vessel arrivals and departures through the single port of

Darwin. This includes verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product).

The PMFES has the power, if necessary, to investigate the records of wholesalers and licensees.

In 2005, there were no significant domestic compliance issues recorded for this fishery.

Consultation, Communication and Education

Regular consultation occurs between NT Fisheries, the NT Timor Reef Fishermen's Association and the Northern Territory Seafood Council. In addition to this, Fisheries staff undertake regular visits to the wharf to speak informally with fishers.

The low levels of participation in the Timor Reef Fishery allows all stakeholders to be directly involved in discussions on any proposed management arrangements. A framework for a Timor Reef Fishery Management Advisory Committee has been developed to formally represent the interests of all stakeholders and provide a forum to discuss any proposed amendments to the management regime.

Conservation groups and non-government organisations are advised and consulted on topical fisheries issues, including the Timor Reef Fishery, through monthly advisory meetings with senior fisheries officers and the Director of Fisheries. Members of the public, including community and environmental/conservation groups are also invited to provide their views to NT Fisheries through the release of public discussion papers and other consultative processes.

NT Fisheries also puts out publications in the form of Fisheries Reports and newsletters to inform and educate stakeholders.

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Table 1. Review of 2005 catch figures against management trigger points for the Timor Reef Fishery

Species	Catch Tonnes	% Total Catch	Fishery Management Review Trigger	Status
Goldband snapper	459	70%	Annual catch exceeds 900 tonnes	Trigger not exceeded
Red snappers (including saddletail snapper)	133	20%	Annual combined catch exceeds 1,300 tonnes	Trigger not exceeded
Red emperor	34	5%	Annual catch exceeds 25% of total catch	Trigger not exceeded
Cod	21	3%	Annual catch exceeds 10% of total catch	Trigger not exceeded
Mixed reef	21	3%	Annual catch of byproduct exceeds 10% of total catch	Trigger not exceeded
Bycatch	<7	<1%	Annual catch of bycatch exceeds 10% of total catch	Trigger not exceeded
Total Catch	669	-	-	-

Trepang Fishery Status Report 2005

INTRODUCTION

Trepang fisheries throughout northern Australia date back to at least the 1700s, when Macassans from Celebes (Sulawesi Island group, Indonesia) visited northern Australia to fish for trepang. Activity in the fishery declined around 1880. By 1907, the South Australian government had ceased issuing licences to Macassans, possibly due to the emergence of a local industry. Landing reports, though scant, suggest the catch was many times higher than current catch levels.

A lower level of commercial exploitation continued until around 1945. Commercial fishers were generally European Australians assisted by Aboriginal people who inhabited the remote Arnhem Land coast. Little subsequent fishing activity was observed until the early 1980s; with virtually no reported exports. Increasing interest in the late 1980s led to the re-opening of the Northern Territory Trepang Fishery. At that time, six licences were issued for the hand harvesting of trepang.

Initially, the fishery was divided into three separate management areas, with two licences permitted to operate in each area. Once the fishery was operational, licensees in the far western area indicated that there was insufficient product for their operations to be economically viable, particularly given the more extreme tidal fluctuation in this management area. For this reason the central and western zones were merged. Currently, one management zone extends east of Cape Grey in the Gulf of Carpentaria to the Queensland border (including Groote Eylandt) and the other extends west of Cape Grey to the Western Australian border. Controls were also introduced at that time to regulate the number of crew and permitted divers/collectors.

The principal species for the fishery is the sandfish *(Holothuria scabra)*. These prefer coastal areas to coral reefs and are often found in beds of seagrass. Seagrass plays an important function in triggering larval settlement. Sexual reproduction is via broadcast spawning which generally occurs in the warm months (December to February). The planktonic larvae of this species spend 10 to 14 days in the water column before settlement. There is therefore, potential for larval dispersal between populations. Genetic studies in Queensland indicate limited genetic variability between shallow and deep populations of sandfish. The latter finding may be consistent with the view that juveniles settle in shallow seagrass beds and then migrate to areas of deeper water during their life span.

The terms trepang, sea cucumber or bêche-de-mer are often used interchangeably, although “trepang” actually refers to the high valued dried body wall of the sea cucumber which belong within the taxonomic group of holothurians.

In late 2004, the Northern Territory Trepang Fishery was assessed by the Australian Government Department of Environment and Heritage. As a result, the fishery received certification as an accredited Wildlife Trade Operation (WTO). This assessment demonstrated that the Trepang Fishery is managed in a manner that does not lead to over-fishing, and that fishing operations have minimal impact on the structure, productivity, function and biological diversity of the ecosystem.

PROFILE OF THE FISHERY

Commercial

Area

The Trepang Fishery operates in waters seaward of the coast to an imaginary line drawn three nautical miles seaward of baselines (ie. the NT coastline and surrounding islands).

Fishing method

Sandfish (*Holothuria scabra*) is the most important species for tropical sea cucumber fisheries. Sandfish is one of the few tropical sea cucumber species that prefer coastal areas to coral reefs. Harvesting of sandfish usually takes place by walking at low tides and diving in shallow coastal bays and foreshores. Snorkel, scuba and hookah may be used when diving for trepang. Collection is generally limited to neap tides and the dry season when water visibility improves and cyclone activity is minimal.

Catch

As mentioned earlier, the Target species for the fishery is the sandfish *(Holothuria scabra)*. Due to the method of operation of the Trepang Fishery, there are no byproduct species taken.

Total harvest* in the Trepang Fishery was low until the late 1990s, growing from a little over 75 tonnes in 1996 and 1997, to vary in the range of 110.5 to 247 tonnes, responding largely to fishing effort (Table 1, Figure 1). Total harvest reported for 2005 was 83.1 tonnes.

Note* - Catch and effort values and derived quantities may differ between annual status reports due to variation in data retrieval procedures, and corrections of minor data errors.

Year	Catch weight (tonnes – Wet weight)	Catch no.	Total Catch (tonnes)	Effort (days)	Effort (hours)
1996	12.6 `	119077	77.4	279	1244.0
1997	15.6`	111619	76.4	249	1148.8
1998	82.3`	51723	110.5	521	2250.6
1999	199.3`	85610	245.9	365	1751.0
2000	247.0	N/A	247.0	274	1344.3
2001	115.0	N/A	115.0	172	799.3
2002	207.0	N/A	207.0	404	2684.1
2003	152.3	N/A	152.3	295	2240.9
2004	102.4	N/A	102.4	255	1471.5
2005	83.1	N/A	83.1	200	1445.5

Table 1. Catch and effort* for the Trepang Fishery, 1996 to 2005
Note: ' Indicates calculated catch.

Effort

Over the period 1996 to 2005, fishing effort* in the Trepang Fishery was highly variable, with between 172 and 521 days fished per year (Table 1, Figure 2). Effort peaked at the latter value in 1998 and gradually decreased to pre-1998 levels in 2001. Effort increased in 2002 (404 days fished) but declined nearly 30% to only 295 days fished in 2003. Effort declined further in 2004 and 2005 to 255 days and 200 days, respectively.

Fishers report that effort levels reflect fishing conditions rather than stock abundance or market factors.

For some periods during 1996-1999, catches were reported alternatively as numbers or weights. The total catch weight for these years was estimated by multiplying catch declared as a number by a typical individual weight (0.544618 kg).

Catch rates*

Until the mid 1990s the catch rates in the Trepang Fishery were low, with 32 kg/hr and 62 kg/hr recorded in 1996 and 1997 respectively (Figure 2). In 2000 the catch rate for trepang peaked at 183.7 kg/hr. Catch rates declined in 2001 levelling out in subsequent years to between 57 kg/hr (2005) and 77 kg/hr (2002). These catch rates remain greater than the early catch rates for this fishery. With a low number of participants, catch rates are subject to high variation as a consequence of fishers entering or leaving the fishery, as well as extrinsic factors such as interannual variation in water clarity that affect catchability.

Licensed commercial operators are permitted to harvest all trepang species. Discussion with fishers indicates that the fishery continues to target sandfish in preference to other lower valued species found in tropical waters. A review of trepang fisheries elsewhere indicates that in the event of a population decline in the higher valued species, fishers seek to maintain profitability by targeting lower valued holothurian species.

Such a situation was observed in the Queensland East Coast Bêche-de-mer Fishery, in which commercial fishers targeted white teatfish (*Holothuria fuscogilvia*) and prickly redfish (*Thelenato ananas*) and in the Torres Strait Fishery, with fishers targeting teatfishes (*H. fuscogilvia, H. noblis),* prickly redfish and surf redfish (*Actinopyga mauritiana*). No such trend has been observed in the Northern Territory Trepang Fishery.

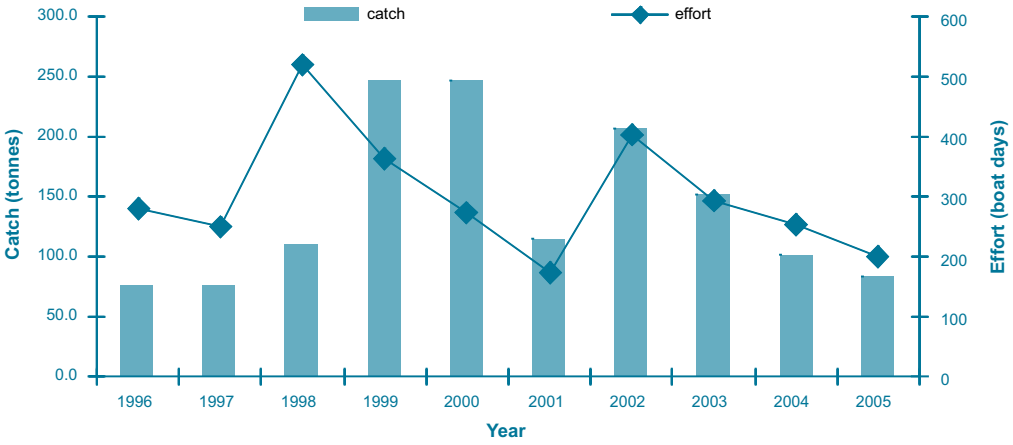

Figure 1. Annual total catch and effort* for the commercial Trepang Fishery, 1996 to 2005

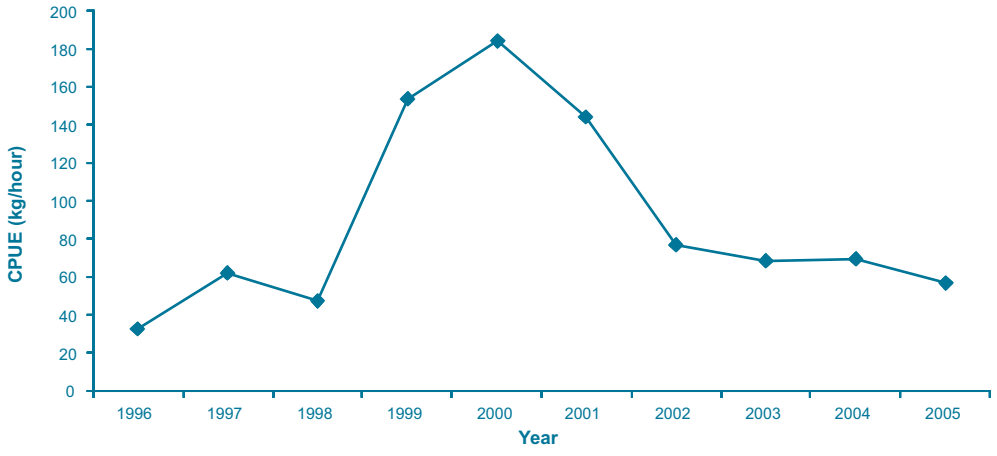

Figure 2. Catch rate for the commercial Trepang Fishery, 1996 to 2005. Catch rates represented here are catch per hour of operation, for those operations where catch was declared in units of weight

Marketing

With restricted land access to the majority of the Northern Territory coastline, all fishing operations are vessel based. Initial processing includes washing, grading and freezing the harvested product, with the majority of the operators removing the stomach, then boiling and freezing all trepang caught. The processed catch is generally unloaded in Darwin (the only Northern Territory port with all season access) and transported to domestic facilities for further processing, typically mechanical drying.

With limited domestic markets, the majority of the catch is exported.

Recreational Sector

The recreational take of trepang is not known but likely to be low. No trepang catch was reported by recreational fishers during either of the two recreational fishing surveys conducted in 1995 and 2000. The local Asian community may take limited amounts for personal consumption.

Fishing Tour Operator Sector

There are no reports of trepang in the catch of FTO clients for 2005.

Indigenous Sector

No take of trepang was reported during the National Indigenous Fishing Survey of Northern Australia undertaken in 2000. Information collected during field trips suggested that trepang is never used as a food source.

Non-retained Species

The targeted hand collection method of fishing for trepang means that there are no non-retained species collected.

Ecosystem Impact

Collection of trepang by hand is likely to have minimal impact on the ecosystem.

Economic Impact

The value of the fishery is confidential as information from less than five active operators in a given fishery is not released without consent from the licensee(s).

STOCK ASSESSMENT

Monitoring

Active commercial fishers in the Trepang Fishery are required to complete daily reports on fishing effort and the level of harvest by both weight and numbers of individuals. This information provides for future detailed assessment of the status of the Trepang Fishery, including the estimation of the average weight of individual trepang harvested as an indicator of the status of the fishery. However, it is important to note that individual weights of trepang vary substantially as the animal may take in or release substantial volumes of water, and the animals have no hard parts that might be a reliable proxy. By reporting total weight and number in catch, fishers nevertheless provide trend information that is of benefit. Fishers also continue to report fishing locality and statistical grid, so that future assessment and management may address the spatial dynamic attributes of the fishery.

Stock Assessment Methods and Reliability

There is no current stock assessment for trepang. As a consequence, NT Fisheries have adopted a precautionary management approach with a limit of six licences in the fishery able to operate within 3 nautical miles of the baseline. This number of licences together with the natural inhibitors, visibility, accessibility, wet season and cyclonic events, limit the potential for over fishing.

Current Exploitation Status

Performance measures for the fishery, catch rates and average size, indicate that the current level of harvest has not exceeded appropriate levels.

Future Assessment Needs

A prog ram to develop a series of cooperative industry and student based projects is currently being developed with the fishing industry and Charles Darwin University. A program of management strategy evaluation (MSE) is to be initiated, to indicate both research directions and monitoring information that would be appropriate for various management options. Research and assessment will seek to assess the status of stocks both within and external to the current fishery area.

Incorporation into Management

Research outcomes indicate that current management and monitoring are adequate. However, future monitoring will depend upon information needs identified above, and future fishery performance.

Current Research

Current research is limited to analysis of trends in fishery statistics and assessment and assimilation of research from other areas and jurisdictions. A framework for the MSE described above is being developed.

MANAGEMENT/GOVERNANCE

Management

Objective

Management of the fishery seeks to satisfy legislative objectives of conserving, enhancing, protecting, utilising and managing the fish and aquatic life resources of the Northern Territory. Key management strategies to achieve the objectives of management include:

- limiting the number of commercial licensees to a maximum of six;
- having two separate management zones, with not more than three licensees authorised to operate in each zone;
- limiting fishing to an area extending from the high water to an imaginary line 3 nautical miles from baselines;
- limiting the number of crew and collectors/ divers; and
- permitting the harvesting of trepang by hand only.

Analysis and monitoring of catch and effort trends, average weight of trepang caught, the continuation of fishing on the same grounds, operational and logistic constraints together with the continued focus on the premier species, the sandfish, indicates that the current arrangements are appropriate to achieve the management objectives of the NT Trepang Fishery.

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

The Trepang Fishery is further managed in accordance with the management objectives, performance indicators, triggers and management actions as agreed through industry and the Australian Government assessment process and as part of the WTO accreditation.

Current issues

Reported catch levels for target sandfish species *Holothuria scabra* throughout 2005 were within acceptable levels.

Over the next 12 months NT Fisheries will be working with the licence owners to develop and implement finer scale data collection and reporting. This will enhance the quality of data collected and mitigate the potential risk of localised depletion of trepang in the fishery.

Compliance

Compliance activities associated with management arrangements for the Trepang Fishery are undertaken by the Police, Marine and Fisheries Enforcement Section (PMFES) of the NT Police, Fire and Emergency Services, under the *NT Fisheries Act 1988.*

The PMFES effectively monitors and enforces the Trepang Fishery management arrangements through the inspection of vessel arrivals and departures through the single port of Darwin. Compliance includes verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product). The PMFES has the power, if necessary, to investigate the records of wholesalers and licensees.

In 2005, there were no significant compliance issues recorded for this fishery.

Consultation, Communication and Education

Regular consultation occurs between NT Fisheries, the single Trepang licence holder and the Northern Territory Seafood Council. In addition, Fisheries staff conduct regular visits to the wharf to speak informally with fishers.

Conservation groups and non-government organisations are advised and consulted on topical fisheries issues, including the Trepang Fishery, through monthly advisory meetings with senior fisheries officers and the Director of Fisheries. Members of the public, including community and environmental/conservation groups are also invited to provide their views to NT Fisheries through the release of public discussion papers and other consultative processes.

NT Fisheries also issue publications in the form of Fisheries Reports and newsletters to inform and educate stakeholders.

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Barramundi Farming Status Report 2005

SUMMARY

Barramundi (*Lates calcarifer*) farming production decreased by 21% in 2005. Combined production from one pond based farm and one cage farm was 837 tonnes in 2005 compared with 1057 tonnes in 2004. The total value of barramundi production decreased from $9.4 million in 2004 to $7.3 million in 2005.

This decrease in production from the commercial barramundi farms was mainly related to technical issues in cage farming. But the rapid growth in production experienced during the three preceding years demonstrated the excellent potential for further industry growth.

PROFILE OF THE FARMING SECTOR

Commercial Production

Distribution of farms

Of the seven licence holders endorsed to produce barramundi, only two farms produced marketable fish in 2005. A third farm continued stocking with juvenile fish throughout the year with first harvests planned for early 2006. The three operational farms were located at Humpty Doo, Berry Springs and the Tiwi Islands.

Hatchery / Nursery production

Commercial fingerling production increased from 1.2 million in 2004 to just over 1.7 million in 2005. Only one hatchery, the government run Darwin Aquaculture Centre (DAC), sold fingerlings during the year. The majority of the fingerlings were sold locally (1.4 million). The size range of the fingerlings supplied to local farmers was 50 mm to 130 mm and 355,000 25-35 mm fish were also sold interstate.

Stocking for recreational fishing

In 2005 over 212,000 excess fingerlings from the DAC were stocked to Manton Dam and a number of other fresh water impoundments in the Darwin area.

Farm production

Only one land based farm, Humpty Doo Barramundi (Australian Barramundi Culture Pty Ltd), marketed fish. The amount of fish produced in ponds increased from 116 tonnes in 2004 to 133 tonnes in 2005. Another pond-based farm, Arda-Tek, started stocking ponds with juvenile barramundi in December 2004 and was expected to commence harvesting in early 2006.

There is only one barramundi sea cage farm in the Northern Territory, operated by Marine Harvest, located on Bathurst Island. The amount of fish produced by Marine Harvest decreased from 941 tonnes in 2004 to 704 tonnes in 2005. This decrease in production was related to technical issues associated with bad weather conditions (fish escapes).

Translocation

There is a translocation protocol which covers health and security issues relating to the importation of barramundi larvae or fingerlings and their movement within the NT. This protocol identifies disease control regions within the Territory. Fish may move between or within zones of equivalent health status but movement into zones of higher health status necessitates quarantine and health certification to ensure that diseases are not distributed along with the translocated stock.

Marketing

In 2005 product was marketed interstate (90%) and overseas (10%) as whole fish (over 1.0 kg).

Employment

Permanent labour employed in the grow-out and hatchery/nursery sectors of the industry had increased from 25.5 in 2004 to 27.5 in 2005 and casual employment increased from 5.5 in 2004 to 8.5 in 2005.

Indigenous Development

Marine Harvest employed two full time Indigenous workers from the Tiwi Islands, and in collaboration with the Vocational Education and Training (VET) programs operated at the Charles Darwin University, provided a training program for others interested in gaining employment with the company. Australian Barramundi Culture Pty Ltd also employed one full time Indigenous worker. There was also one Indigenous apprentice working at the DAC undertaking training in Aquaculture.

Ecologically Sustainable Development / Environmental Management

The Office of Environment and Heritage within the Department of Infrastructure Planning and the Environment (DIPE) oversees environmental assessments and approvals. As part of aquaculture licence conditions, all farms must have an approved environmental management plan

(EMP). The EMP stipulates the environmental parameters under which the farm must be constructed and operated. Pond based farms are required to have discharge licences and all farms are subject to environmental and aquaculture license compliance audits.

Research

Summary to date

Development of barramundi farming in Australia was based originally on the adoption of practices developed in Thailand in the 1970's. The Northern Territory Government first invested in the development of barramundi aquaculture in 1988 and has maintained support for the industry since that time. Recently, European intensive hatchery and nursery technology has been successfully adapted for use in the Territory and is now routinely implemented at the DAC.

In 2002 Marine Harvest Pty Ltd funded work on the development of a bacterin against two pathogenic marine bacteria detrimental to barramundi fingerling production: *Vibrio harveyi* and *Photobacterium damselae*. These bacteria were responsible for a significant mortality at the DAC hatchery/nursery and at the Marine Harvest cage farm. Although controlled studies have not been conducted, it appears that the prevalence of bloat has been reduced, at least in some populations of fish.

The DAC has also assessed new hatchery and nursery feeds (Gemma and Gemma micro from Nutreco), and implemented feeding and grading strategies to improve weaning, growth, survival, and reduce size variation, within the same batch of juvenile fish. Fingerling growth rate to 100 mm has been increased by 20-30% with a 95-100% reduction in Artemia usage.

Current Research

A project proposal was prepared and submitted to the Australian Research Council seeking funding for a new project to improve detection and management of nodavirus, the causative agent of VER (Viral Encephalopathy and Retinopathy), the most important viral disease affecting barramundi hatchery and nursery production. The project application was successful and two PhD students will commence research in May 2006, in collaboration with DAC, Berrimah Veterinary Laboratory, the University of Sydney and Marine Harvest.

An autogenous vaccine against *Streptococcus iniae*, the causative agent of the disease streptococcosis, the most devastating bacterial disease affecting farmed barramundi in Australia, was developed and commercially produced by Intervet Norbio Australia in collaboration with Marine Harvest and the Berrimah Veterinary Laboratory. The vaccine has been approved by the APVMA (Australian Pesticides and Veterinary Medicine Authority) for use on Marine Harvest's barramundi sea cage farm.

Early planning is also underway for the establishment of program to develop a broad spectrum vaccine against *Streptococcus iniae* that can be applied at all barramundi farms.

INDUSTRY DEVELOPMENT

History

Commercial barramundi farming was first introduced in the early 1990's with support from the NT Government. Since then the level of barramundi production has varied, with some farmers turning to marine prawns in the mid-late 1990's. Recently, depressed prawn prices have seen at least one prawn farmer return to barramundi culture.

Humpty Doo barramundi (Australian Barramundi Culture Pty Ltd) established a pond-based farm in 1993 and commenced full commercial operation in 1998. Marine Harvest established a sea cage farming operation at Bathurst Island in 2000. The NT Government has supported Humpty Doo Barramundi and Marine Harvest through expansion of its commercial barramundi hatchery and nursery at the Darwin Aquaculture Centre.

The government also provides a disease investigation and certification service through the Berrimah Veterinary Laboratory, which has assisted industry development and helped to ensure that aquatic animal health issues are effectively managed.

Current Issues

Further development of the barramundi industry will require assessment of new inland and offshore farm sites. Areas in Darwin region are the most likely areas for expansion in the short-medium term.

The DAC, in collaboration with Marine Harvest, are working to develop improved disease control systems and better hatchery production techniques to enhance the efficiency of the production of barramundi in the NT.

Humpty Doo Barramundi is exploring the use of large-scale, recirculating, ponds as a means of improving both production and sustainability.

Maintenance of strict quarantine and health certification is required to limit the spread of streptococcosis and other potential diseases within the Territory.

Future plans

The projected fingerling requirement for 2006 is in excess of 1.5 million.

Barramundi production from the Northern Territory is projected to increase to over 1,000 tonnes in 2006. A long term-vision of developing a barramundi farming sector of over 10,000 tonnes per annum in the Northern Territory has been espoused by the NT industry.

The DAC is currently helping industry to design a new hatchery and nursery. The aim is to transfer the technology developed by DAC over the past 5 years to a larger facility. The future hatchery/ nursery will be capable of producing a minimum of 3 million advanced juveniles per year using recirculating technology for better production control and minimal environmental impact.

Industry liaison

The Case Management Officer, within NT Fisheries, regularly facilitates contact with all active aquaculture licence holders with a barramundi farming endorsement to encourage open channels of communication. In addition, all farms have access to an Extension Officer who visits the farms regularly, usually weekly.

Barramundi farmers are able to raise issues of importance, and be involved in aquaculture industry development generally, through their representation on the Ministerial Advisory Committee on Aquaculture in the NT (MACANT). MACANT acts as a conduit between industry and government where aquaculture issues can be formally addressed.

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Pearling Industry Status Report 2005

SUMMARY

In 2005 Territory pearling industry produced 90,789 momme* of pearls from farmed pearl oysters *Pinctada maxima*. Production decreased by 7% from 97, 501 momme produced in 2004 and the total value of industry production decreased by 20% from $17.1M (2004) to $14.2M (2005). The continued decline in the value of the local industry is also exhibited in adjoining jurisdictions and reflects the current depressed world market.

Cyclone Ingrid in March 2005 had a devastating effect on several pearl farms and was the major factor in the reduced production for 2005. It is predicted that the production and value of Australian South Sea Pearls will improve in the near future due to refined production practices, industry rationalisation and increased marketing opportunities.

**Momme is an old Japanese unit of weight equal to 3.75 grams. A 13 mm round pearl weighs about one momme.*

PROFILE OF THE FARMING SECTOR

Commercial Production

Distribution of farms

Active pearl oyster farms are distributed along the northern coast of the Territory in two main areas: Cobourg Peninsula / Croker Island and English Company Islands / Truant Island areas. There are other lease sites owned by licensees, yet they are not currently being used for the cultivation of pearls. Six of the seven licence holders are currently farming pearl oysters.

Hatchery / nursery production

Most pearl oysters used for the production of Australian South Sea Pearls are hatchery reared, however only one company operates a hatchery in the Northern Territory. This company uses the spat produced in its hatchery for grow out on its leases and has the option to sell spat to other licensees. Pearl oysters farmed by other licensees are sourced from hatcheries or wild harvested oysters from Western Australia.

Farm production

Pearl oyster farms are usually located in sheltered embayments to protect the pearl oysters that are placed in panels suspended from a floated longlines. Each shell is attended regularly to ensure that fouling does not impede the viability of the oyster or production of the pearl.

Pearl oysters are seeded by artificially placing a nucleus derived from the shell of the Mississippi mud mussel into the oyster. Pearl nacre forms around the nucleus creating the pearl. A series of turning programs are completed after the nucleus is implanted to ensure even coating of the nacre. It then takes two years to produce a pearl.

If an oyster produces a good quality round pearl, the oyster may be re-seeded with another nucleus and maintained for another full grow-out cycle. Only a small percentage of good pearl producing oysters are seeded a second time and an even lesser amount are re-seeded a third time. Re-seeding of pearl oysters generate larger pearls as a space in the oyster is already created by the production of the first pearl.

Farmed pearls vary in size, shape and quality and are priced accordingly. There are also several other products from pearl oyster culture, namely half pearls or Mabe, Keshi (natural pearls of various shapes and sizes), Mother of Pearl (MOP - pearl oyster shell used for buttons, jewellery and a paint additive) and pearl meat (the pearl oyster's adductor muscle).

Translocation

A translocation protocol is in place that covers health and security issues relating to the importation into the Territory and translocation within the Territory of adult and juvenile pearl oysters.

Marketing

The marketing of Australian South Sea Pearls is undertaken individually by licensees, yet the majority of pearls produced each year are sold via auction in either Sydney or Hong Kong, or through shops operated by the companies in both Australia and overseas. Mother-of-Pearl is sold to many different countries, with Italy a major customer. Pearl meat, which is valued at around $85/kg is sold in Australia.

Employment

417 people were directly employed by the NT pearling industry in 2005. This is an increase in employment from 303 people in 2004 due largely to an increase in the number of people employed in the transport part of pearling operations. There was also an increase in the number of reported divers that were employed.

Indigenous Development

Aboriginal people play an important role in the servicing of pearl farms. The land-based infrastructure of most farms are located on Indigenous owned land and controlled through access agreements with traditional owners and land councils. Employment opportunities exist for local aboriginal people to assist with the operation of the farms.

Ecologically Sustainable Development / Environmental Management

Pearling farms are encouraged to operate under an Environmental Management Plan (EMP) to ensure that best practices are employed in minimising the effects of pearling operations on the environment. Government, together with industry, will be developing a range of protocols to be included in EMPs.

RESEARCH

Summary to Date

The renewed interest in pearling in the mid-1980s highlighted the lack of knowledge of the Northern Territory pearl stocks. This resulted in a pearl oyster dive survey in 1989 by the Bureau of Rural Resources. This was followed by a Fisheries Research and Development Corporation (FRDC) funded project commencing in 1991 with an objective to provide a description of the current status of the fishery, determine the size-frequency and morphometric characteristics of harvested Northern Territory pearl oysters, and monitor the period and abundance of pearl oyster settlement.

Work on improving the feeding of pearl oyster spat and broodstock was undertaken in the mid-1990s using funds from the Cooperative Research Centre for Aquaculture.

In 1998, a survey of pearl oyster health across northern Australia, funded by FRDC, provided valuable information to assist industry and Government to improve their disease management protocols.

Much of the research undertaken by the pearling industry is conducted in-house and its outcome is seen as contributing to the competitive advantage of individual companies.

Current Research

A book titled “The pearl oyster *Pinctada maxima*: An atlas of functional anatomy, pathology and histopathology” has been compiled, based on samples taken during the pearl oyster health survey and samples submitted to Veterinary Pathology Laboratories in WA, QLD and NT. The production of this publication is funded by the FRDC.

INDUSTRY DEVELOPMENT

History

Several species of pearl oysters are found in Australian waters. The gold or silver lipped pearl oyster *Pinctada maxima* forms the basis of Australia’s pearl oyster fishery and pearl oyster culture industry. The distribution of this species extends across the central Indo-Pacific region from India to New Guinea and the Philippines, and in Australia from Carnarvon on the west coast to south of Cairns on the east coast.

Pearl oysters were fished commercially from Northern Territory waters since 1884 when 50 tonnes of pearl shell were harvested from Darwin Harbour. Historically, most pearl oysters were collected for their shell which was sold for their MOP value – the lustrous nacre of the shells which is used for the production of buttons, ornaments and as an additive in paints and cosmetics. Oysters were collected in the following three years from the Harbour until it was fished out.

As the pearlers spread around the coast from Darwin, new pearling grounds were discovered as the old ones were progressively fished down. This resulted in large MOP yield fluctuations during the next 80 years. By 1899 there were 51 luggers working the grounds harvesting about 200 tonne of MOP a year. This slowly fell to 60 tonne by 1910 and then ceased during WWI and did not start again until 1923. Again production increased until 1930 when 32 luggers yielded about 700 tonne a year. Production stayed around this level until 1939 when WWII halted production until 1948. Once again production slowly increased until 1953 when the Commonwealth Government permitted 35 Japanese divers into Australia in an attempt to rebuild the industry. The MOP industry flourished again with production peaking at 1,100 tonnes a year and remained at this level for the next three years. As the new areas were fished down, production again slowly declined.

The arrival of plastics made shell harvesting uneconomical and MOP harvesting had virtually ceased by 1964 when only two luggers remained in the industry, harvesting only five tonnes that year. The Japanese fleet’s last harvest was in 1961.

Meanwhile, pearl culture techniques were proving commercially viable and pearl oysters were being collected for this purpose. In 1964, Paspaley Pearls established a pearl oyster farm for the culture of pearls at Knocker Bay, Port Essington. From 1966 until 1987 Paspaley Pearls was the only company farming and diving for NT pearl oysters. Unlike the shallow and productive grounds in Western Australia, the local grounds are deeper, more isolated, patchier and have a higher proportion of oysters which are not suitable for round pearl culture. Consequently, in the early 1970s, Paspaley Pearls started to obtain culture stock from Western Australia and as techniques improved in the transport of these oysters to the Northern Territory, the reliance on sourcing local oysters declined.

The success of Paspaley Pearls pearling activities in the Northern Territory and Western Australia, along with an expanding Western Australian industry, prompted the Northern Territory Government to promote the expansion of a local pearling industry. Five additional companies that met the Governments selection criteria were given restricted licences in 1988. Companies that met the development covenants over the following three years had their licences converted to unrestricted licences. From 1987 to 1993 there was renewed interest in harvesting pearl oysters from Northern Territory waters, with average yields during this period of 40 tonnes per year. Since 1994, there has been very limited harvesting of pearl oysters due to a reliable supply of hatchery reared oysters, combined with poor yields of good culture stock from the local pearling grounds.

Current Management Arrangements

The Northern Territory pearling industry is managed under a quota based system and operates using two types of licences: a licence to fish for wild pearl oysters and a licence to culture pearls (either from fished or hatchery propagated pearl oysters). There are 120 quota units in the wild harvest fishery with each unit currently being 1,000 oysters that may be fished. Licensees may substitute part or all of their annual pearl oyster fishing quota for hatchery-reared pearl oysters. In 2005, no licensee fished for pearl oysters in the Territory.

The number of hatchery-reared pearl oysters that may be seeded is also quota-managed. The industry can seed 300,000 new hatchery reared pearl oysters each year. Therefore, the total number of new oysters that may be seeded each year under the Northern Territory quota system is 420,000. The full entitlement of NT pearl oysters was not seeded in 2005.

Current Issues

It has been generally agreed between the Northern Territory and Western Australian Governments that the Australian South Sea Pearl industry should be managed in a consistent manner given that it is highly susceptible to market pressures and any change in management arrangements for one jurisdiction could impact on the other. A Memorandum of Understanding is being developed to ensure that complementary management measures are put in place and that both jurisdictions are consulted on any matter affecting the industry.

The Western Australian Government is undertaking a review of their current Hatchery Policy which expires at the end of 2005. The review is to include mechanisms for assessing the total quota level and determining new quota levels plus allocation models for any increases in hatchery quota. The Northern Territory is being consulted throughout this review process.

Future Plans

In addition to finalisation of the Memorandum of Understanding and comments to the Hatchery Policy review, a compliance program for NT pearling operations is required and will be developed in consultation with industry.

There have also been proposed changes to the *Pearl Oyster Culture Industry Management Plan* and Fisheries Regulations in regards to assisting with the development of the industry. The changes will principally include the change of licensing year from a financial to calendar year, the provision of additional pearl oysters to assist training technicians in the art of pearl oyster seeding and the allowance of additional shell to account for pearl oysters that fail to retain their seeded nucleus.

Industry has also indicated that they wish to have the option of seeding their NT quota in Western Australia and afterwards more the oysters to their NT farms for culture. Liaison has commenced with the Western Australian Government to facilitate this option in 2006.

Industry Liaison

NT Fisheries provides a dedicated management officer for the pearling industry to assist with issues as they come to hand as well as the

strategic development of the industry. The Pearl Industry Advisory Committee (PIAC) meets once a year, to address issues of importance specific to the pearling industry. PIAC is composed of a representative from each pearling licensee and is chaired by the Executive Director, Fisheries.

The industry also has the opportunity to raise any issues of concern and contributes to aquaculture development in the Northern Territory, through representation on the Ministerial Advisory Committee on Aquaculture in the Northern Territory (MACANT). MACANT meets approximately four times per year.

Prepared by

Annette Souter – A/Pearling Industry Manager

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Prawn Farming Status Report 2005

SUMMARY

In 2005, a maximum of 43 hectares of ponds in the NT were used to produce marine prawns. The three operational farms produced 16 tonnes of prawns from a possible two crops per year. Most of the prawns produced were “black tigers” (*Penaeus monodon*), with a small production of red-legged banana prawn (*Penaeus indicus*). This represented a decrease in total production of 62 tonnes from 2004. This reduction in production is not as dramatic as it seems as crops were still being harvested throughout December which means that this production will be included in the 2006 figures

Some ponds were stocked with post-larvae (PL) imported from Queensland and one farm finished construction of a large hatchery for *P. monodon* and carried out two PL production runs

There was no additional pond development in 2005.

PROFILE OF THE FARMING SECTOR

Commercial Production

Distribution of farms.

In 2005, there were seven aquaculture licences with endorsements to culture marine prawns in the Northern Territory. Of these, three were active operations, two were inactive established farms and two were held by licensees without farm facilities. *Penaeus monodon* (black tiger prawn) was the main species cultured on the operating farms with only one farm culturing another species i.e. *Penaeus indicus (*red legged banana prawn). All the farms were located in the Darwin area.

Hatchery / nursery production.

One farm commenced operation of its hatchery and produced 7.8 million *P. monodon* PL’s and a further 3.5 million *P. monodon* PL’s were imported from Queensland.

A hatchery for *Penaeus indicus* (red legged banana prawn) halted production due to low prawn prices.

A joint project between an industry partner and Charles Darwin University continued to operate an experimental *P. monodon* hatchery. This project aimed to collect and domesticate specific pathogen free *Penaeus monodon* (black tiger prawn) broodstock.

Farm production

All marine prawn farming was carried out in unlined, earthen ponds. Sea water was pumped into the farms and delivered to the ponds via channels or pipes. Depending on the management method, water was exchanged through the ponds at various times of the grow-out cycle to control water quality. There has been a trend to reduce the throughput of water during the grow-out period to limit the likelihood of introducing pests and disease into the farms, and also reducing effluent. Oxygenation of the pond water was by mechanical aeration, usually using paddlewheel aerators or aspirators. Prawns were fed on formulated pelleted feeds imported into the Northern Territory.

Translocation

There is a translocation protocol that covers health and security issues relating to the importation or translocation of live prawns of all life stages.

Marketing

The majority of prawns are sold as whole, cooked, frozen product to interstate wholesale markets. Small amounts of green or cooked prawns are also sold locally.

Employment

Throughout 2005, the prawn farming industry employed 18.5 full time employees and the equivalent of 4 full-time staff on a casual basis, usually to assist with harvesting.

Indigenous Development

During the year two licences were held by businesses with Indigenous principals.

Ecologically Sustainable Development / Environmental Management

The Office of Environment and Heritage within the Department of Infrastructure Planning and the Environment (DIPE) oversees environmental assessments and approvals. As part of aquaculture licence conditions, all farms must have an approved environmental management plan (EMP). The EMP stipulates the environmental parameters under which the farm must be constructed and operated. Pond based farms are required to have discharge licences and are subject to environmental compliance audits.

RESEARCH

Summary to date

In 1999 a project to identify aggregations of *P. monodon* broodstock in the Northern Territory was undertaken by the Darwin Aquaculture Centre in collaboration with the then Queensland Department of Primary Industries (QDPI). The project was funded by the Fisheries Research and Development Corporation (FRDC - project F1999/199) and was completed in 2002

A collaborative project undertaken by Charles Darwin University and an industry partner is seeking to domesticate specific pathogen free black tiger prawn broodstock. This important project may form the basis for further industry expansion.

Current Research

Current research is being fully funded by industry and includes ground-truthing of the *P. monodon* hotspots identified in the FRDC project, and the production of domesticated specific pathogen free broodstock.

INDUSTRY DEVELOPMENT

History

Prawn farming began in the Northern Territory in the early 1980s when overseas and local companies invested in farms in the Darwin area. These first attempts failed for a variety of reasons. In the mid 1990s a small pilot prawn farm on the Elizabeth River was established and a Barramundi farmer on the Blackmore River switched from fish to prawn farming and became the first viable prawn farmer in the Northern Territory. The Blackmore River project still currently operates as a prawn farm, although under different ownership. In the late 1990s a farm was established on the Blackmore River using innovative pond design and production techniques. Another farm with a similar operational system was constructed close to this farm soon after.

Following on from these developments another larger farm was established in 2003 on the Blackmore River estuary and is currently the largest operating prawn farm in the NT.

There was no further prawn farm expansion in 2005

Current Issues

One of the major issues of concern to the industry is the availability of broodstock. If locally caught or cultured broodstock are available local hatcheries can provide quality PL's for stocking into ponds. PL supplied from local broodstock will not have been stressed by long periods of transport and will have a reduced risk of importing disease.

There are a limited number of sites available for prawn farming in close proximity to Darwin. As a result, future prawn farm development is likely to occur in coastal areas away from Darwin.

A recent issue of concern to farmers is the low price of imported prawns from countries with lower cost structures. The importation of prawns puts local farmers under increased economic pressure. Imported green prawns also have an increased risk of acting as a disease vector for exotic disease.

Future Plans

Although cheap imported prawns have negatively affected prawn prices in Australia, the NT prawn farming sector is still set to expand in the near future with two farms planning to expand their operations.

Crustacean farming in remote areas may also develop with the increasing interest of Indigenous groups in developing aquaculture projects on their land.

Negotiations with the Australian Fisheries Management Authority (AFMA) to gain more open access to *P. monodon* broodstock in Northern Territory waters have resulted in broodstock collection being permitted under AFMA Scientific Permits. Negotiations to further improve access are continuing.

Industry Liaison

Prawn farmers are able to raise issues of importance, and be involved in aquaculture industry development generally, through their representation on the Ministerial Advisory Committee on Aquaculture in the NT (MACANT). MACANT acts as a conduit between industry and government where aquaculture issues can be formally addressed.

The Case Management Officer, within NT Fisheries, regularly facilitates contacts with all active aquaculture licence holders with a prawn farming endorsement to encourage open channels of communication. In addition, all farms have access to an Extension Officer who visits the farms regularly, usually weekly.

Prepared by

Graham Williams – Industry Case Management Officer

Industry Support and Development Status Report 2005

SUMMARY

The Northern Territory aquaculture industry underwent a period of rationalisation and consolidation in 2005. Our three largest sectors, Pearling, Barramundi farming and Prawn farming, all experienced decreases in production and value for a variety of reasons. The Pearling industry had one farm that ceased production in preparation for sale, the Prawn farming industry had a late stocking which moved most of the annual production into the next reporting year, and the Barramundi Farming industry experienced technical difficulties which resulted in decreased production from the sea cage sector. There were however further significant developments in extending aquaculture opportunities to Aboriginal communities, and further farm growth generally.

DEVELOPMENT OF AQUACULTURE

Aquaculture planning

An inventory of available sites for aquaculture development in the Darwin/Bynoe regions continues to be compiled, and the Aquaculture Development Officer continues to facilitate access to land and sea areas suitable for aquaculture in an integrated coastal management system for the NT.

Aquaculture policy

In 2005, the duties of the Aquaculture Policy Officer were consolidated with those of the Planning Officer to create the Aquaculture Development Officer position. This position continues to develop strategic and operational policies for sustainable aquaculture development in the Northern Territory. An industry-initiated Site Separation Policy was drafted and sent out for consultation, as was a policy for sea cucumber fishery enhancement and ranching. It is expected that policies for these issues will be finalised in 2006.

Pearl Industry Management Officer

Support for the Pearling industry continued through the employment of full-time dedicated Pearl Industry Management Officer. That position provides executive support for the Pearl Industry Advisory Committee and assists with issues of strategic importance, specific to the development of the Pearling industry.

Involvement with national issues

NT Fisheries maintains an active presence on two national committees of importance to aquaculture, the Aquatic Animal Health Committee and the Aquaculture Committee, both of which report to the Australian Fisheries Management Forum.

Aboriginal liaison

The Gwalwa Daraniki Association, in conjunction with NT Fisheries and a local company with expertise in aquaculture development, continue to develop and operate a commercial pond-based mud crab farm in Darwin. Approximately 50,000 crablets have been stocked to 2.5 ha of ponds. Several Federal funding agencies have provided funding for the project and the community is benefiting from training, employment and capacity building. Models for crab farming in regional and remote communities are being investigated.

Discussions continue with the Anindilyakwa Land Council of Groote Eylandt to determine if mine rehabilitation sites could be used for aquaculture development. The Tiwi Land Council has also begun looking at appropriate aquaculture projects.

In an Australian-first, the Maningrida community gained approval to develop a pilot scale mangrove enclosure for the grow-out of mud crabs produced at the Darwin Aquaculture Centre. Five Hundred crablets were stocked late in 2005.

Sponge Aquaculture was trialled at two locations in the NT, at Maningrida and at Warruwi. This was a collaboration between the Indigenous Sea Rangers of the communities, the Australian Institute of Marine Science (AIMS) and a private company. Early results have identified several impediments and work is progressing to overcome these.

Environmental management

Staff of the NT Fisheries Group continued to maintain close contact with staff of the NT's newly developed Environmental Protection Agency (EPA). They have been liaising to maintain the currency and percentage of operators working under an approved environmental management plan. In addition, they have also been working to produce a clearer understanding of the process proponents need to follow to pass environmental assessment and obtain an aquaculture licence.

Several producers are working toward full adoption of ISO 14000 standards.

Ecologically sustainable development of aquaculture is an on-going focus. Environmental and social guidelines to underpin the future growth of aquaculture in Australia are currently being developed.

Publications aimed at dispelling some of the damaging myths associated with aquaculture were initiated.

New investment

Several groups have expressed interest in ranching trepang, and some initial enquiries were made concerning potential lease areas. Formal applications have been lodged for lease areas with the Lands Administration Branch of the Department of Infrastructure, Planning and the Environment (DIPE).

A pilot hatchery for trepang developed by private industry, within the grounds of the Darwin Aquaculture Centre, continues to operate.

Infrastructure development

Following negotiations with the Commonwealth, local prawn farmers continue to fish for broodstock *Penaeus monodon* prawns, with moderate results.

The pilot hatchery for *Penaeus indicus* (red legged banana prawn) halted production with the farmer changing to barramundi culture. The prototype prawn hatchery constructed in a partnership between industry and the Charles Darwin University has produced some specific pathogen free *Penaeus monodon*, (black tiger prawn) PL's and is looking to sell these to industry and further develop these stocks.

RESEARCH

Mud Crab Aquaculture

Farm-based research continues on the joint-venture Kulaluk mud crab farm. Broad scale research aims to develop farming models and practises that will be applicable in regional and remote aboriginal communities. In addition improvements are being made to the efficiency of the larval rearing process at the hatchery.

Research in support of the barramundi farming industry was conducted at the Darwin Aquaculture Centre, resulting in continued improvements in larval rearing and nursery production procedures.

AQUATIC ANIMAL HEALTH PROGRAM

The Berrimah Veterinary Laboratory provided a valuable service for maintaining monitoring programs, certification and diagnostic services for aquatic animal health. A key output was the delivery and implementation of a new translocation strategy entitled:- "Transboundary movements of living aquatic animals : A zoning strategy for disease control in the Northern Territory". It is the first of its kind in Australia. The approach used to establish disease control zones in the Northern Territory for each target species is based on the characterisation of zoogeographic zones, consideration of historic factors relating to earlier movements, consideration of population dynamics and genetic composition and the occurrence and distribution of pathogens, parasites, pests and diseases impacting on the target species.

INDUSTRY LIAISON

The Aquaculture Branch provided secretarial and logistical support for the Ministerial Advisory Committee on Aquaculture in the NT (MACANT). This is a non-statutory committee offering a formal channel by which advice from industry can be passed on to the Minister for Primary Industry, Fisheries and Mines. The terms of reference for the Committee were changed in 2003 to allow for a greater focus on existing industry, whilst still accounting for the needs of developmental sectors.

The Darwin Aquaculture also maintains a farm-based extension program where experienced technicians assist farming operations through weekly visits.

Prepared by

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Glenn Schipp – Aquaculture Branch Manager

indigenous fishing and economic development

Indigenous Fishing and Economic Development Status Report 2005

INTRODUCTION

Aboriginal and Torres Strait Islander people have lived in Australia for over 40 000 years. Many Indigenous groups live on the coast and depend on the sea for social, cultural and subsistence benefits. Subsistence fishing is an important part of Aboriginal culture in the Top End as well as a traditional source of protein. Many of the marine and freshwater species found in the billabongs, rivers and along the coastline of northern Australia are totemic to Aboriginal people and are therefore of great cultural significance.

The majority of Northern Territory coastal Aboriginal groups continue to practise customary management and education relating to the sea through law that has been passed down over generations in the form of stories, dance, song, art and ceremony. Management styles vary, with some Aboriginal groups electing families to act as sea managers while others allow people to undertake this role in their mothers' country. This usually means that Aboriginal people will only fish and hunt within their own country and would seek permission before fishing in someone else's country. Aboriginal customary fishing and hunting is undertaken according to seasons, which allows species to be targeted when in abundance and in prime condition. These are some examples of the customary management practices used by Aboriginal people to ensure the sustainability of their aquatic resources.

Today Aboriginal groups have established community ranger programs for the purpose of natural resource management and protection. Six community ranger groups receive annual funding and support from NT Fisheries under the Indigenous Community Marine Ranger Program. Ranger groups contribute to the enhancement of monitoring and compliance activities by providing reports to NT Fisheries of any coastal surveillance they have undertaken.

PROFILE OF THE FISHERY

Commercial Sector

Under the NT *Fisheries Act 1988*, Indigenous people have the same access to commercial fishing licences as those from any other cultural group. However, the high costs of purchasing commercial licenses remains a significant barrier to their entry into the fishing industry and therefore restricts the level of Indigenous participation. The exact number of Indigenous owned commercial licences is not known as new applicants or current holders of such licenses are not required to advise of their cultural background. However, it is known that one barramundi licence and two developmental coastal net licences were held by Indigenous operators in 2005. A further two development permits for the harvest of tropical crayfish (including other species such as stingrays and mullet) were issued to Indigenous groups. At least one mud crab licence and one coastal line licence is Indigenous owned and operated.

In 2005, there were two Aboriginal coastal licences issued within the Northern Territory. Each community may have one community licence and the community council or traditional owners must nominate the licensee. This fishing licence allows the licensee to catch and sell fish (except managed species) within their own community. There are no reporting requirements for this type of licence. To look at ways of increasing opportunities and capacity for Indigenous Territorians to participate in commercial fishing, the Northern Territory Government is currently reviewing the nature of Aboriginal coastal licenses.

Area

In 2005, Aboriginal coastal licenses were in operation in the north east Arnhem Land and Bathurst Island regions.

While a commercial fishing license allows fishing to take place across a range of the NT coastal habitats, Indigenous operators are reluctant to fish other people's 'sea country' without appropriate permission from the traditional owners. In 2005, an Indigenous owned and operated mud crab license was working in the Maningrida region. There were also two development permits harvesting tropical crayfish, mullet, blue swimmer crabs and stingrays operated by Indigenous groups in the Nhulunbuy region.

Fishing method

Aboriginal coastal licenses allow for the use of amateur fishing gear, including amateur dragnets that are the most common fishing method used with this type of licence. All other forms of commercial fishing by Indigenous people is undertaken according to the rules and regulations of that particular fishery.

Fishing Tour Operator Sector

Some Aboriginal groups and individuals have established agreements with Fishing Tour Operators (FTOs). Such agreements may include employment opportunities or payments for the use of land based facilities established on Aboriginal land.

Indigenous Sector

Indigenous subsistence fishing does not value individual species according to the same values as the commercial and recreational fishing sectors, but rather as a valuable source of protein. As previously mentioned, the Indigenous sector targets species when they are most abundant and in prime condition. Other fishing is done opportunistically with virtually no waste or by-catch. The impact of Indigenous fishing activities were only assessed on a large scale for the first time in 2000 with the completion of the Northern Territory component of the *National Recreational and Indigenous Fishing Survey* (NRIFS). The data described below is taken from this survey research.

Area

The majority of Indigenous fishing activities occurs in the close vicinity of communities and out-stations and is widespread across the northern part of the Territory. Such activity occurs in inshore and estuarine waters (61% and 11% respectively) and rivers (17%). It should be noted that some areas of significance or sacred sites may exclude Indigenous as well as non-Indigenous fishers, depending on the level of cultural significance. These exclusions may be according to age or gender. In addition, some species have totemic value and cannot be harvested by particular people. These restrictions act as management tools that help protect species and habitats.

Fishing method

The most preferred fishing method for Indigenous fishers in 2000 was the use of lines that represented 45% of all fishing events. Not surprisingly the use of bait (84%) was far more common than using lures (16%). Surface spearfishing, hand collecting and cast nets account for the majority of the remaining fishing effort.

Catch

In 2000, Indigenous people living in communities in the Northern Territory harvested over 1.5 million individual fish and other aquatic organisms. The most prevalent species of finfish taken by Indigenous fishers were mullet (83,000 or 5% of the total harvest), catfish (60,000 or 4%) and barramundi (44,000 or 3%). The most important non-fish species were mussels (580,000 or 35% of the total harvest) and mud crabs (86,000 or 5%).

Effort

In 2000, a total of 20,700 Indigenous people living in communities in the northern region of the Territory went fishing. This represented 91% of the area population. A total of 245,698 days fishing was expended, and on average this equates to 12 days of fishing per fisher per year.

Non-retained Species

Many Indigenous groups would prefer not to waste any food that is caught, so only a very small amount of the catch is released.

Eco-system Impact

The effect on the eco-system by Indigenous fishing is unknown. However, in localised areas near to Indigenous population centres, it is likely that fishing activities will have some impact on the surrounding eco-system.

Social Impact

Fishing is an important lifestyle activity for Indigenous people in Northern Australia and assists with maintaining a more healthy diet. In part fishing allows communities and families to retain their independence and connection to country.

Many studies have documented the importance of wildlife catch in the diet of Indigenous people, and seafood has also been shown to contribute a large proportion of caloric intake for those living in coastal out-stations.

The value of food collecting, hunting and fishing is also important in maintaining the social cohesion of communities, with social networks reinforced through the customary sharing of gathered food. Hunting is also used as an important educational tool for teaching younger people Aboriginal law through the expression of knowledge and reinforcement of spiritual beliefs.

Economic Impact

Aboriginal coastal net licence holders are able to catch and sell non-managed species, allowing them to gain some economic benefit. The licence holder can only sell to their local community or outstation and this has forced some Indigenous fishers to give away their catch to their extended families rather than sell it, as cultural status and obligation still remains strong in many Aboriginal communities. New applications for these licenses are currently not being considered until the review of the coastal net fishery is completed.

STOCK ASSESSMENT

Monitoring

As mentioned earlier, Indigenous fishing activities have only been assessed on a large scale for the first time through the NRIFS research undertaken in 2000. Other monitoring programs tend to be fishery specific and such details have been included within individual fishery status reports contained elsewhere in this publication. Through the establishment of community marine and sea ranger programs, many Indigenous groups are becoming more active in the monitoring of their fishing activities. Most of these groups have included the monitoring of fishing activities in their own specific management plans.

Stock Assessment Methods and Reliability

Information gained from the Indigenous fishing sector may also be used as part of species specific stock assessments. However, a variety of Aboriginal and non-Aboriginal agencies and groups have questioned the reliability of data collection methods that have been used. More specific stock assessment information has been included in the individual fishery status reports within this document.

Current Exploitation Status

Catch data obtained about the impact of the Indigenous fishing sector has been included within individual fishery status reports.

Future Assessment Needs

Continuing assessment of the Indigenous fishing sector is required. A methodology for such assessment may be established with a view to collecting this information as part of any future surveys of recreational fishing.

RESEARCH

Summary to Date

Prior to 2000, there was no research concentrating specifically on the Indigenous fishing sector. In 2000, the NRIFS was conducted with the aim of this national survey to provide detailed information that would be available on a total fishery basis. In some States this was possible by combining the recreational catch with that of the commercial sector. However in some areas, particularly northern Australia, Indigenous people are also an important user of fisheries resources. On this basis, the terms of reference for the national survey were expanded to include all non-commercial fishing and included a survey of Indigenous fishing in northern Australia. The specific objectives of a component of the NRIFS were to quantify the catch and effort of the Indigenous fishing sector in Northern Australia.

A community/dwelling based area sample with face to face interviewing was used.

Incorporation into Management

Information obtained from the 2000 NRIFS focused research on Indigenous fishing has been used by NT Fisheries for a variety of purposes, including as part of the management of individual fisheries as well as the planning of future activities.

Current Research

At present there is no specific research currently being undertaken on general Indigenous fishing activities.

MANAGEMENT/GOVERNANCE

Management

Objective

Indigenous groups have been included in the management process through the establishment of Aboriginal Fisheries Consultative Committees (AFCC). These Committees offer a mechanism for Indigenous Territorians to contribute to the management of resources within their sea country. The aim of the AFCC process is to provide a mechanism that allows an information

flow between Aboriginal people engaging in customary fishery management practices and NT Fisheries using more contemporary management approaches.

In addition to AFCCs, Indigenous representation also exists on the Aquatic Resource User Group Forum (ARUG), and individual Fishery Management Advisory Committees (FMACs), both of which provide advice to the Minister for Primary Industry and Fisheries.

History

Aboriginal groups throughout the Northern Territory have managed their marine resources in a sustainable manner for many thousands of years. European settlement saw the implementation of western management regimes. Prior to 1993, consultation between NT Fisheries, Aboriginal communities and the fishing industry in relation to fisheries management regimes tended to be on an informal basis only. In 1993, the first AFCC was established in the Northern Territory, which focused on information sharing between the parties and providing coastal Aboriginal communities a mechanism to voice their concerns relating to fisheries management in a more formal manner. There are now seven consultative committees across the Northern Territory.

Further recognition of Aboriginal people as an important stakeholder group occurred in 1996 with the creation of a dedicated Aboriginal Liaison Officer position within NT Fisheries. Subsequently, this has led to the formation of the Indigenous Liaison and Economic Development Unit within NT Fisheries, which is staffed by three full-time officers.

Current issues

Management of the Indigenous fishery in the Northern Territory is part of an integrated approach. Certain key species have specific management arrangements and these details are included in individual fishery status reports contained elsewhere in this publication.

The Northern Territory *Fisheries Act 1988* exempts Aboriginal people from the restrictions of bag limits, size limits or taking of any protected species, if they are fishing and hunting within their own traditional country. This allows Aboriginal people to continue with their custodial rights and to practice customary management with regard to aquatic resources.

To further enhance the capacity and knowledge sharing between Government and Aboriginal people, in 2004, NT Fisheries employed a manager and support officer to carry out community engagement activities including on-going consultation, economic development and resource management. This also included the employment of two Indigenous apprentices with one apprentice taking up an offer of permanent employment within the Indigenous Liaison Unit. In 2005 a further two Indigenous apprentices were employed, with one taking up an offer of extended employment.

Aboriginal groups have had to face the challenge of managing their traditional resources while living in communities made up of multiple clan groups. Over recent years there has been a trend for Aboriginal people to move back to their homelands. This outcome may reduce some of the pressure on local fish and other aquatic stocks. However these stocks often have the added fishing pressure from outside influences such as the recreational, fishing tour and commercial fishing sectors, as well as the unknown harvest quantity from illegal foreign fishing vessels.

This combined impact on fishing resources may lead to a requirement to restrict the level of total fishing activity. It is important to note that under the NT *Fisheries Act 1988*, specific provisions exist ensuring that Aboriginal fishing activities would be the last area targeted with restrictions should such steps be deemed necessary to protect a resource.

Future plans

There is a desire to increase the number of AFCCs and broaden their scope to ensure that the consultative approach adopted by NT Fisheries is more inclusive. NT Fisheries will continue to employ Indigenous apprentices when and where possible. Further, the department will engage with Indigenous community ranger groups to work together on a range of research projects that will benefit all Territorians. In 2007, NT Fisheries will fund an additional two to three ranger groups to carry out coastal surveillance activities.

Compliance

The Northern Territory Police Marine and Fisheries Enforcement Section undertake the monitoring, compliance and enforcement of fishing activities in Northern Territory waters. However, a network of Indigenous community marine rangers has been established across the Northern Territory to deal with localised monitoring and surveillance of coastal waters.

Increasingly, these rangers play an important role in educating both Indigenous and non-Indigenous fishers, as well as being a visual presence on the water to deter illegal fishing activities.

The Indigenous Community Marine Ranger Program allocates funds to the Tiwi Islands, Borroloola, Port Keats, Maningrida, Goulburn Island and Elcho Island rangers. In 2005, some 50 rangers completed a Certificate II in Fisheries Compliance (Seafood Industry). The majority of these rangers were also issued with Marine Safety Inspector cards.

Consultation, Communication and Education

The AFCCs were established to give coastal Aboriginal communities an avenue to voice their concerns to Government with matters relating to fisheries, as well as providing an opportunity for Indigenous Territorians to take a more formal role in the contemporary management of aquatic resources. After the first committee was established in 1993, a further five were established between 1995 and 1998. The Maningrida Fisheries Consultative Committee was established in 2004. There are currently seven of these committees and it is intended to establish another two.

Aboriginal members decide on the composition of each committee, which also includes representatives from the following agencies and departments: Northern Territory Police Marine and Fisheries Enforcement Section, NT Fisheries, Amateur Fisherman's Association of the NT, NT Seafood Council and relevant Land Councils. In 2005, four AFCC meetings were conducted and these took place both in Darwin and in local communities.

The consultative process provides an opportunity for the Northern Territory Government to discuss, plan and implement new initiatives relevant to coastal communities. This may include exploring commercial development opportunities for remote coastal communities in order to help with social and economic problems that many of them face. These committees give Government the opportunity to work closely with Indigenous Territorians on issues from the 'grass roots' level.

To date, a number of issues and projects discussed through the AFCC process have successfully contributed to the management of NT fisheries. These include:

- the introduction of a possession limit on painted crayfish;
- the establishment of recreational fishing campsites on Aboriginal land;
- agreements with commercial crabbers for restricted access areas;
- a fisheries compliance course for Aboriginal Community Police Officers;
- a greater awareness of the FISHWATCH campaign;
- a greater emphasis on Indigenous economic development in the fishing industry;
- development of an Indigenous Aquaculture Policy for the NT;
- the implementation of a Dugong Code of Practice for the commercial fishing sector;
- the establishment of the Fisheries Indigenous Apprenticeship program;
- greater Indigenous participation in the fishing industry;
- the introduction of the Indigenous Community Marine Ranger Program; and
- the donation of vessels* to coastal ranger groups to carry out coastal surveillance.

*Note – A number of these vessels had previously been seized by officers from the NT Police's Marine and Fisheries Enforcement Section as allegedly they had been engaged in illegal fishing activities contrary to provisions under the *Fisheries Act 1988*. If convicted under the Act, such vessels (and other items) used in the commissioning of an offence may be forfeited to the Director of Fisheries, who in turn has powers with respect to the disposal of seized goods.

There have also been several other projects including undertaking research activities, school visits, show displays and the cleaning up of marine debris.

Prepared by

Robert Carne – Manager, Indigenous Liaison and Economic Development

Reference

Henry, G. W. and Lyle, J.M. (Eds.) (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158. NSW Fisheries Final Report Series.

recreational fishing

Recreational Fishing Status Report 2005

INTRODUCTION

Although Northern Territory waters are home to an impressive range of tropical fish species, no fish stirs local or visiting anglers with the same enthusiasm as the legendary barramundi. It is a fact that more than half of all barramundi caught in Australia come from Northern Territory waters.

Barramundi can be caught year round, although the best fishing occurs during the southern autumn and spring. Heavily flooded rivers can limit access and fishing activity during wet seasons and the cooler dry season months will often provide slower barramundi fishing. However, the dry season is when many anglers focus on the vast range of other marine species available, which is enhanced by inshore migrations of mackerel and tuna. It is also when mud crabs are most easily caught, and they are particularly abundant in the Territory.

Some other popular saltwater species include threadfin and blue salmon, mangrove jacks, golden snapper, blue lined emperor, red emperor, coral trout, black jewfish, blue tusk fish, saddle-tail snapper, queenfish, trevally, sailfish and black marlin. There are also several species which are popular in southern states but mostly overlooked in the Territory, such as flathead, mullet, whiting, bream, garfish, blue swimmer crabs and squid. These and many other smaller fish abound, but they hardly rate a mention among most local anglers.

In freshwater habitats saratoga and sooty grunter can be caught together with barramundi, cherabin and red claw yabbies, while other species like tarpon, sleepy cod, catfish and archerfish add variety. There are also stocked barramundi populations in Manton Dam, Lake Bennett and Lake Todd, although the latter is not yet open for fishing.

One of the most important prerequisites for fishing in the Territory is a boat. Although various land based fishing opportunities exist, large tidal movement and the presence of crocodiles make boat fishing a more productive and safe option. The size of boat required usually depends on how far offshore travel is intended, but vessels between four and five metres long, are suitable for both inshore barramundi water and many grounds further from the coast.

Northern Territory waters are lightly fished compared to other parts of this country, mainly because of the Territory's small population and remoteness. But there is also a great abundance of aquatic life generally. In addition, several areas have been closed to commercial barramundi netting specifically to benefit recreational fishing and tourism. These closures have been implemented in conjunction with the buy back of commercial barramundi fishing licences and include the Mary, Daly, Adelaide, Roper and McArthur Rivers, Darwin Harbour, Shoal Bay and part of the Victoria River. Further, all waters within Kakadu National Park are closed to any type of commercial fishing.

Further enhancement of recreational fishing has been undertaken by the construction of artificial reefs. The Northern Territory Government has constructed twelve popular artificial reefs for divers and anglers close to Darwin near Lee Point, East Point, in Bynoe Harbour and further offshore at Fenton Patches. In 2005 additional materials of opportunity were added to the Lee Point Artificial Reef Complex.

There are several strong fishing clubs throughout the Territory and many major annual fishing tournaments. While there are also offshore and saltwater tournaments, most focus on barramundi under rules which promote catch and release.

The Amateur Fishermen's Association of the Northern Territory (AFANT) was formed in 1981 and receives part funding from Government in recognition of its role as the peak representative association for recreational fishing. The Northern Territory Government first dedicated personnel to the management, development and promotion of recreational fishing in 1987 and in 2005 a team of three people manage these responsibilities.

Representation of the Territory's significant guided fishing tourism industry has been provided by fishing tour operators since 1989, but at varying levels. The incorporation of the Northern Territory Guided Fishing Industry Association in 2005 is expected to enhance industry cohesion, consultation and development. Government funding was provided in 2005 to enable the Association to employ an executive officer to more formally represent the industry.

While size and possession limits are the primary recreational fishery management tools used in the Northern Territory, seasonal area closures also apply to the lower Mary and Daly Rivers during spawning periods. Signage depicting fishery regulations and other advice is posted at popular boat ramps, launch sites and fishing tourism establishments, including those which are appointed under the River Watch Program administered by NT Fisheries. These River Watch Centres are located on the Mary, Daly, Roper, Victoria, McArthur, South and East Alligator Rivers.

Proprietors provide a range literature and advice of interest to anglers and convey reports from the public to relevant agencies concerning fishing or boating infringements, and aquatic environmental issues such as fish kills and noxious weed or animal infestations.

The Northern Territory Government undertook broad scale recreational fishing surveys in 1986, 1995 and 2000/01 as part of its wider fisheries research program. Much of the information conveyed in this report is extracted from the most recent survey, the National Recreational Fishing Survey: The Northern Territory (NRFSNT). The survey period was from May 2000 to April 2001.

NT Fisheries would like to thank Ms Anne Coleman, who was responsible for the NRFSNT and the preceding 1995 survey, known as Fishcount 95. Ms Coleman's reports on both surveys are available by contacting NT Fisheries.

PROFILE OF THE FISHERY

Between the surveys undertaken in 1995 and 2000/01, recreational fishing participation levels among Northern Territory residents remained stable at around 32%. The NRFSNT provides a comprehensive overview of the recreational fishery in the Northern Territory.

Area

Over 25% of all recreational fishing in Territory waters occurs in Darwin Harbour, Shoal Bay and the offshore area adjacent to Darwin. About 40% of recreational fishing activity occurs in estuaries and 30% occurs in rivers. A further 22% occurs within 5 kilometres of the coast, 6% occurs further from the coast and 2% occurs in impounded waters. The Mary River accounts for 11% of all hours fished, while all other areas account for less than 10% of hours fished.

Fishing Method

More than 75% of all recreational fishing in Territory waters is undertaken from boats. Eighty-four percent involves the use of lines. Artificial lures are used during half of all the time spent line fishing, while using bait accounts for 41% of this time. Those using a combination of both lures and bait accounted for 10% of all time spent line fishing.

Fifteen percent of fishing effort involved the use of pots and traps, but the NRFSNT recorded very little use of cast nets, drag nets or other gear.

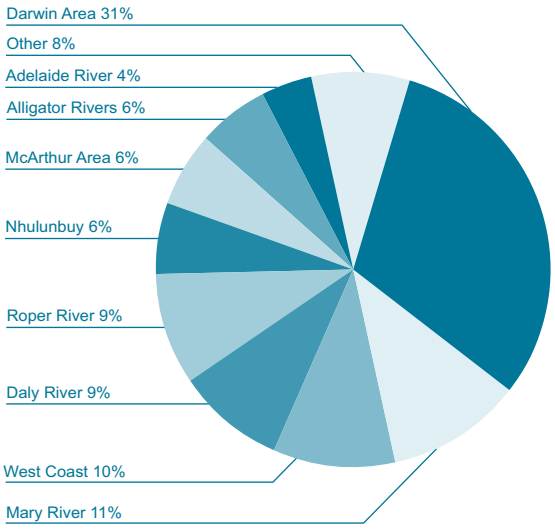

Figure 1. Recreational fishing line hours (time spent with lines in the water) by residents and visitors by area

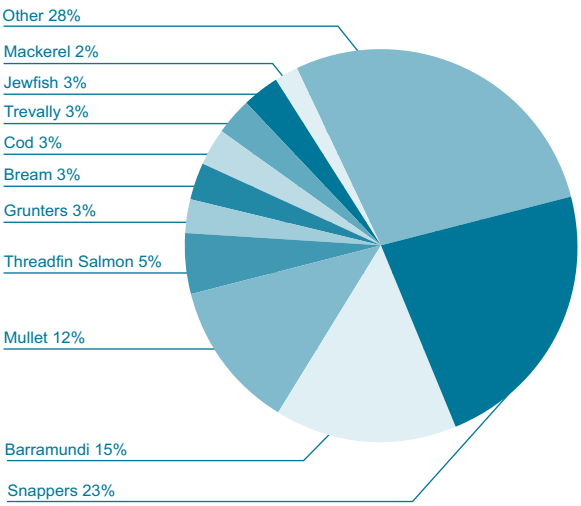

Figure 2. Estimated annual recreational finfish harvest by species (note - not counting fish released)

Catch

Of the 1.83 million aquatic organisms reported during the NRFSNT, 1.6 million (89%) were fish, while fewer than 0.2 million were crabs, molluscs and other types of aquatic life. Twenty-nine percent of these captures were made in the offshore area adjacent to Darwin, in its Harbour and Shoal Bay. All other areas provided between 1% and 11% of the overall catch.

Effort

People in the Territory spent 314,272 days (or 1.9 million hours) recreational fishing during the 2000/01 NRFSNT reporting period. Residents fished an average of 5 days in that year, a reduction from the average 8 days per year recorded during Fishcount 95. However, the hours visitors to the Territory spent fishing increased from 23% in 1995 to 37% in 2000/01.

Queensland visitors undertook 33% of the increased effort while New South Wales and Victorian visitors undertook 26% and 16% respectively. Recreational fishing visitor numbers are highest in the dry season, when they account for 40% of overall effort, and lowest in the wet season when visitors undertake 15% of the effort.

Non-retained Species

Fifty-five percent of all aquatic animals recorded during the NRFSNT period were released and this trend has increased from 43% in 1995. The introduction of more restrictive size and possession limit controls since 1995 accounts for some of this increase but it is also linked to the increasing number of anglers who catch and release. There is a particularly strong trend toward releasing larger barramundi in recognition of their increased spawning potential.

Eco-system Impact

Although no significant studies have been made on the affects of recreational fishing on natural Territory eco-systems, no significant detriment has been identified. The National Policy for Recreational Fishing and The National Code of Practice for Recreational and Sport Fishing promotes the importance of ecological awareness. NT Fisheries' River Watch Program is another example of how environmental awareness is promoted among the fishing community.

Social Impact

Approximately 40,000 non-Indigenous Territorians (32%) fish for recreation each year. The NRFSNT queried people's fishing motives and found that 32% of anglers fish to be outdoors, 28% fish to relax and unwind and 11% fish to be with family. Other reasons to go fishing were to be with friends, to catch fish for the table, to participate in fishing competitions and for sport.

Recreational fishing is a significant lifestyle pursuit in the Territory, where participation rates are higher than elsewhere in Australia and fishing for consumption is not always the primary motivator.

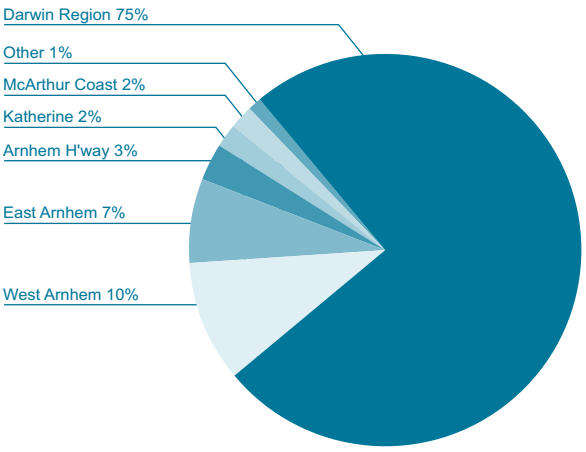

Figure 5. Annual expenditure by economic zones

Economic Impact

Territorians and visitors spend nearly $35 million each year on recreational fishing and most of this sum is directed toward the purchase of boats, vehicles and their associated running costs. The purchase of fishing gear is another significant expenditure component. Visitors to the Territory contributed 25% of this income overall.

STOCK ASSESSMENT

Monitoring

Many of the research programs being undertaken by NT Fisheries focus on species which are significant to recreational, commercial and indigenous fishery stakeholders. Current research on black jewfish, Spanish mackerel, sharks, barramundi and mud crabs is of particular importance to recreational fishing interests. Outcomes of this research will influence future management decisions. More information on specific research programs that are relevant to recreational fishing is provided in individual status reports shown elsewhere in this publication.

Data from surveys such as the NRFSNT are used in conjunction with log book returns information provided as a condition of fishing tour operator licences. The combination of research, survey and fishing tour operator data is supplemented with catch, size and effort information which is provided by fishing clubs that host major annual tournaments. Further information of this nature is provided through specific monitoring programs administered by AFANT on the McArthur, Roper and Adelaide Rivers.

Stock Assessment Methods and Reliability

Research, survey, fishing tour operator and other voluntary program data from the recreational fishing sector are combined with data from the commercial fishing sector and used for fishery stock assessment purposes. Details are included in other fishery status reports.

Current Exploitation Status

The same data is used to monitor harvest levels, which are considered sustainable.

Future Assessment Needs

Most of the information conveyed in this report is sourced from the National Recreational Fishing Survey, which was undertaken between April 2000 and May 2001. This survey provided national, state and territory databases and was jointly funded by each jurisdiction and the Federal Government. An agreement between states and territory fisheries agencies reached in 1994 to support a repeat of this survey every five years with similar funding arrangements was nullified when some states withdrew support in 2005. NT Fisheries are exploring alternative cost effective survey techniques to provide recreational data necessary to effectively manage fisheries in the territory.

Another future need is the assessment of stocked barramundi populations in the three impoundments mentioned above. More intensive sampling will be undertaken in 2006 to address this.

RESEARCH

Summary to Date

The first broad scale survey of recreational fishing in the Northern Territory occurred in 1986 but the value of its data is considered minimal by comparison to more modern survey methodology. Fishcount 95 provided more valid data which proved quite useful until it was superseded by the NRFSNT in 2000/01, which employed similar methodology. NRFSNT data is the most current broad scale survey data available, however, a proposal for a further survey to provide similar, updated data will be costed and considered in 2006.

Fisheries research is generally species or area specific and many species that are subject to current research are significant to recreational, commercial and traditional fishers. Specific details on researched species are provided in individual fishery status reports found elsewhere in this publication.

Incorporation into Management

The incorporation of survey, research, monitoring and fishing tour operator data was applied in reaching decisions with regard to the closure of the McArthur and Adelaide Rivers to commercial barramundi gillnetting.

Research and survey information was also used during initial consultation regarding the establishment of the proposed Bynoe Harbour and Cobourg Marine Parks. They also contribute to information provided in relation to land and native title claims considered by NT Fisheries.

Current Research

Currently, the most significant research to the recreational fishing sector relates to barramundi, mud crabs, Spanish mackerel, black jewfish and sharks (see relevant status reports).

MANAGEMENT/GOVERNANCE

Management

Objective

Recreational fishing in the Northern Territory is managed by the Department of Primary Industry, Fisheries and Mines and underpinned by specific provisions found in the *Fisheries Act* and its Regulations.

Management controls include species specific personal possession limits and a thirty fish general personal possession limit. Minimum size limits apply to barramundi (55cm) and mud crabs (male 13 cm, female 14 cm) and a maximum size limit of 1.2 metres applies to cod and groper. Seasonal area closures apply on the lower Daly and Mary Rivers from 30 September to 1 February. Specific fishing controls apply at the East Point Aquatic Life Reserve and access restrictions apply at Stokes Hill Wharf. No fishing is allowed at the Doctors Gully Aquatic Life Reserve.

NT Fisheries' Recreational Fishing Controls Booklet stipulates fishery regulations as well as the gear that recreational fishers may use.

History

Prior to 1991, recreational fishers in the Northern Territory were required to observe a daily barramundi bag limit of five per person and a limit of ten for extended trips. In 1991 the concept of bag limits was abolished in favour of personal possession limits. A five per person barramundi possession limit was introduced in that year, together with limits of ten mud crabs per person and thirty per vessel with three or more people on board.

Possession limits of five Spanish mackerel and five black jewfish were introduced respectively in 1993 and 1997. In 1997 a general possession limit of thirty fish per person was introduced, but this did not include the specific possession limits for managed finfish until 2002.

To enhance recreational fishing, the Mary River was closed to commercial barramundi gillnetting in 1988. This was soon followed with the closure of the Daly River in 1989, the closure of the Roper River in 1991, the partial closure of the Victoria River in 1993, the closure of Darwin Harbour and Shoal Bay in 1998, the closure of the McArthur River in 2002 and the closure of the Adelaide River in 2004.

Current issues

The resolution of area use sectorial conflict and the maintenance of existing access rights are the two main issues for the recreational fishers in the Territory. Issues of area use conflict are addressed within the Aquatic Resource User Group Forum, which is administered by NT Fisheries. The department also collaborates with the Department of Planning and Infrastructure and other agencies regarding matters of fishing access and infrastructure.

Future plans

A key planning priority in 2005 was the establishment of an industry representative association for fishing tour operators. NT Fisheries provided funding to the guided fishing industry to employ an executive officer to represent and promote the industry. The executive officer formally incorporated the Northern Territory Guided Fishing Industry Association (NTGFIA) later that same year. Industry negotiation will ensue throughout 2006 to identify a permanent funding source for the executive officer position on the expectation that the Association's membership will grow.

Compliance

The Marine and Fisheries Enforcement Section is responsible for monitoring and enforcing infringements under the *Fisheries Act* and its Regulations. Proprietors of River Watch Centres play a supporting role, but have no enforcement powers. Recreational fishing controls are displayed widely at boat ramp, launching sites, tourist establishments and River Watch Centres throughout the Top End of the Northern Territory.

Consultation, Communication and Education

NT Fisheries administered the Amateur Fishermen's Consultative Committee between 1984 and 1994 when its structure was reconstituted to form the Ministerial Advisory Committee on Recreational Fishing (MACRF). MACRF comprised representatives of the AFANT, the fishing tourism industry, club and non-club anglers, regional anglers from Katherine, Borroloola, Nhulunbuy, the Roper River Land Care Group, the tackle and boating industries and NT Fisheries. Since MACRF was disbanded in 2002, NT Fisheries has primarily consulted with AFANT. The recent formation of the NTGFIA will enable more formal consultation with and development of the guided fishing tourism industry.

Education is undertaken by way of presentations, workshops, show displays, publications and signage. Regional extension occurs in Katherine and Nhulunbuy with the delivery of three day junior fishing workshops which are convened each year by the Recreational Fishing Unit. Further education is provided throughout the Top End of the Northern Territory through the nine River Watch Centres which are located on or near the major tidal rivers.

Prepared by

Phillip Hall and Tricia Kelman – Aquatic Resource Management Officers, Recreational Fishing Unit.

References

Angler survey data is sourced from the *Fishcount 95* survey and the *National Recreational Fishing Survey: Northern Territory*.

fishing tour operators

Fishing Tour Operator Status Report 2005

INTRODUCTION

Individuals who conduct paid fishing tours must do so under a current Fishing Tour Operator (FTO) Licence issued by NT Fisheries. Those who operate in Kakadu National Park require an additional permit issued by the Commonwealth Department of Environment and Heritage (DEH).

NT Fisheries began licensing FTOs in 1994 with no licence fees payable, but on the condition that daily log returns are provided monthly. This has enabled development of a significant data base that is important to the management of the guided fishing tourism industry and recreational fishing generally. Much of the information conveyed in this status report is extracted from the FTO log returns data base.

Information from FTO log returns is combined with data from broad scale recreational fishing surveys to provide a comprehensive overview of the recreational fishing industry. Fishery managers refer to the combined data when making decisions or recommendations concerning land and native title claims, commercial fishing area closures, marine park planning and fishery regulation amendments.

Most FTOs target barramundi in coastal and inland areas but there is a growing number who operate offshore targeting other species from vessels which range in size up to luxury mother ships. Most operate out of Darwin but the industry is well represented in the regional areas of Nhulunbuy, Borroloola and Katherine. While there are also resident FTOs based on most of the big tidal rivers, several others are based on the various Aboriginal owned islands that surround much of the Northern Territory's coast.

Some FTOs operate full time while others gain a supplementary income from guiding. Apart from boats of various sizes, they operate from comfortable bush camps, lodges and various commercial accommodations. A few run bus tours and there are even those who offer helicopter transport to fishing hot spots.

FTOs and their clients must observe the same fishery controls as recreational fishers and none of their catch may be sold or bartered. Throughout much of the 1990s the industry was represented by the Fishing Tour Operator's Association (FTOA), but this was disbanded in 1996. Between that time and the beginning of 2005, the industry was not formally represented and this made consultation with Government and other organisations difficult.

To encourage the re-establishment of a representative association, in 2005 NT Fisheries provided funding to enable the industry to employ its own executive officer. This led to the incorporation of the Northern Territory Guided Fishing Industry Association (NTGFIA) and an active recruitment campaign. One of the conditions of funding was a requirement that the NTGFIA consult with their sector on the most appropriate means of securing permanent funding for their executive officer position. This advice to government is due in early 2006.

PROFILE OF THE FISHERY

Area

FTOs operate in areas which are generally accessible to the public, however, there are restrictions on the number of commercial operations allowed in specific areas managed by the Department of Environment and Heritage (DEH) and the Parks and Wildlife Service. Some FTOs maintain financial agreements with landholders to operate exclusively from land of Aboriginal and other tenure.

Fishing Method

The methods and gear used by FTOs and their clients are the same that may be used by other recreational fishers. Fishing methods used are indicated on FTO log return sheets and Figure 2 shows the number of line hours spent using various methods.

Catch and Effort

Numbers of fish caught, kept and released are recorded by species on FTO log returns, together with the number of hours each client spends per day with lines in the water. Figure 1 below shows the number of line hours fished each year between 1994 and 2005 and a steadily increasing annual catch between 1994 and 2001. There was a significant increase in 2005 from 2004 in line hours fished (28%), fish caught and released (38%) and client numbers (27%).

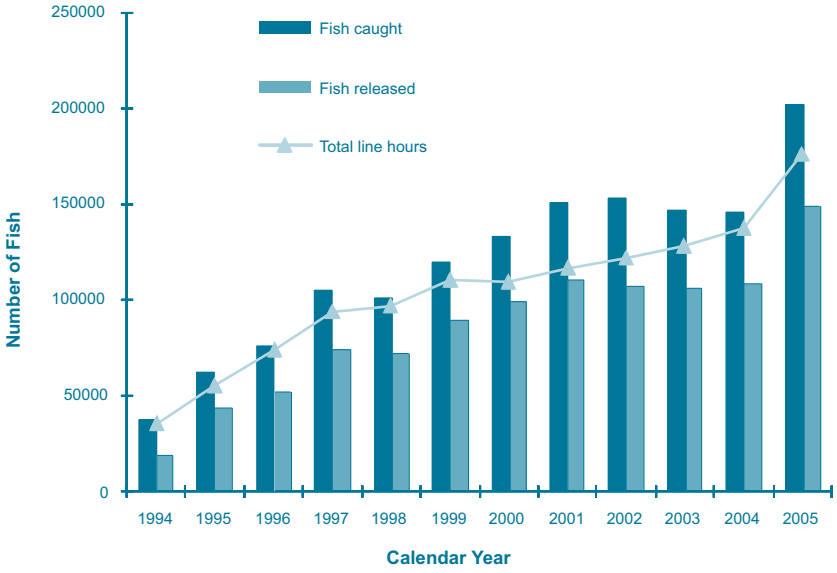

Figure 1. Total catch, release and line hours 1994 to 2005

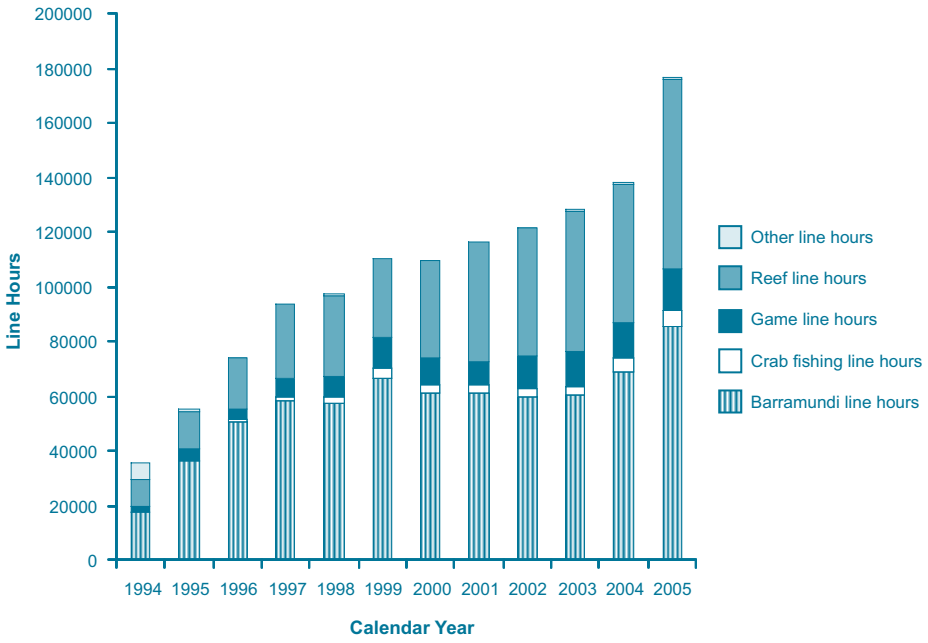

Figure 2. Line hours spent using various fishing methods

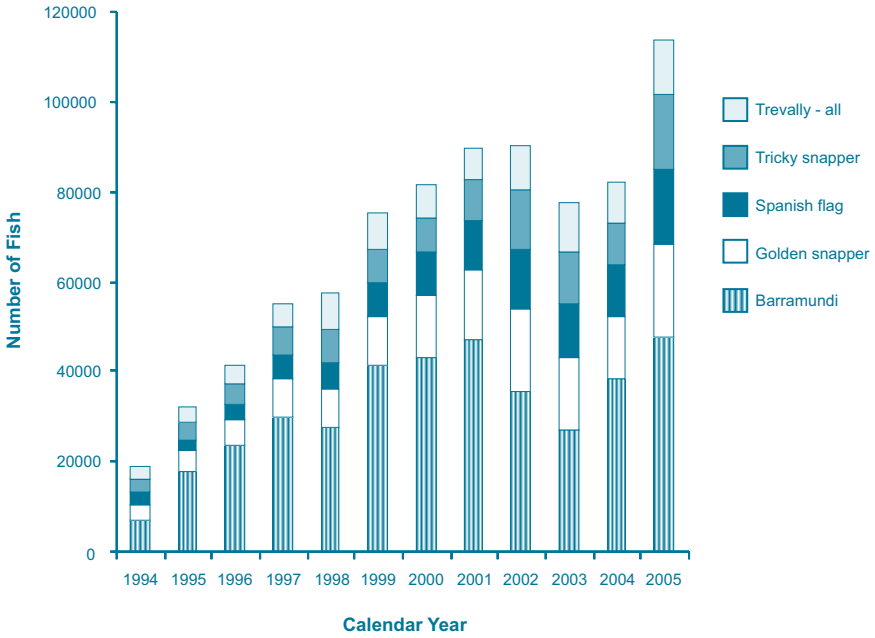

Figure 3. Five most frequently caught species 1994 to 2005

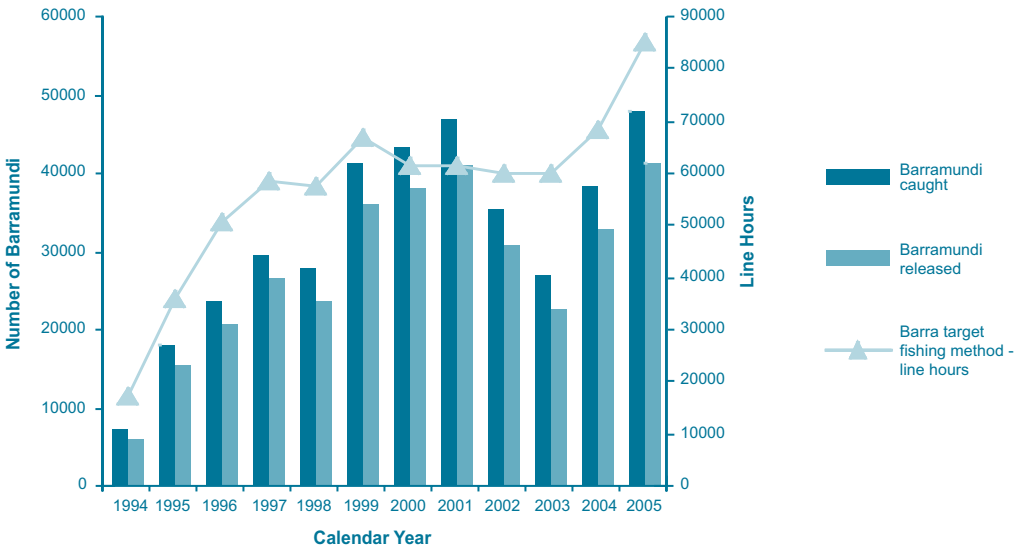

Figure 4. Total barramundi catch, release and line hours 1995 to 2005

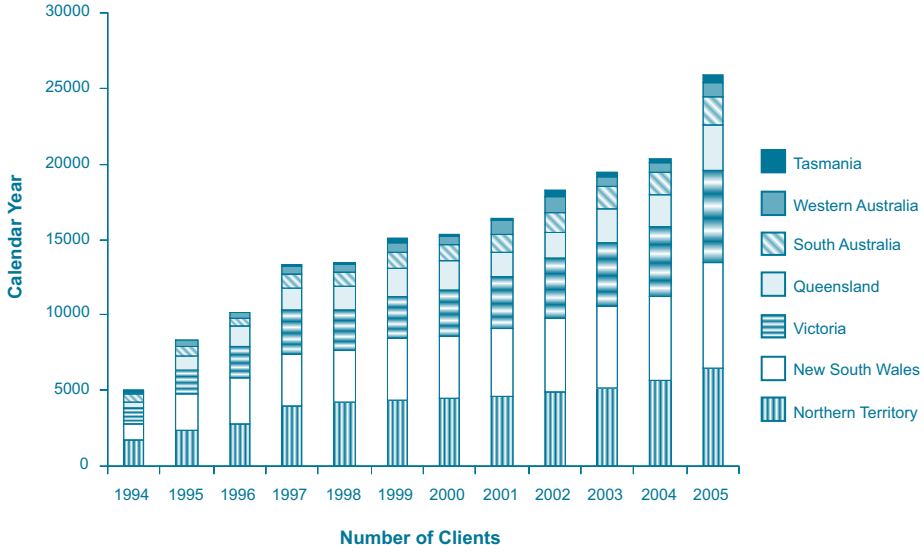

Figure 5. Australian client origin trend from 1994 to 2005

Non-retained Species

FTO's are required to report the number of each species their clients catch and release in their logbook returns. A consistently high release rate is one of the more notable attributes of this fishery, particularly for barramundi. In 2005, eighty-six percent of all barramundi captured were released. Of all the fish caught during this period, 74% were released.

Eco-system Impact

No detrimental impacts on eco-systems have been linked to the guided fishing tourism industry. A strong culture of catch and release fishing within this industry is evident by a consistent overall release rate of 70% or higher.

Social Impact

The number and origins of FTO clients are recorded on their log returns. About a quarter of all clients are Northern Territory residents. This supports data from the National Recreational Fishing Survey: The Northern Territory (NRFSNT), which revealed a higher recreational fishing participation rate per capita in the Territory than in other Australian jurisdiction.

In 2005 the number of clients increased by 27% from 2004, with a 17% increase in overseas clients and a 29% increase in Australian clients. The Northern Territory provides most clients, followed by New South Wales, Victoria, Queensland, South Australia and other countries.

Economic Impact

The guided fishing tourism industry's annual contribution to the Northern Territory's economy has yet to be assessed. While the number of client days is recorded each year, variable day rates charged by different operators make such an assessment difficult. Nonetheless, the licence numbers and activity suggest that this is a significant industry that generates considerable income for the Territory.

STOCK ASSESSMENT

Monitoring

The fishery is monitored primarily through the log returns system, which must be observed as a condition of licences. Annual log data summaries are compiled which show the number of each species caught and released, fishing methods used and areas fished.

Stock Assessment Methods and Reliability

Data from FTO log returns and the NRFSNT are used for species specific stock assessments. Details have been included in individual fishery status reports provided elsewhere in this document.

Current Exploitation Status

Refer to Figure 1 for the annual numbers of fish caught and released.

Future Assessment Needs

The FTO log return program provides essential data to fishery managers and is intended to continue. These data are combined with those from surveys such as the NRFSNT to provide a comprehensive overview of the Territory's recreational fishing sector.

RESEARCH

Summary to Date

All fisheries research on recreationally significant species is important to FTOs. The current relevant research programs focus on barramundi, black jewfish, sharks, Spanish mackerel and mud crabs.

Incorporation into Management

FTO and NRFSNT data are considered when decisions are made regarding fishery area restrictions, regulation amendments, infrastructure developments and land and native title claims.

Current Research

Spanish mackerel migration is being investigated through gene tagging research and black jewfish spawning aggregations are being investigated using tagging and sonic tracking technology. Mud crab monitoring and habitat productivity is currently being researched. There is also the annual study of barramundi numbers, size and recruitment continues in the Mary River.

Some monitoring of stocked impoundment barramundi populations occurred in 2005 and this will continue in coming years.

MANAGEMENT/GOVERNANCE

Management

Objective

NT Fisheries' primary objective is to assist the sustainable management and development of the guided fishing tourism industry, recognising the NTGFIA as its formal representative association. The Association has proposed various changes to the management of FTOs which will be considered in 2006.

History

FTO licences have been issued free of charge since 1994 and no limit on licence numbers is set. Table 1 shows the numbers of licences issued and fished each year since 1995.

Licence numbers were fairly stable at close to 120 per year between 2000 and 2004. However, there was a significant increase (33%) in the number of licences issued between 2004 and 2005. This growth is noteworthy in view of the 27% increase in client numbers over the same period.

The industry was represented by the FTOA between 1989 and 1996 but representation languished between then and the incorporation of the NTGFIA in 2005.

A valuable data base has evolved through the FTO log returns system and this is essential to fishery managers.

Current Issues

The NTGFIA will advise Government on the most appropriate means of funding its executive officer position permanently in 2006. This may lead to the introduction of licence fees or some other means of establishing a revenue base. Not all FTOs are NTGFIA members and there is no mandate on membership. However, membership is expected to increase throughout 2006 and beyond.

Future Plans

It is anticipated that a growing number of FTO licensees will support the NTGFIA and that this will enhance industry cohesion and consultation. The Association has indicated support for a review on the number of FTO licences issued by NT Fisheries, the introduction of a management plan for the guided fishing tourism industry, and

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Licences issued	137	155	218	152	145	124	121	116	108	120	160
Active licences	71	97	126	104	110	69	88	82	75	88	117

Table 1. Number of FTO licences issued annually from 1995 to 2005 showing active and inactive licences

the electronic lodgement of returns information. Means by which its executive officer position can remain funded are yet to be proposed, but a licence fee regime appears to be the most likely option.

Compliance

The Marine and Fisheries Enforcement Section of the Northern Territory Police Force are responsible for the monitoring and enforcement of fishery regulations, including those related to FTOs and their clients.

Consultation, Communication and Education

The incorporation of the NTGFIA in 2005 and its subsequent recruitment campaign are expected to enhance consultation and communication between Government agencies and the industry.

Prepared by

Phillip Hall and Tricia Kelman – Aquatic Resource Management Officers, Recreational Fishing Unit.

References

Angler survey data is sourced from the *Fishcount 95* survey and the *National Recreational Fishing Survey: Northern Territory*.

aquatic pest management

Aquatic Pest Management Status Report 2005

INTRODUCTION

Aquatic Pest Management (APM) protects the Northern Territory's aquatic resources from introduced aquatic pests. Reliant upon these resources are the recreational and commercial fishing, and aquaculture industries, worth an estimated $315 million to the Territory annually.

The APM unit was established following recognition of the vulnerability of Territory waterways to invasion by exotic species, as highlighted by the incursion of the black-striped mussel (*Mytilopsis sallei*) in April 1999.

The roles of the APM unit are to:

- maintain an aquatic resource surveillance program to detect introductions of aquatic pests to the Northern Territory;
- document natural changes in the abundance and species composition of marine fouling communities;
- coordinate the inspection and treatment of high-risk vessels;
- provide a contact point for reporting potential pest species observed in the local environment;
- provide an emergency response to detected introductions of exotic species;
- represent the Northern Territory in national forums that address the prevention and management of introduced aquatic species;
- coordinate the implementation of national arrangements that will provide Australia with a coordinated approach to marine pest issues; and
- raise public awareness of the threat of aquatic pests through educational activities.

Eco-system Impact

The introduction and subsequent establishment of an aquatic pest species in Northern Territory fresh, estuarine or marine waters has the potential to seriously impact on biological diversity and the productivity of Northern Territory aquatic resources.

Aquatic pests tend to share a number of characteristics – they have high reproduction and growth rates, broad environmental tolerances and are highly invasive. These characteristics allow them to colonise a wide variety of habitats in large numbers to the exclusion of native plants and animals. They may out-compete or prey on native species, affect community dynamics and food webs, or alter the physical structure of habitats.

Social Impact

Aquatic resources have intrinsic social values as a basis for income and recreation. The negative impact of exotic species on the aesthetics of our waterways and the variety of species of fauna and flora has the potential to dramatically impact upon these social values.

Economic Impact

The introduction and establishment of aquatic pests has potential for a significant negative economic impact on the Northern Territory. Establishment of aquatic pests may reduce the productivity of fisheries resources and increase expenses associated with maintenance and amelioration costs. Such costs may be associated with increased fouling of infrastructure (eg. nets, pipes, vessels) and increases in aquaculture losses (resulting from reduced water quality, competition with fouling aquatic pest species, and increased risk of disease).

Trade may also be affected. The establishment of marine pest species has the potential to limit interstate trade, as destination ports wishing to remain free of marine pests may restrict the entry of vessels from infested ports.

ENVIRONMENTAL ASSESSMENT

Water quality and species diversity monitoring in Darwin Harbour and marinas commenced following the eradication of the marine pest *Mytilopsis sallei* (black-striped mussel), from Cullen Bay, Frances Bay and Tipperary Waters marinas in April 1999. Similar data is available for Bayview Marina from time the marina was first filled with water in November 2000. Such data documents the changes in water quality and species diversity.

In 2005, no marine pests were detected in Darwin Harbour and marinas, or at Rankin Point (Bynoe Harbour), Raffles Bay (Cobourg Peninsula), Milner Bay (Groote Eylandt), Garden Point (Melville Island) or Gove Harbour.

Biological Monitoring

Monitoring of marine biofouling organisms continued during 2005 with the assistance of local industry. In Darwin, monitoring is undertaken by APM, and sites are located within each of Darwin's locked marinas as well as in open water locations in Darwin Harbour. Monitoring at other locations along the NT coastline is conducted by APM with assistance from industry: Gove Harbour (Alcan Pty Ltd), Raffles Bay (Cobourg Peninsula - Paspaley Pearls Co. Pty Ltd), Rankin

Point (Bynoe Harbour - Paspaley Pearls Co. Pty Ltd), Milner Bay (Groote Eylandt, GEMCO), and Garden Point (Aspley Strait, Melville Island – Great Southern Plantations). Throughout 2005, no recognised marine pest species were found at any of the locations monitored.

Differences in the species colonising artificial settlement surfaces are most apparent when comparing enclosed marina sites with open water sites. Although the species present amongst biofouling assemblages varies from one location to another, open water sites (including those in Darwin Harbour and across the Territory coastline) generally have a greater diversity of biofouling taxa as well as the number of individual species present within the fouling community. It is very rare for a single taxa or species to dominate the fouling community to the exclusion of other taxa or species at open water sites.

Marinas, however, are an artificial environment. They are not exposed to the tidal regimes and water exchange that characterise open water environments. The extreme variations in temperature and salinity that occur during the Wet Season as cool freshwater runoff is trapped within the marinas creates an environment hostile to native species. Further, marinas are subject to concentrated vessel movements which expose them to an increased likelihood of marine pest incursion.

Nuisance fouling and marine pest species include those which are able to colonise vessel hulls quickly and are able to survive long journeys across climatic ranges. As a result, these species are likely to establish within marinas. What separates the two groups are the impacts on the environment and economy that result from the species establishment. Several well known marine biofouling organisms which are cosmopolitan in distribution, being recorded from many ports around the world, are frequently recorded from Darwin marinas and include: the polychaetes *Hydroides sanctaecrucis* and *H. elegans*; the barnacle *Balanus amphitrite*; and the bryozoans *Bugula neritina* and a *Bowerbankia* species. These species are not often recorded outside marinas, and when they are, are in much smaller numbers.

In Darwin's marinas, the fouling community is generally dominated by blooms of single species. The most common types of organisms are barnacles and polychaete tube worms. Both these have a calcareous structure and are able to form large quantities of hard fouling matter in short time frames, and colonise hard substrates including boat hulls.

The type of organisms which initially grow on artificial settlement surfaces (primary coloniser) placed in Cullen Bay Marina and Frances Bay Mooring Basin, and those which subsequently grow over them (secondary coloniser) are listed in Tables 1 and 2 respectively. The tables also indicate the relative abundance of each organism (high, > 70% estimated cover; medium, 30 to 70%; low, < 30%). It is evident that barnacles and polychaete tube worms are often the first organisms to colonise new substrates (artificial settlement surfaces) in the marinas, but in turn are often colonised by a secondary layer of marine growth. These 'secondary' organisms are frequently ascidians and non-calcareous bryozoans.

In the marina environments the primary fouling species are most often *Hydroides sanctaecrucis* , *H. elegans*; or *Balanus amphitrite*, and they generally occur in single species blooms (although *Hydroides* spp. will grow over *B. amphitrite*). As a rule, *Hydroides sanctaecrucis* and *H. elegans* do not bloom at the same time. Similarly, the secondary organisms tend to form single species blooms.

Water Quality Monitoring

Water quality in the marinas varies seasonally and is largely driven by freshwater run-off as a result of Wet Season rainfall. Stratification of marina waters (layering of water possessing different temperature and salinity characteristics) is most notable in Cullen Bay and Tipperary Waters marinas between November and May (Figures 1 and 2).

Incorporation into Management

The change in environmental conditions that results from a cooler, freshwater layer developing above warmer, denser water is hostile to many native species. In contrast the same environment can provide opportunities for the establishment of aquatic pests which are generally more tolerant of extreme variations in environmental conditions. Information gained from environmental monitoring has highlighted water quality as an important factor influencing seasonal variation in fouling communities.

It should be noted that changes in water quality between the Dry and Wet Seasons (Figures 1 and 2) correspond to changes observed in the fouling communities at Cullen Bay Marina (Tables 1 and 2).

A reduction in the degree of Wet Season stratification should result in a reduced potential for the establishment of aquatic pest species. Seasonal stratification can be minimised by marina management implementing practices that promote the mixing and flushing of marina waters.

	Primary colonising taxa		Secondary colonising taxa	
	Taxa	**Level**	**Taxa**	**Level**
Jan	Ascidian	High	Polychaetes	High
Feb	Polychaete/Barnacle	High	Bryozoa	High
Mar	Barnacle	High	Bryozoa	High
Apr	Barnacle	High	Polychaetes	High
May	Barnacle	Low	Polychaetes	Low
Jun	Polychaete	Medium	Ascidian (solitary)	Medium
Jul	Polychaete	Medium	Ascidian (solitary)	Medium
Aug	Polychaete	Low	Ascidian (colonial)	Low
Sep	Polychaete	High	Ascidian (colonial)	High
Oct	Polychaete	Medium	Ascidian (colonial)/ Bryozoa	Medium/Medium
Nov	Polychaete	Low	Ascidian (solitary)	Low
Dec	Polychaete	Low	Ascidian (solitary)	Low

Table 1: Primary and secondary colonising taxa recorded from Cullen Bay Marina during 2005

	Primary colonising taxa		Secondary colonising taxa	
	Taxa	**Level**	**Taxa**	**Level**
Jan	Barnacle	Low	Polychaetes	High
Feb	Barnacle/Polychaete	High/Low	Bryozoa	Medium
Mar	Barnacle	Medium	Bryozoa	Medium
Apr	Barnacle	Low	Bryozoa	High
May	Barnacle	High	Bryozoa	High
Jun	Barnacle	High	-	-
Jul	Barnacle	Medium	Polychaetes	Low
Aug	Barnacle	Medium	Polychaetes	High
Sep	Barnacle	Medium	Polychaetes	High
Oct	Barnacle	Low	Polychaetes	High
Nov	Barnacle/Polychaete	Low/Medium	Ascidian	High
Dec	Barnacle/Polychaete	Low/Medium	Ascidian	High

Table 2: Primary and secondary colonising taxa recorded from Frances Bay Mooring Basin during 2005

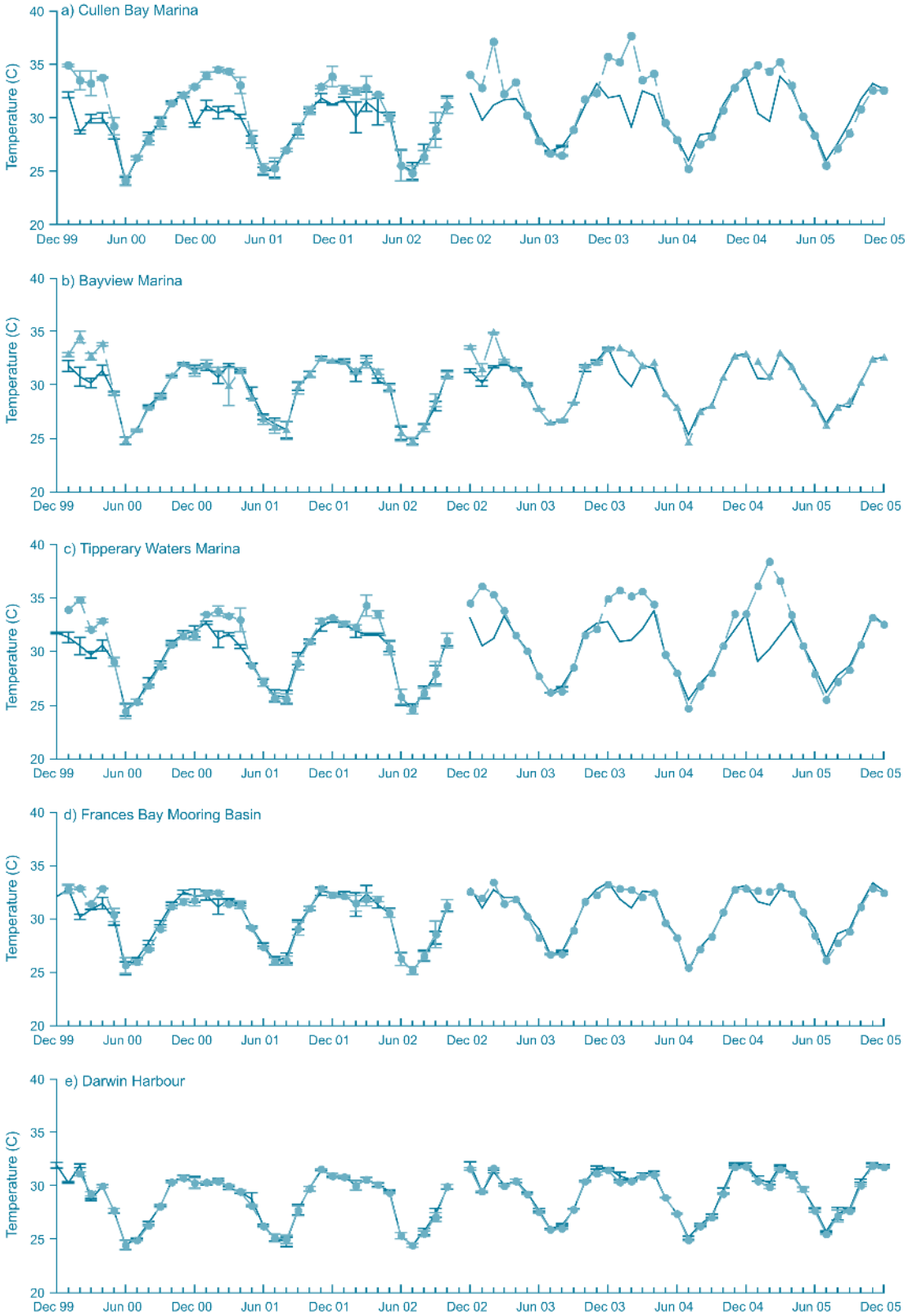

Figure 1: Temperatures (ºC, mean ± standard error) recorded at marina and open water sites of Darwin Harbour at 0.5m (—) and 3.0m (–■–) [Note - 2.0m (–▲–) at Bayview Marina] depth between December 1999 and December 2005

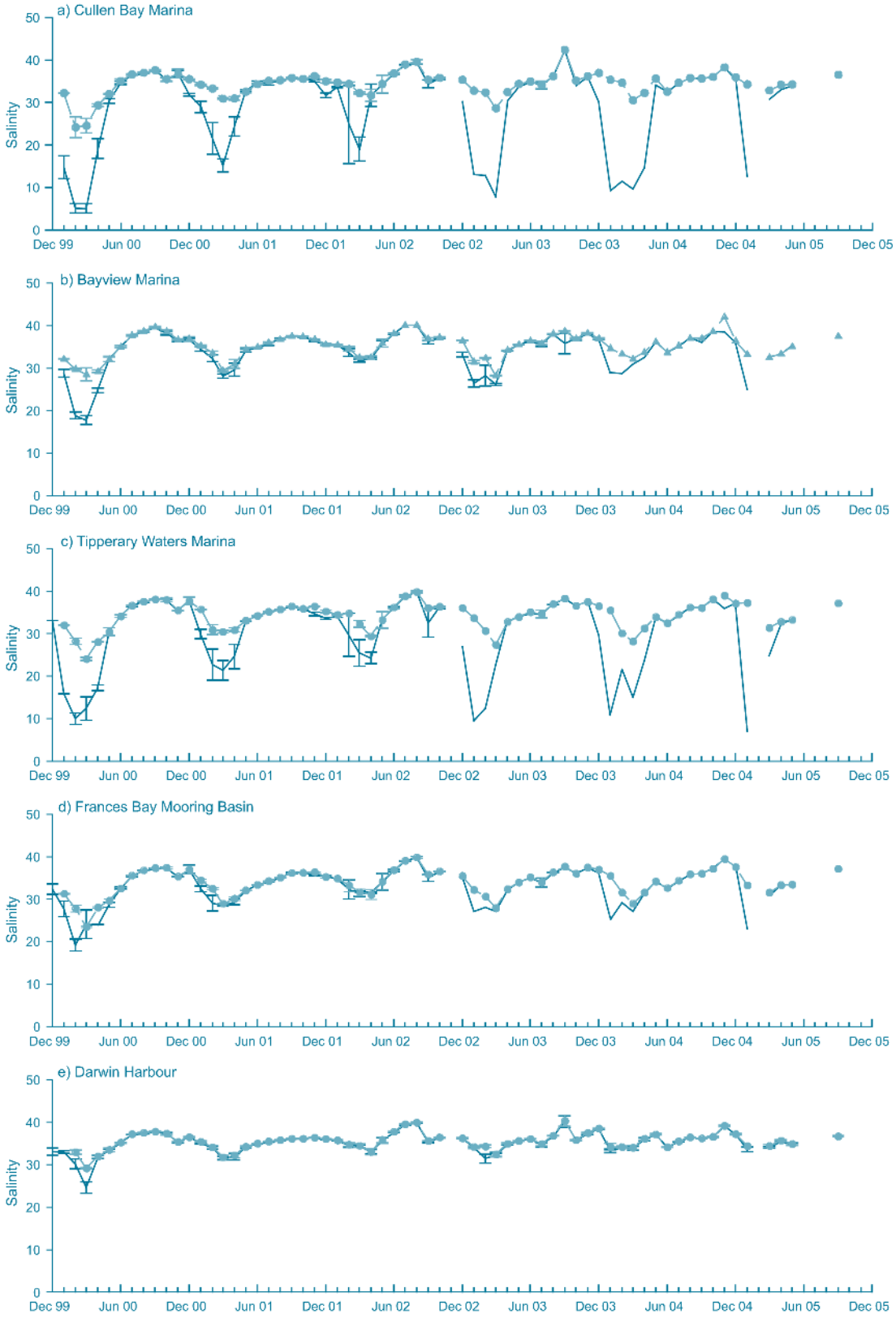

Figure 2: Salinity (PSS 78, mean ± standard error) recorded at marina and open water sites of Darwin Harbour at 0.5m (—) and 3.0m (–■–) [Note - (2.0m (–▲–) at Bayview Marina] depth between December 1999 and December 2005

AQUATIC PEST CONTROL

Prior to 1999, no record of noxious marine species had been reported from the waters of Darwin Harbour. April 1, 1999 marked the quarantining of Darwin marinas as a result of an extensive invasion by the exotic black-striped mussel - *Mytilopsis sallei*.

This bivalve has the potential to seriously impact on local marine biodiversity and threatens the social and economic benefits derived from the marine environment. Following the discovery, a rapid response by the Northern Territory Government successfully eradicated the species, at a cost exceeding $2.2 million. This is believed to be the first documented successful eradication of an established marine pest population.

In recognition of the vulnerability of Darwin Harbour to invasion by exotic organisms and its status as a primary port and popular tourist destination, the APM unit was established. The issue of freshwater exotics also fell within the scope of the APM unit.

Only 18 months after the eradication of the black-striped mussel from Cullen Bay Marina, the species was again found within Darwin Harbour. In September 2000, dive surveys detected *Mytilopsis sallei* (black-striped mussel), on the hulls of two apprehended foreign fishing vessels, the Indonesian Type III Iceboats Hasil Jaya and Queen Nathalia. In consultation with the commonwealth Australian Fisheries Management Authority (AFMA), both vessels were removed from Australian waters and returned to Indonesia. Intensive surveys in the following months failed to detect any further populations of black-striped mussels.

A population of Asian green mussels (*Perna viridis*) was discovered on the hull of an apprehended vessel during routine monitoring in November 2001. The infested vessel was destroyed following cooperation between the APM unit, AFMA and the Australian Quarantine and Inspection Service (AQIS).

In 2000, the APM successfully eradicated two populations of exotic aquarium species: the jewel cichlid and Gambusia. The jewel cichlid (*Hemichromis bimaculatus*) is a prohibited import to Australia. This aquarium fish is a mouth-brooder capable of out-competing native fishes as it is a prolific breeder. It was eradicated from Racecourse Creek, Darwin. The creek was restocked with native fishes from a nearby waterway to assist with mosquito control.

A population of Gambusia (*Gambusia* sp.) was eradicated from Ilparpa Swamp in Alice Springs with the cooperation of Waterwatch. The mosquito fish is a prohibited species in Australia. Gambusia are prolific breeders and would compete with native species for food and space.

Four established populations of exotic freshwater snails were eradicated in 2002. The snails were identified as the giant ramshorn aquarium snail (*Planorbarius corneus*) and *Lymnaea columella*, a snail that is a potential host for a parasitic liver fluke that affects cattle. Subsequent investigations revealed two further contained populations of these snails. It appears that movement of ornamental aquatic plants facilitated their spread.

No confirmed incursions of marine or freshwater pests were detected in 2003.

Two species of exotic freshwater snails were controlled during 2004. *Pseudosuccinea columella* (the liver fluke snail) and *Pomacea bridgesii* (the mystery snail) appear to have been introduced in association with the movement of pond and aquarium plants.

Routine vessel inspections and treatments conducted during 2004 resulted in the detection of a bivalve identified as a *Perna* species – potentially the marine pest, Asian green mussel. The bivalve was found in the pipe-work of a visiting yacht.

Current

Of the twelve marine pest reports received during 2005, ten were of no concern and proved to be native or widely distributed oceanic species. The remaining two reports, however, were of great concern. Both black-striped and Asian green mussels were found in association with apprehended illegal foreign fishing vessels. Appropriate steps were taken to address the risk posed by the vessels. Immediate disposal of the vessels was orchestrated and inspection regimes were amended with cooperation from AQIS and AFMA.

Two freshwater pest reports were received during 2005, only one proving to be of concern. A population of exotic aquarium fish (Platy, *Xiphophorus maculatus*) was reported from a stormwater drainage network at Charles Darwin University. Wet Season rains had the potential to spread this population of fish into neighbouring Rapid Creek. Platys are tolerant of salt water and have the potential to compete with native

species and impact on the ecosystem. University management worked with APM to control overflow from an ornamental pond to prevent further fish from entering the drainage system. The Platy population within the stormwater drains was also eradicated.

Future Assessment Needs

With the expansion of port industries and the associated increase in shipping movements, as well as the transient nature of our population, the opportunities for exotic species to be introduced to the Northern Territory will increase. Therefore, it will be important to continue obtaining environmental information for habitats outside Darwin Harbour, and find ways to expand aquatic (marine and freshwater) pest monitoring and surveillance activities.

MANAGEMENT/GOVERNANCE

Management

Objective

The objective of Aquatic Pest Management is to minimise the opportunity for both the introduction and establishment of aquatic pest species in Territory waters through the development of local protocols under the Northern Territory *Fisheries Act 1988*.

History

The successful eradication of the black-striped mussel from Darwin waters in April 1999 initiated a series of events at both a local and national level.

A dedicated unit was established within the NT Fisheries Group to assess and implement policies and strategies to minimise a recurrence of a similar potential ecological and economic disaster. Concurrently, the Commonwealth initiated processes required to develop a National System for the Prevention and Management of Marine Pest Incursions.

A risk-assessment based on voyage history, stop-overs in international ports and vessel maintenance regimes identified two high risk categories of vessels frequenting Territory waters: internationally travelled vessels entering Darwin marinas and apprehended vessels. Vessels apprehended for illegal activities originate from, or have transited, areas known to be inhabited by potential aquatic pest species. A subgroup of this class, Iceboats from the Province of Probolinggo in East Java, were declared an extreme risk as a high proportion of these vessels had hulls infested with either black-striped or Asian green mussels.

Recreational vessels transiting international waters can transport exotic species as fouling, either on the hull or in the internal pipe-work of the vessel. In addition to those vessels arriving from international waters, vessels arriving in Darwin that have spent a significant time in the Port of Cairns also pose a risk due to the continued presence of *Perna viridis* (Asian green mussel) in the Port of Cairns. The ease with which Asian green mussels may be transported to Darwin puts vessels from Cairns in the high risk category.

Marinas are recognised as high risk areas because they are frequented by high risk vessels, and the marine organisms established within the marinas are subject to unnatural environmental stresses. Stressed native species do not compete effectively against exotic species, increasing the chances of the establishment of an aquatic pest.

Current issues

The two vessel categories mentioned above continue to be of concern and inspections and treatments of high risk vessel entering Darwin marinas continues with cooperation from marina management bodies.

As a result of the Alice to Darwin railway and further industrial development an increase in international shipping is predicted. Larger commercial vessels using the Port of Darwin carry tonnes of ballast water which could introduce potential marine pest species to the NT.

In addition, there is a need to educate the public in relation to aquatic pests in freshwater systems and improve access to native aquarium species and local bait supplies. The use of native species in aquaria and ponds, as opposed to exotics, will be promoted and encouraged. For example, native freshwater fish are more effective in the control of mosquitoes than Gambusia.

At the national level, the development of the National System for the Prevention and Management of Marine Pest Incursions will largely address the paths of introduction for marine pest species such as vessels (recreational and commercial), aquaculture and port environments. The aquarium trade in marine species is also included in the National System, however freshwater species fall outside the terms of reference.

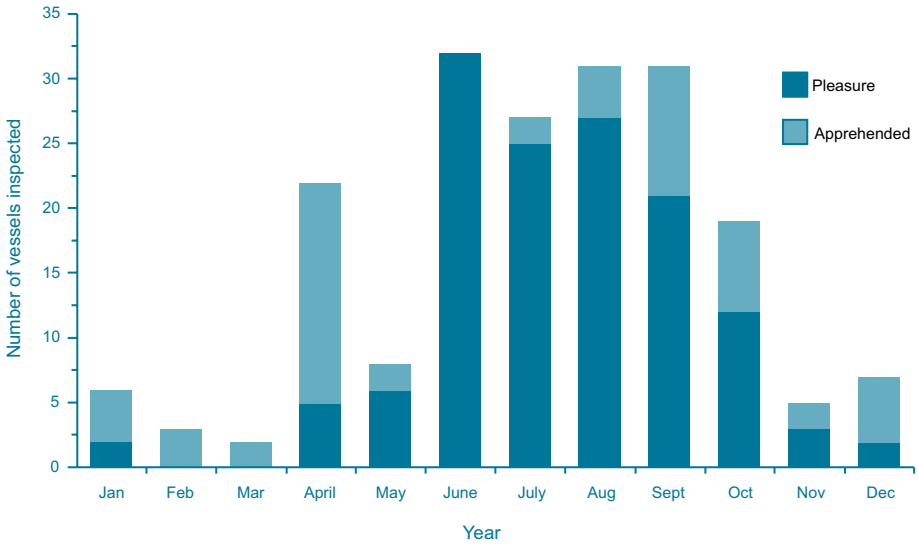

Figure 3: The total number of vessels inspected each month during 2005

Importation of and trade in freshwater species is being considered by the Ornamental Fish Trade Policy Working Group. This group, in which the APM unit is active, has undertaken a national review of the current ornamental fish trade and has developed and distributed for public consultation a Strategic Approach to the Management of Ornamental Fish in Australia.

Future plans

The National System for the Prevention and Management of Marine Pest Incursions (the National System) is currently being developed by the National Introduced Marine Pest Coordination Group. Some elements of the National System were implemented on a voluntarily basis during 2005. Full mandatory implementation of the National System, including regulatory and non-regulatory components, is expected to be achieved by mid 2008. Implementation of the National System arrangements in the coming years, and the associated transition from current arrangements will impact upon APM activities and require appropriate planning and communication with affected stakeholders.

Compliance

Vessels intending to enter Darwin marinas are required to undergo an inspection prior to being permitted entry. Compliance has been 100 % and the Darwin Port entry requirements are providing a basis for the development of national protocols to minimise the introduction of marine pest species into Australian waters.

In addition, vessels apprehended off the northern Australian coastline and destined for the Ports of Darwin and Gove are examined for the presence of aquatic pest species. Early in 2004 inspection protocols for apprehended vessels were reviewed in light of the information collected during the previous 12 months. The majority of vessels apprehended during 2003 were found to be very lightly fouled upon inspection prior to entry to the Port of Darwin. Protocols were subsequently adjusted so that all Type III vessels were inspected inside the Port of Darwin. Changes to the protocols reduced the expense and inconvenience to AFMA, Australian Defence Force (ADF), Australian Customs Service (ACS) and AQIS without compromising the level of protection against the risk of these vessels introducing marine pests into the aquatic environment of the Northern Territory.

Further amendments to inspection protocols were made during 2005. In September, APM staff inspecting what remained of a vessel following destruction by burning, detected a cluster of *Mytilopsis sallei* (black-striped mussels) on a propeller. The propeller was traced back to a Type III Iceboat. This vessel had been inspected on its arrival in the Port of Darwin and declared clear of marine pests. This discovery highlighted the longer detention of apprehended vessels and the risk posed by small recently settled mussel juveniles or larvae, and the lack of ability of divers to detect organisms of such small size. Protocols were immediately amended to ensure a follow-up inspection of all Type III Iceboats one month after their arrival.

The first group of one month inspections were conducted during October 2005. During these inspections, a juvenile *Perna viridis* (Asian green mussel) was discovered. The individual's size was consistent with it being a recently settled juvenile at the time of the initial inspection.

These results gave immediate support for the new protocols. With cooperation from AQIS and AFMA, arrangements were made for the vessel's immediate destruction.

In 2005, a total of 135 pleasure craft and 58 high risk apprehended foreign fishing vessels were inspected (Figure 3). The number of recreational vessels inspected each month clearly highlights Darwin's Dry Season tourism high. No such seasonal pattern is evident for apprehended vessels, as the number of apprehensions is influenced by operational factors.

Consultation, Communication and Education

Vessel inspection and treatment protocols were developed in consultation with fishing industry members, marina owner/operators, and ship repair and maintenance facilities and the commonwealth agencies ACS, ADF, AQIS and AFMA. Information from ongoing environmental monitoring is also reported to stakeholders via the departmental website and on request. Brochures outlining general marine pest information and vessel inspection protocols have been distributed to stakeholders.

The general issue of aquatic pests has been presented in seminar forums and through articles in the popular media. These have targeted the general public and stakeholder groups such as commercial and recreational fishers, scuba divers, sailors, port operators, ship repair and maintenance facilities, naturalists and indigenous groups.

Regular reports (Fisheries Report series) to industry stakeholders associated with the aquatic resource monitoring program have continued. Electronic copies of these reports are available from the APM pages of the Fisheries website, along with other general information publications.

In 2005, the contact numbers for the APM unit (which have been widely publicised to facilitate the reporting of any aquatic pest sightings) received fourteen reported sightings comprising of twelve marine and two freshwater species.

Prepared by

Helen Cribb – Program Coordinator, Aquatic Pest Management.

licensing

Licensing Status Report 2005

LICENCES AND PERMITS ISSUED IN 2005

The Fisheries Licensing Unit co-ordinates the issuing and renewal of licences and permits issued under Section 11 and 15 of the *Fisheries Act 1988*. In 2005, there were 1014* separate licences and permits issued to 909 parties. A breakdown of the numbers of licences and permits issued per type, and the numbers of parties in receipt of these licences and permits, is provided in the table below.

Note* - The holders of a specific licence type may have exercised an option (e.g. a two-for-one licence surrender) in order to obtain a single unrestricted licence for a particular fishery. In such instances, the number of licences issued may not reflect the number of licences available and/or operating in a particular fishery.

Licence Type	Licence Count*	Party Count
A1 - COASTAL LINE FISHERY LICENCE	56	50
A2 - COASTAL NET FISHERY LICENCE	14	13
A3 - BAIT NET FISHERY LICENCE	2	2
A4 - SPANISH MACKEREL LICENCE	20	17
A5 -SHARK FISHERY LICENCE	17	15
A6 - DEMERSAL FISHERY LICENCE	60	50
A7 - BARRAMUNDI FISHERY LICENCE	24	23
A8 - MUD CRAB FISHERY LICENCE	49	40
A9 - MOLLUSC FISHERY LICENCE	1	1
A10 - PEARL OYSTER FISHERY LICENCE	7	7
A12 - AQUARIUM FISH/DISPLAY LICENCE	13	13
A13 -TREPANG FISHERY LICENCE	6	1
A15 - RESTRICTED BAIT ENTITLEMENT	127	103
A16 - FINFISH TRAWL FISHERY LICENCE	1	1
A17 - JIGGING FISHERY LICENCE	1	1
A18 - TIMOR REEF FISHERY LICENCE	12	12
A50 - DEVELOPMENT FISHERY-COAST NET	2	2
B1 - FISH TRADER/PROCESSOR LICENCE	40	40
B2 - FISH RETAILER LICENCE	323	313
C1 - AQUACULTURE LICENCE	16	16
C2 - PEARL OYSTER CULTURE LICENCE	8	7
D1 - ABORIGINAL COASTAL LICENCE	2	2
D2 - FISHING TOUR OPERATOR LICENCE	160	128
D3 - AQUARIUM TRADER LICENCE	12	12
D4 - NET LICENCE	15	15
S16 – PERMIT	1	1
S17 – SPECIAL PERMIT	25	24
	1014	**909**

Table – Number of licences and permits issued in 2005

Prepared by

Steve Wilmore – Senior Licensing Officer

appendices

APPENDIX 1: GLOSSARY OF ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
AFANT	Amateur Fishermen's Association of the NT
AFCC	Amateur Fishermen's Consultative Committee
AFZ	Australian Fishing Zone
APMU	Aquatic Pest Management Unit
AQIS	Australian Quarantine and Inspection Service
BFAC	Barramundi Fishery Advisory Committee
CI	Confidence Interval
CPUE	Catch per unit effort
CRC	Cooperative Research Centre
DAC	Darwin Aquaculture Centre
DBIRD	Department of Business, Industry and Resource Development
DIPE	Department of Infrastructure, Planning and Environment
EA	Environment Australia
EMP	Environmental Management Plan
EPA	Environment Protection Agency
EPBC	*Environment Protection and Biodiversity Conservation Act* (C'wealth)
FRDC	Fisheries Research and Development Corporation
FTO	Fishing Tour Operator
GIS	Geographic Information System
IFSNA	Indigenous Fishing Survey of Northern Australia
MACANT	Ministerial Advisory Committee on Aquaculture in the Northern Territory
MACRF	Ministerial Advisory Committee on Recreational Fishing
MCFAC	Mud Crab Fishery Advisory Committee
MOP	Mother of Pearl
NRIFS	National Recreational and Indigenous Fishing Survey
NTAA	NT Aquarium Association
NTFDOC	NT Fisheries Development Opportunities Committee
NTFJA	NT Fisheries Joint Authority
NTSC	NT Seafood Council
PFMES	Police Fisheries and Marine Enforcement Section
PL	Post-larvae
QDPIF	Queensland Department of Primary Industries and Fisheries
SMFMAC	Spanish Mackerel Fishery Management Advisory Committee
WTO	Wildlife Trade Operation

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