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Fishery Status Reports 2011

December 2012

Northern Territory Government
Department of Primary Industry and Fisheries
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AUSTRALIA

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Contents

INTRODUCTION

I am pleased to release this report on the status of fisheries in the Northern Territory.

A key role of the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) is to ensure the ecologically sustainable development of our fisheries and aquatic resources. In undertaking this role NT Fisheries works in partnership with all of the fishing industry sectors to assist wild fisheries and aquaculture development and facilitate access and sharing of fish resources between Aboriginal, recreational and commercial users.

A wide range of Territorians and visitors depend upon or enjoy the healthy state of our fisheries. Many Aboriginal communities have strong customary links with our aquatic environments and rely on fish for food, culture and potential economic development opportunities. Our commercial fisheries are valued at over $35 million and provide valuable supplies of high quality seafood such as mud crab, tropical snappers, barramundi, shark and mackerel to restaurants and retail markets. Recreational fishing is an intrinsic part of the Territory lifestyle, and quality fishing experiences attract visitors to the Territory and also support a growing fishing tour operator industry. The annual expenditure on the recreational and fishing tour sectors is estimated at over $80 million.

NT Fisheries has recently commenced a program to assist Aboriginal communities increase their participation in fishing and to supply fresh fish into regional areas. Community marine ranger groups also play a valuable role in monitoring our fisheries and coastlines and NT Fisheries provides significant training and support to improve the skills and capacity of ranger groups to monitor their sea country.

The Darwin Aquaculture Centre is a world class research facility and provides essential research, breeding facilities and industry extension services to support the Territory's $25 million aquaculture industry. New and innovative aquaculture projects are being actively explored in partnership with local companies and remote Aboriginal communities. Recent advances in culture methods for sea cucumbers, giant clams and tropical rock oysters have been encouraging with pilot scale trials underway at Groote Eylandt, Goulburn Island and the Tiwi Islands.

This report provides a summary of the assessments of the status of our fish stocks and socioeconomic data on fishing activity as well as outlining key management issues and future directions for each of our fisheries.

In the vast majority of cases, our fisheries are in a healthy condition with governance structures in place to ensure their ongoing development in an ecologically sustainable manner. Nonetheless, careful management is still required if we are to ensure we achieve the optimum use of our fish and aquatic resources, particularly in high use areas around the main population centres.

Our current assessments are backed up by work undertaken in 2011 by Professor Carl Walters (from the University of British Columbia, Canada) who assisted NT Fisheries with the assessment of eight of our most important fisheries species. The assessments revealed that the stocks of three species of blacktip sharks, grey mackerel, goldband snapper, mud crab and Spanish mackerel are extremely healthy and that only black jewfish and golden snapper have shown signs of population declines in waters adjacent to major population centres.

I would like to thank all fisheries staff, water police officers and those Aboriginal, commercial and recreational stakeholders who have worked collaboratively with the Department across our monitoring, research and management programs, to ensure the ecologically sustainable development of our fisheries.

Ian Curnow
Executive Director, Fisheries

NT FISHERIES – 2011 HIGHLIGHTS AND 2012 PRIORITIES

DEVELOPING FISHERIES WHILST MAINTAINING ECOLOGICAL VALUES

Highlights

A new management framework was implemented for the Demersal and Finfish Trawl fisheries.

A compliance risk assessment was completed for the Spanish Mackerel Fishery.

A Memorandum of Understanding was developed with the Northern Territory (NT) Police and the Australian Fisheries Management Authority to facilitate fisheries compliance in the Timor Reef Fishery.

The status of key NT fish species was assessed, including barramundi, mud crabs, golden snappers and black jewfish, grey mackerel, blacktip sharks, and goldband snapper,

A discussion paper was released to the industry for consideration for the future development of the fishing tour operator industry.

Legislative amendments for the Fisheries Act were actively promoted in consultation with key fishery stakeholder groups.

A formal research partnership was established with Charles Darwin University and a tripartite partnership was established with Queensland and Western Australian fisheries and aquaculture research agencies.

Priorities

Continue to develop new management arrangements in the Coastal Line Fishery to control catches of targeted species while maintaining supplies of fresh fish for the market.

Finalise re-accreditation of the Offshore Net and Line, Aquarium, Mud Crab and Trepang fisheries under Australia's *Environment Protection and Biodiversity Conservation Act.*

Implement new resource allocation arrangements for the Barramundi Fishery.

Implement the unitisation of the restricted bait net entitlement in the Mud Crab Fishery.

Implement relevant priorities from Shark Plan II.

Continue to explore the potential for the establishment of both an inshore and an offshore fishery targeting small species, such as pilchards and herring.

Develop a three-to-five-year strategic fisheries research plan.

Prepare a Memorandum of Understanding with NT Police and the Australian Fisheries Management Authority to facilitate fisheries compliance in the Demersal Fishery.

Commence a review of Environmental Risk Assessment processes.

Investigate automatic vessel monitoring options in inshore fisheries.

Collect key biological information on coastal reef fish species.

Continue to monitor and assess NT fisheries.

Publish the recreational fishing survey results and review the appropriateness of existing recreational fishing controls.

Implement priorities from the Recreational Fishing Development Plan.

Implement legislative amendments to the *Fisheries Act*.

SHARING FISH RESOURCES BETWEEN THE INDIGENOUS, RECREATIONAL AND COMMERCIAL SECTORS

Highlights

Development of a draft resource-sharing framework that will ensure the equitable use of barramundi stocks by all fishers was undertaken by the Barramundi Management Advisory Committee.

The Indigenous Fisheries Development Strategy 2012–14 was finalised after 18 months of consultation.

Consultations were commenced with Aboriginal groups and the fishing industry for the implementation of the East Arnhem Indigenous Fisheries Network which will promote and support the development of Aboriginal fisheries and aquaculture-related businesses.

Negotiations were conducted with Aboriginal land councils for a practical outcome to the Blue Mud Bay decision.

Indigenous Community Marine Ranger Guidelines were implemented by NT Fisheries whilst undertaking research and monitoring activities.

The Certificate II in Fisheries Compliance course was delivered to 12 Aboriginal women rangers in partnership with the NT Water Police and Charles Darwin University.

Priorities

Commence work on the development of an aquatic resource allocation framework for the NT.

Review management arrangements in the Offshore Net and Line Fishery, including a review of catch share arrangements for the Spanish mackerel byproduct.

Explore the potential for developing an inshore fishery targeting small fish species.

Continue to assist in negotiations with Aboriginal land councils for a practical outcome to the Blue Mud Bay decision.

Continue to develop initiatives under the NT Indigenous Fisheries Development Strategy 2012-14.

Encourage and support the establishment of two Aboriginal fishing businesses.

Enhance the Indigenous fishing mentoring program for the East Arnhem region.

Deliver the Certificate II Fisheries Compliance course to 15 Aboriginal rangers.

Develop an Indigenous scientific mentoring program to facilitate the engagement of Aboriginal rangers in fisheries research projects.

PROTECTING AQUATIC ECOSYSTEMS FROM PESTS AND DISEASES

Highlights

The *Darwin Harbour marine pest monitoring survey 2010* report was released. No targeted marine pest species were detected.

NT Fisheries implemented the marine pest monitoring program according to national standards as part of the National System for the Prevention and Management of Marine Pest Incursions (NSPMMPI).

In collaboration with the industry, managed a disease incursion and helped to improve biosecurity practices.

Priorities

Continue to monitor for marine pests and implement NSPMMPI.

Maintain a responsive and effective aquatic animal health diagnostic service.

ASSISTING IN THE DEVELOPMENT OF THE AQUACULTURE INDUSTRY

Highlights

A four-year strategic aquaculture development plan was released.

Over 1 million barramundi fingerlings were produced and sold to barramundi farmers.

Juvenile giant clams were produced in partnership with the aquarium industry.

The industry was assisted to improve the production of juvenile sea cucumbers.

NT Fisheries collaborated with international researchers on sea cucumber ranching.

Participated with Aboriginal rangers and Community Development Employment Program workers in a trial to grow-out giant clams at sea.

Continued sea-based feasibility trials with Aboriginal communities for sea-cucumber ranching.

A feasibility study was conducted for the culture of edible oysters at the Tiwi Islands.

Priorities

Continue to produce juvenile barramundi to assist the industry's expansion.

Cooperate with a remote Aboriginal school to engage children in aquaculture.

Maintain strong research partnerships with existing and emerging aquaculture industries.

Ensure all aquaculture programs and services are aligned with the industry's priorities.

Participate with Aboriginal communities to conduct pilot programs for sea-farming in remote locations.

Identify and address constraints to the involvement of Aboriginal people in aquaculture.

Ensure that the NT aquaculture industry operates according to relevant environmental management plans.

Develop a policy on fisheries enhancement for consideration by the industry.

Establish an aquaponics demonstration unit at the Darwin Aquaculture Centre.

PROMOTE THE AVAILABILITY OF FISHING FACILITIES AND ACCESS OPPORTUNITIES

Highlights

Upgrades of recreational fishing infrastructure across the NT were finalised, including works at Corroboree Billabong, Hardies Lagoon, Saltwater Arm, Middle Arm, Southport boat ramp, Buffalo Creek and Milne Inlet.

The draft Recreational Fishing Development Plan was released for public comment.

Priorities

Continue to support negotiations for access to waters that are impacted by the Blue Mud Bay decision.

Implement priorities from the Recreational Fishing Development Plan.

COMMERICAL WILD HARVEST

AQUARIUM FISHERY STATUS REPORT 2011

INTRODUCTION

The Northern Territory (NT) Aquarium Fishery is a small-scale, multi-species fishery that prospects freshwater, estuarine and marine habitats to the outer boundary of the Australian Fishing Zone (AFZ). The fishery supplies a wide range of aquarium fishes, plants and invertebrates (including corals) to local and interstate pet retailers and wholesalers. A small number of specimens are also sold to overseas buyers.

The current harvest and value of the fishery is small by national and international standards, but there is scope for growth given the increasing demand for aquarium species worldwide. Aquarium Fishery licences became transferable in 2008, enabling new operators to enter the fishery.

The NT Aquarium Committee (NTAC) is the peak body representing licensees in the fishery. The main role of the committee is to work with the Fisheries Division of the Department of Primary Industries and Fisheries (NT Fisheries) to determine future development opportunities and management arrangements for the local industry within the principles of ecologically sustainable development (ESD).

Management arrangements for the NT Aquarium Fishery were assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in 2011. The fishery was subsequently accredited as a Wildlife Trade Operation (WTO) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for a period of one year (ending 30 November 2012). The assessment demonstrated that the fishery is managed in a manner that does not lead to over-fishing, and that fishing operations have minimal impact on the structure, function, productivity and biological diversity of aquatic ecosystems. The NT Aquarium Fishery will be assessed again in late 2012.

PROFILE OF THE FISHERY

Commercial Sector

There are three licence categories in the NT Aquarium Fishery:

- The Aquarium Fishing/Display licence A12 (limited to 12 licences), which permits the collection, sale and display of aquarium species.
- The Aquarium Trader licence D3 (licence numbers not limited), which permits the sale and trade of aquarium species but does not permit the harvesting of aquarium species.
- The Public Aquarium licence D5 (licence numbers not limited), which permits the collection of live fish and aquatic life for the purposes of commercial display only (i.e. trade of these organisms is not allowed).

Nine out of the 12 Aquarium Fishing/Display licences permitted in the fishery recorded fishing activity in 2011. No new Aquarium Trader licences or Public Aquarium licences were issued in 2011.

Following a review of the fishery in 2004-05, all Aquarium Fishing/Display Fishery licence holders were permitted to collect limited quantities of coral and associated benthic species. However, these organisms cannot be collected from Darwin or Gove harbours. Regional triggers for the harvest of coral and associated benthic species (i.e. 20 tonnes within each of three regions) were introduced in 2009 to reduce the likelihood of localised depletion.

The management objectives for the different components of the NT Aquarium Fishery, the current (2011) impacts on these components (through harvesting or other interactions) and their corresponding performance indicators,

trigger reference points and management responses are shown in Table 3.

Area

Aquarium Fishery licensees can harvest from most inland, estuarine and marine waters provided they have permission to access land or sea country to the outer boundary of the AFZ. However, harvesting is not permitted in designated protected areas, such as Doctor's Gully and East Point Aquatic Life Reserves in Darwin Harbour, Aboriginal sacred sites, aquaculture farm leases and sanctuary zones.

Freshwater and estuarine species are generally collected between the Adelaide and Daly rivers, whilst the harvest of marine species is concentrated around Nhulunbuy (with limited collection of marine species in the greater Darwin area).

Fishing Method

Aquarium Fishing/Display Fishery licensees can use barrier, cast, scoop, drag and skimmer nets, hand pumps, freshwater pots and hand-held instruments to collect aquarium species.

Catch

The majority of the NT Aquarium Fishery catch is recorded in terms of the number of individuals (or items), but products such as live rock (i.e. fragments of dead hard coral covered with other organisms) are generally recorded by weight.

Hermit crabs and corals comprised most of the invertebrate harvest (by numbers) in 2011 (Table 1). About 5.0 tonnes of live rock was also collected. The 46 giant fluted clams (*Tridacna squamosa*) taken were well below the harvest trigger point of 2000 individuals for this species.

The harvest of 5000 estuarine shrimp is considered inconsequential as this animal can be found in massive numbers at certain times of the year. The 'Others' category in Table 1 consists of 16 taxa, including crabs, gastropods, prawns, sea cucumbers, sea urchins, shrimps, sponges and starfish taken in small numbers (average 34 individuals per group).

Table 1. The harvest of invertebrate taxa by the Aquarium Fishing/Display Fishery in 2011. The term 'items' refers to both solitary and colonial organisms as well as pieces of live rock covered with same.

Taxon	Harvest
Estuarine shrimps (*Acetes* sp.)	5000 individuals
Hermit crabs (Diogenidae + Coenobitidae)	20 300 individuals
Undifferentiated Crustacea	1000 individuals
Giant fluted clams (*Tridacna squamosa*)	46 individuals
Marine snails (Trochidae + Turbinidae)	729 individuals
Live rock	5038 kg + 28 items
Gorgonians (Gorgonacae)	173 individuals
Mushroom anemones (Corallimorpharia)	650 kg + 6234 items
Sea anemones (Actiniaria)	60 kg + 1390 items
Soft corals (Alcyonacea)	1437 items
Stony/hard corals (Scleractinia)	420 kg + 4856 items
Zoanthids (Zoanthiniaria)	243 kg + 1258 items
Others	540 individuals

The estimated harvest of coral and associated benthic species (calculated using a mean weight of 220 g per item where catch was recorded by number) was 9.8 tonnes, well below both the regional and overall trigger points for this group (i.e. 20 and 60 tonnes, respectively).

Rainbowfish/blue eyes and catfishes were the most popular piscine catch (Table 2), followed by giant perches/glassfishes and scats. All harvested fishes are widespread and abundant in the NT. All seven 'Group A' finfish (i.e. striped [silver] scat, spotted scat, sevenspot [common] archerfish, blackbanded rainbowfish, eastern [chequered] rainbowfish, sailfin glassfish [perchlet] and black catfish) were harvested in 2011. The total catch for this group was 10 515 individuals. Note that the fish names in square brackets above, which have historically been applied to 'Group A' finfish, are now obsolete, having been superseded by Australian Standard Fish Names, which are used hereafter.

Table 2. Harvest of fish taxa by the Aquarium Fishing/Display Fishery in 2011

Taxon	Harvest (Individuals)
Archerfishes (Toxotidae)	1429
Butterflyfishes/Angelfishes (Chaetodontidae + Pomacanthidae)	393
Catfishes (Plotosidae + Arridae)	5427
Damselfishes (Pomacentridae)	157
Giant perches/Glassfishes (Latidae + Ambassidae)	2218
Gobies (Gobiidae)	495
Grunters (Terapontidae)	187
Gudgeons (Eleotrididae)	194
Mouth almighty (*Glossamia aprion*)	493
Mullets (Mugilidae)	636
Nursery fish (*Kurtus gulliveri*)	100
Oxeye herring (*Megalops cyprinoides*)	125
Puffer fishes (Triodontidae)	378
Rainbowfishes/Blue eyes (Pseudomugilidae + Melanotaeniidae)	9681
Northern saratoga (*Scleropages jardinii*)	1943
Scats (Scatophagidae)	1945
Soles (Soleidae)	104
Others	496

Effort

It is difficult to quantify and compare effort in this fishery because of the range of different collection methods used and the fact that harvesting (of marine species in particular) is heavily reliant on favourable weather conditions, the duration of which may vary from year to year. However, weather-induced limits on fishing activity, in conjunction with strict catch controls and low participant numbers, result in minimal fishing effort. Total effort in 2011 was 184 days, which is around 67% of the 2010 figure (275 days). Note that both of these totals are below the 10-year average of 295 days.

Marketing

Advances in affordable aquarium technology have led to an increase in demand for new and unusual aquarium species by private aquaria. Most products harvested by the Aquarium Fishing/Display Fishery licensees are exported interstate by air.

Recreational Sector

A prohibition on the recreational take of giant fluted clams came into effect on 1 January 2010. Otherwise, there are no specific regulations on collecting fish for personal aquaria other than the recreational fishing rules and regulations regarding minimum sizes and possession limits. For example, recreational aquarium hobbyists may not possess under-size barramundi unless they have proof of purchase from a licensed aquarium trader. Similarly, recreational fishers cannot possess more than 30 fish (except for specific bait fish species) outside of their place of permanent residence.

Fishing Method

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

Catch

The recreational harvest of aquarium species is not known, but is assumed to be very low. The collection of aquarium fish by members of the public was not recorded during recreational fishing surveys in 1995 or 2000, despite the inclusion of specific questions pertaining to this issue (Coleman 1998; Coleman 2004).

Non-retained Species

There is little bycatch in the NT Aquarium Fishery due to the combination of selective fishing methods and licence conditions that require all non-target species to be returned to the water quickly and carefully. Monitoring by NT Fisheries has verified the extremely low levels of bycatch and post-release mortality in this fishery.

Threatened Species Interaction

The EPBC Act requires fishers to report any interactions with threatened, endangered and protected (TEP) species found in Commonwealth waters to SEWPaC within seven days of becoming aware of the incident.

Although hard corals, giant fluted clams and sawfish are listed under the Convention on International Trade in Endangered Species (CITES), small quantities of these organisms can be harvested provided their collection is within acceptable sustainability limits (see Table 3). A number of other factors also provide protection for these animals, including their wide distribution, the large area of the fishery and weather- induced limits on fishing activity.

No TEP species were harvested in 2011 and there were no reported interactions with TEP species.

Ecosystem Impact

The potential impact of this fishery on the environment is limited due to its small size and the unique climatic and regional characteristics of the NT. Monsoonal weather conditions render large portions of the NT inaccessible or unsafe for several months each year. Furthermore, the biology of many species limits the frequency at which they can be caught in commercially-viable numbers.

The distance between collection sites and population centres imposes economic constraints on aquarium collectors, which has led to a concentration of effort around Darwin and Nhulunbuy. The combination of these factors acts to protect extensive areas of coastline from commercial or recreational exploitation.

Social Impact

The harvesting of coral in areas adjacent to major population centres is an important issue of concern for NT Fisheries, due largely to a lack of community awareness regarding the actual impacts of coral harvesting. In an effort to minimise social conflict, NT Fisheries and NTAC have negotiated the closure of Darwin and Gove harbours to commercial collection of coral and associated benthic species.

Economic Impact

Based on market sales, the catch value of the fishery was estimated to be in the vicinity of $350 000 in 2011.

STOCK ASSESSMENT

Monitoring

Licensees are required to complete and submit monthly logbook returns reporting catch and effort data from their operations. Fishery monitoring trips are also undertaken as necessary. Monitoring provides significant information on the areas fished and the capture methods used. Common aquarium species targeted by licensees at a particular point in time are also identified.

No monitoring trips were undertaken during 2011. However, monitoring trips are planned to periodically validate logbook data in the future.

Current Harvest Status

The current level of harvest is low and the impact on the resource by commercial operations is considered to be negligible.

All Aquarium Fishery species/groups were below their total harvest trigger reference points in 2011. However, several of the trigger reference points relating to the percentage difference between the 2011 catch and the mean of the previous three years' harvest were exceeded,

with both large increases and decreases. This type of trigger reference point is of limited biological meaning because it does not take into account variations in the time spent targeting the particular species/group (i.e. fishing effort). Hence, these trigger reference points may fluctuate widely from year to year in response to changes in market demand. For this reason, the utility of these trigger points will soon be reviewed.

Future Assessment Needs

Future assessment needs of the Aquarium Fishery will be driven by the requirements for ESD reporting.

RESEARCH

Summary

The Department of Land Resource Management has monitored coral reefs around Nhulunbuy and Cobourg Peninsula for several years. In 2005, Cyclone Ingrid destroyed some regions of reef within the fishery. Bleaching of corals, possibly related to high water temperatures, has also been documented in these reefs (Gomelyuk 2003).

Scientists from the Museum of Tropical North Queensland in Townsville and Kansas State University are currently clarifying the taxonomy and identification of anemones, corallimorphs and hard corals in the Nhulunbuy area, using morphology and genetic techniques.

A survey entitled 'A Comprehensive Analysis of the Freshwater Fish Faunas and their Key Management Issues across Northern Australia' coordinated by James Cook and Griffith universities, which also involved NT Fisheries, was completed in 2008. The results of this work (Pusey 2011) provide information on the geographic distribution, biodiversity and habitat requirements of freshwater fishes (including many aquarium species) in all major catchments across northern Australia, including the NT, which will aid in the informed management of this group of fishes.

Studies on the biology and potential sustainable yield of the land hermit crab (*Coenobitat variabilis*) were conducted by NT Fisheries in 2008 and 2009. Empty shells were tagged and distributed over suitable habitat to determine if shells are a limiting resource for hermit crabs. A number of individuals were tagged to ascertain movement patterns and others were retained for fecundity assessment. Hermit crabs quickly 'upgraded' their shells to those provided suggesting that the abundance (and perhaps size) of adults is constrained by the number of available shells. The crabs showed limited movement, averaging less than 11 m/day; the longest daily track was 70 m. Female hermit crabs have a protracted spawning period of at least five months duration (i.e. October to February), with most females producing at least 200 eggs.

Many inland water courses in the NT are ephemeral and evaporate either partially or completely during the dry season. This can lead to significant fish mortalities through a combination of high water temperatures, reduced dissolved oxygen, and increased vulnerability to predators as the water body shrinks. Electrofishing surveys were conducted during 2009 and 2010 in one such water course, Scott's Creek (approximately 50 km east of Darwin), to describe the number and type of fishes that can die under such circumstances. Fish diversity and abundance between years was also documented.

Current Research

NT Fisheries and Charles Darwin University conducted surveys of freshwater fishes in the Mary and Daly rivers in 2011 as part of a long-term monitoring program of these systems. Information from this research highlights the strong links between fish diversity/abundance and the magnitude/duration of wet season rainfall in northern Australia.

MANAGEMENT/GOVERNANCE

Management

Objective

Management arrangements for the fishery aim to ensure the ecological sustainability of aquarium species with minimal impact on TEP species and the aquatic environment. This is achieved through a combination of input and output controls, including catch, area and gear restrictions (which are stipulated in the licence conditions).

The impact of the NT aquarium industry on the aquatic environment is considered negligible due to limited fishing effort targeting a wide range of species (using selective fishing methods) over a large geographic area.

The recreational harvest of aquatic organisms for display in home aquaria is regulated through recreational fishing controls, such as limits on the size, number and type of fishes that can be retained as well as how and where they can be caught.

History

Management framework

Regulation of the NT Aquarium Fishery began in the 1970s, with individuals wishing to collect, trade or culture aquarium species requiring a 'C-class' licence. C-class licences were then separated into three categories (depending on the original endorsement) in 1993. The categories were: 1) an Aquarium Fishing/Display Fishery licence permitting the collection, display and sale of aquarium species, 2) an Aquarium Trader licence predominantly for importers of aquarium species and 3) an Aquaculture licence.

Aquarium Fishing/Display Fishery licensees were permitted to collect coral until 1994, when a ban was imposed on this activity. However, some exemptions were granted shortly thereafter allowing certain aquarium collectors to take limited quantities of coral.

A moratorium on the issue of new Aquarium Fishing/Display Fishery licences was implemented in 2001 (thereby capping the number of such licences at 12) in response to concerns over coral collection and the need for a comprehensive review of the fishery.

The review process resulted in changes to licence conditions for both the Aquarium Fishing/Display Fishery and Aquarium Trader licences. The new conditions (implemented in 2005) allowed all Aquarium Fishing/Display Fishery licence holders to collect limited quantities of coral and associated benthic species (up to a maximum trigger point) and made it possible for Aquarium Trader licensees to establish display aquaria (noting that the collection of aquatic life under this licence remained prohibited).

Further changes to the management of the fishery were made in 2008: the introduction of the Public Aquarium licence (to enable the development of new public aquaria in the NT) and the transferability of Aquarium Fishing/Display Fishery licences.

Wildlife Trade Operation accreditation

The management arrangements for the NT Aquarium Fishery were first assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by SEWPaC in December 2004. A WTO approval was subsequently granted for a period of three years subject to a number of conditions. One of these conditions was the development of a number of performance indicators for the fishery (see Table 3).

Following a short bridging period, the fishery was re-accredited as a WTO in June 2008, again for three years. New conditions were applied, such as the need for more accurate and detailed logbook reporting, improved consistency and accuracy of species identification, and the implementation of a bioregional approach to coral trigger points to minimise risks of local depletion.

Aquarium Fishery

Aquarium Fishery logbooks were subsequently changed in 2009 to facilitate recording of the exact location of coral harvesting and a fish identification guide was produced. Harvest trigger points for corals and associated benthic species were set at 20 tonnes maximum in each of three bioregions (the Gulf of Carpentaria, Arafura Sea and Bonaparte Gulf) in the same year.

A third assessment was completed in June 2011 and the fishery was re-accredited as a WTO until 30 November 2012.

Listing of noxious fishes

An Ornamental Fish Management Implementation Group (OFMIG), consisting of representatives from the aquarium industry and fisheries management agencies in all states and territories, was established in 2007 to provide advice regarding the management and control of ornamental fish in Australia. The working group agreed that a consistent assessment process for the importing of aquatic species should be incorporated into state and territory legislation.

The group subsequently developed a list of noxious fishes (identified as being of high risk to the domestic environment) to be banned throughout Australia. These species were then officially declared as noxious (through legislation) in 2009. Additional noxious species have since been identified and will be incorporated into NT fisheries legislation in 2012.

Current Issues

Countries wishing to export CITES-listed species must demonstrate that the harvest of such species (or genus where applicable) is not detrimental to its future viability. This is achieved by compiling all relevant information on the species (e.g. biology/life history, catch data, population surveys etc.) to support a non-detriment finding (NDF) on its harvest. Recent international scrutiny on the level of information required to establish an NDF has meant that the Australian CITES Scientific Authority for Marine Species has had to review and, where appropriate, modify the approach for determining NDFs for marine species.

A higher burden of proof to obtain an NDF in conjunction with a scarcity of information on the biology, distribution and abundance of many CITES listed species harvested by the NT Aquarium Fishery (particularly corals) could potentially limit future export opportunities for this fishery.

Future Plans

NT Fisheries will maintain a monitoring program with logbooks and fishery monitoring trips aligned with the management objectives and performance indicators for the fishery (Table 3) with a view to maintaining the WTO status of the fishery. Further refinement of the performance indicators for the fishery may be required, particularly in regard to the harvest of coral and associated benthic species.

Changes to the NT noxious fish list will be made as and when additional species are identified by OFMIG.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services ensures operators comply with the management arrangements for the fishery through random on-the-spot inspections of harvesting activities and targeted enforcement programs with fishers and traders. There were no recorded convictions for compliance breaches in the fishery in 2011.

Consultation, Communication and Education

NT Fisheries regularly consults and communicates with individual aquarium licensees, NTAC and other stakeholder groups (such as recreational fishers and Aboriginal communities) on matters relating to the NT Aquarium Fishery. NT Fisheries also produces educational material outlining catch and area controls for the fishery.

Senior Research Scientist – Dr Mark Grubert

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Table 3. Management objectives and current status against performance indicators for ecosystem components related to the NT Aquarium Fishing/Display Fishery for 2011

Ecosystem component	Management objective	Performance indicator	Trigger reference point/s (TRP)	Status of ecosystem components in 2011	Management response to be taken
Group A finfish (spotted and striped scat, sevenspot archerfish, eastern and blackbanded rainbowfish, sailfin glassfish, and black catfish).	1) Ensure intergenerational equity by maintaining ecologically sustainable annual catches in all sectors.	2) Significant increase or decline in the annual catch.	Harvest of Group A finfishes exceeds 30 000 individuals per species. Harvest of any Group A finfish species increases (↑) or decreases (↓) by 70% compared with the mean of the previous three years.	The total harvest of Group A finfish species in 2011 was 10 500 individuals – TRP not reached. The difference between the 2011 catch and the mean of the previous three years' harvest for the remainder was: • ↑ 42% for black catfish • ↑ 639% for sailfin glassfish • ↓17% for sevenspot archerfish • ↓ 19% for blackbanded rainbowfish, • ↓ 29% for eastern rainbowfish, • ↓ 45% for spotted scat. • ↓ 89% for striped scat. - TRP reached for sailfin glassfish and striped scat.	3) NTAC to review fishery and make recommendations to the Executive Director of Fisheries (EDF) to ensure that the resource is harvested in an ecologically sustainable manner. Within three months of becoming aware of the TRP being reached, a timetable for appropriate management responses will be developed.
Coral and associated benthic species (CABS).	As per 1) above.	As per 2) above.	Harvest of CABS exceeds 60 tonnes total or 20 tonnes in any region. The harvest of CABS ↑ or ↓ by 50% when compared with the mean of the previous three years.	Total harvest of CABS for 2011 was estimated at 9.8 tonnes – total and regional TRPs were not reached. The % difference between the 2011 catch and the mean of the previous three years' harvest of CABS was ↑ 121% - TRP exceeded by ↑ 71%.	As per 3) above.
Giant fluted clams (*Tridacna squamosa*).	As per 1) above.	As per 2) above.	Harvest of giant fluted clams exceeds 2000 individuals. Harvest of this species ↑ or ↓ by 50% compared with the mean of the previous three years.	46 giant fluted clams were harvested in 2011 - TRP not reached. The % difference between the 2011 catch and the mean of the previous three years' harvest for giant fluted clams was ↓ 75% - TRP exceeded by ↓ 25%.	As per 3) above.
Narrow sawfish (*Anoxypristis cuspidate*).	As per 1) above.	As per 2) above.	Harvest of *Anoxypristis* spp. Exceeds 20 individuals. Harvest of this group ↑ or ↓ by 50% compared with the mean of the previous three years.	No *Anoxypristis* spp. were harvested in 2011 – TRP not reached. n/a – none harvested in 2011 or in any of the previous three years.	No action required.
Syngnathid species, other than *Hippocampus* (seahorses) – NT waters only.	As per 1) above.	As per 2) above.	Harvest of Syngnathids other than *Hippocampus* exceeds 150 individuals. Harvest of this group ↑ or ↓ by 50% compared with the mean of the previous three years.	No Syngnathids other than *Hippocampus* spp. were harvested in 2011 – TRP not reached, n/a – none harvested in 2011 or in any of the previous three years.	No action required.

Ecosystem component	Management objective	Performance indicator	Trigger reference point/s (TRP)	Status of ecosystem components in 2011	Management response to be taken
Hippocampus (seahorses) – NT waters only.	As per 1) overleaf.	As per 2) overleaf.	Harvest of *Hippocampus* spp. exceeds 50 individuals. Harvest of this group ↑ or ↓ 50% compared with the mean of the previous three years.	No *Hippocampus* spp. were harvested in 2011 – TRP not reached. n/a – none harvested in 2011 or in any of the previous three years.	No action required.
Hermit crabs.	As per 1) overleaf.	As per 2) overleaf.	Harvest of hermit crabs exceeds 120 000 individuals. Harvest of hermit crabs ↑ or ↓ 70% compared with the mean of the previous three years.	20 300 hermit crabs were harvested in 2011 – TRP not reached. The % difference between the 2011 catch and the mean of the previous three years' harvest for hermit crabs was ↑ 26% -TRP not reached.	No action required.
EPBC Act listed species (excluding Syngnathids) in NT waters.	Ensure continued protection of species and communities listed under the EPBC Act.	Endangered, threatened or protected species and/or communities are identified in NT waters.	Identifiable impacts observed by NT Fisheries, commercial fishers, or other agencies regarding EPBC Act listed species or communities.	There were no identifiable impacts on EPBC species or communities observed in NT waters in 2011 - TRP not reached.	No action required.
EPBC Act listed species in Commonwealth (CWTH) waters.	Ensure continued protection of TEP species.	N/A	No EPBC Act listed species may be taken in CWTH waters.	There were no EPBC Act listed species taken in CWTH waters off the NT during 2011 - TRP not reached.	Advice provided to EDF and SEWPaC.
Ecosystem components.	Minimise effects on ecosystem components.	Identification of threatening processes.	Identification of significant negative ecosystem impacts on aquarium fishing grounds.	There were no negative ecosystem impacts observed in 2011 - TRP not reached.	No action required.
Harvest of TEP species intended for trade to public aquariums (except CABS).	Continuation of public education while ensuring the ongoing protection of species and communities listed under the EPBC Act, *Territory Parks and Wildlife Conservation Act 2001* and CITES.	As per 2) overleaf.	Harvest of any TEP species ↑ or ↓ by 50% compared with the mean of the previous three years.	No TEP species were harvested in 2011or any of the previous three years – TRP not reached.	No action required.

BARRAMUNDI FISHERY STATUS REPORT 2011

INTRODUCTION

Barramundi (*Lates calcarifer)* is widely distributed in the Indo-Pacific region and across northern Australia. It is valued for the quality of its flesh, its fighting ability, size and readiness to take artificial lures. This has made it an iconic species that supports major commercial and recreational fishing industries. Barramundi is also fished by Aboriginal people, who value it for its economic, health and cultural importance.

All of the available evidence suggests that current harvest levels in the Barramundi Fishery are extremely low and well within sustainable limits. The low harvest rate is probably a result of the stringent management arrangements in this fishery and recent large wet seasons combining to produce an increase in the abundance of barramundi.

PROFILE OF THE FISHERY

Commercial Sector

Area

T The commercial sector of the fishery operates from the high water mark to 3 nautical miles seaward from the low water mark and is restricted to waters seaward from the coast, river mouths and legislated closure lines. Fishing is not permitted within the confines of Kakadu National Park, the Mary River Fish Management Zone, Bynoe Harbour, Darwin Harbour and Shoal Bay 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 Barramundi Fishery Management Plan specifies closure lines, defining the inland boundary of the fishery.

The commercial fishing season operates each year from 1 February through to 30 September. The areas where commercial fishing is most concentrated have changed over time. Historically, the highest catches came from Chambers and Anson bays. However, over the last ten years, the highest catches have occurred in Van Diemen Gulf, East Arnhem Land, Anson Bay, Central Arnhem Land and Limmen Bight.

Commercial operators fish over 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 on board motherships. 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 inches) and within a river, the minimum legal mesh size is 175 mm (7 inches). The maximum net allowance per licence is 1000 m (10 units of 100 m) and there are restrictions on the amount of spare net that may be stored onboard vessels.

Catch

The primary target species are barramundi and king threadfin (*Polydactylus macrochir*). Barramundi are generally large enough at three years of age to be caught in a 150 mm gillnet. Commercial operators target barramundi that are usually three to eight years old.

The commercial catch in 2011 consisted of 701 tonnes of barramundi and 325 tonnes of king threadfin. This represents an increase over the 2010 harvest of 635 tonnes of barramundi and 295 tonnes of king threadfin (Figure 1).

A number of byproduct species are also taken in the commercial fishery, depending on their marketability. The most common byproduct species retained in 2011 were blue threadfin (*Eleutheronema tetradactylum*), black jewfish (*Protonibea diacanthus*), blacktip shark (*Carcharinus sp.*) and scaly jewfish *(Nibea squamosa)* (Figure 2). Sharks are also a common byproduct although the amount that can be taken is restricted to 500 kg of converted whole shark weight on board each vessel at any time.

The total amount of byproduct retained in 2011 was 58 tonnes, constituting 8% of the total harvest, which was an increase of 21 tonnes from the 37 tonnes retained in 2010. The catch of blue threadfin increased by almost five times and there were generally increases in most other species with the exception of scaly jewfish, queenfish (*Scomberoides* spp.) and tripletail (*Lobotes surinamensis*) catches which all declined (Figure 2).

Effort

There were 20 fully transferable licences in the commercial fishery in 2011, all of which were fully utilised. Most of them were 'full 10 unit' licences (1 unit = 100 m of net) equating to a total of 16 500 m of net. Effort is measured in '100 m net days' (hmnd), where one hmnd equals 100 m of gillnet set for one day.

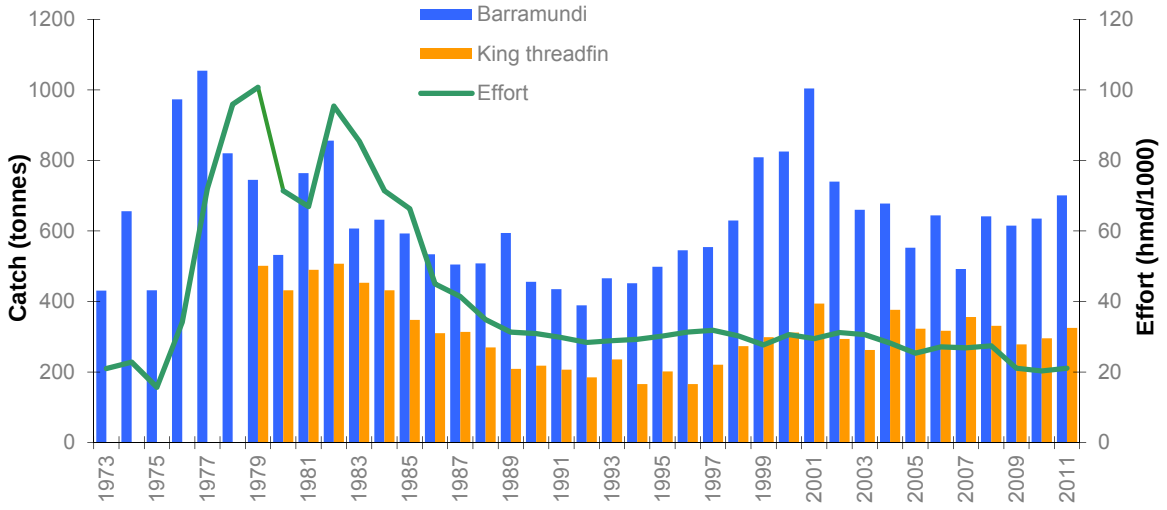

Figure 1. Catch and effort in the commercial Barramundi Fishery from 1973 to 2011

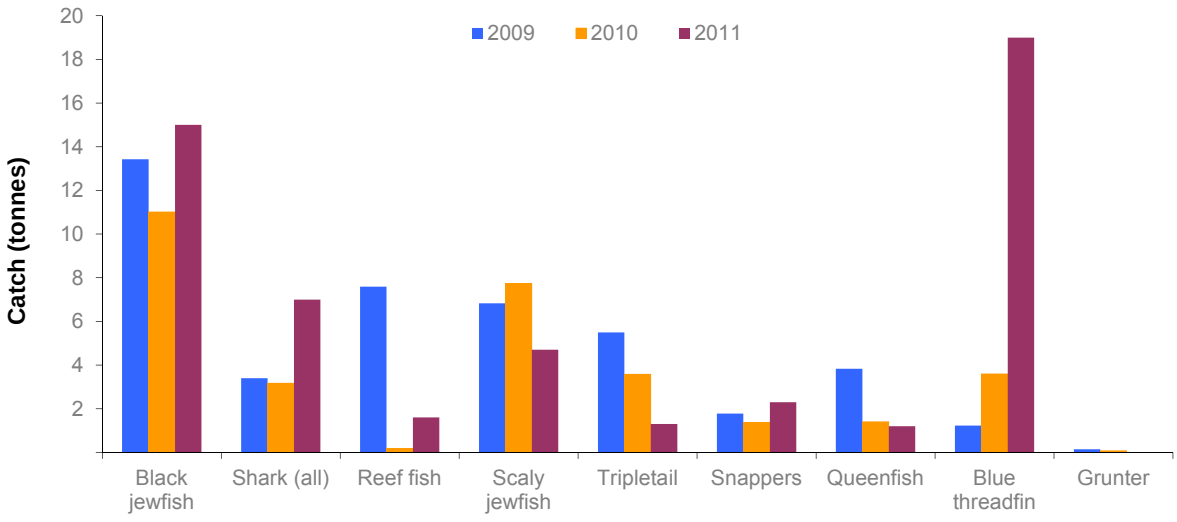

Figure 2. Byproduct composition in the Barramundi Fishery from 2009 to 2011

In 2011, 21 093 hmnd were expended in the commercial Barramundi Fishery, representing a slight increase from the 20 336 hmnd of effort in 2010 (Figure 1). The 2011 effort figure is among the lowest recorded in this fishery since 1975. However, despite the buy-back of four licences in 2009, catches have increased, suggesting either an increase in operator efficiency, or an increase in abundance of fish stocks and/or advances in technology. Given that commercial operators have not changed their gear since the inception of the fishery, it is likely that barramundi numbers have increased.

The distribution of commercial effort has changed significantly over the past 10 years, moving away from areas where recreational activity has increased (e.g. Chambers Bay, Darwin area and Anson Bay) to more remote areas, such as Arnhem Land and Van Diemen Gulf.

Catch Rates

The catch per unit of effort (CPUE) for barramundi showed a sharp downward trend in the late 1970s and early 1980s, reaching levels as low as 7.1 kg/hmnd. This decline was probably caused by a combination of several consecutive years of poor wet season rainfall nd excessive fishing effort. Following management changes, CPUE has steadily increased, peaking at 34.0 kg/hmnd in 2001. Thereafter, CPUE declined, dropping below 20 kg/hmnd in 2008. However, barramundi CPUE has subsequently increased to 33.2 kg/hmnd in 2011, which is the second highest value recorded in the history of the fishery (Figure 3).

In recent years, 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 a period of lower abundances during the 1970s, when CPUE was as low as 5.0 kg/hmnd. In 2011, CPUE for king threadfin was 15.4 kg/hmnd, which is the highest value recorded in the history of the fishery for this species (Figure 3).

While fluctuations in CPUE for both species most likely reflect annual variation in environmental conditions, recent increases suggest that fish numbers have increased.

Marketing

Historically, barramundi and king threadfin have been sold as frozen fillets to local and interstate markets. However, many fishers are now providing barramundi wings and swim bladders, and are selling whole barramundi and king threadfin fresh on ice to local and southern markets.

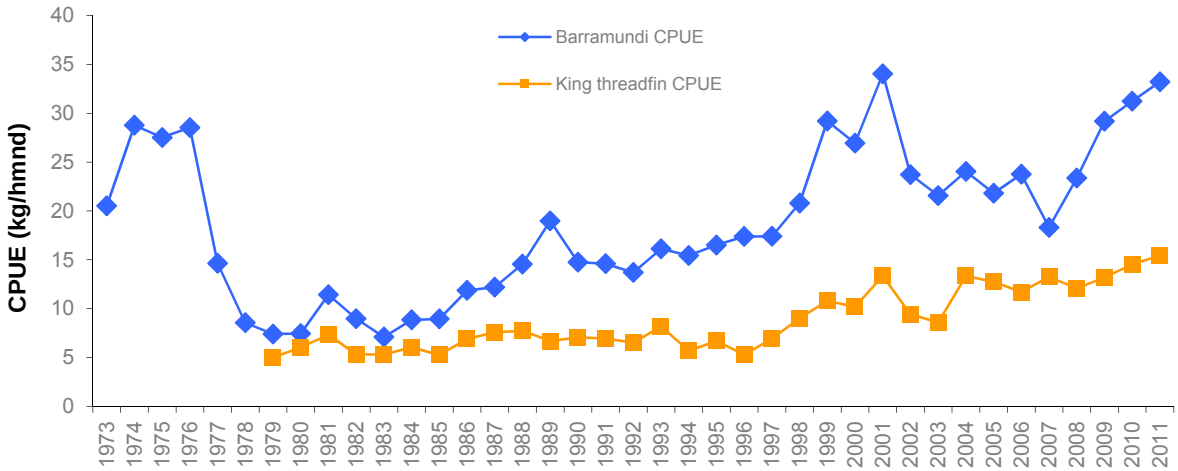

Figure 3. Catch per unit effort (CPUE) for barramundi and king threadfin in the Barramundi Fishery from 1973 to 2011

Recreational Sector

Area

Barramundi have historically been caught by anglers throughout inland billabongs and the upper reaches of rivers and creeks. Improvements in technology and greater access to the coast have allowed many anglers to 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.

Darwin Harbour, Bynoe Harbour, Shoal Bay, and the Adelaide, Mary, Daly, Finniss and Alligator rivers are important fishing locations due to their proximity to Darwin. Farther south, the Victoria, Roper and McArthur rivers are also well utilised by regional NT and interstate anglers.

Fishing Method

Recreational fishing for barramundi is mostly carried out from boats of between 4 and 6 m in length, using light weight rods and reels, fly fishing gear and hand lines to cast or troll a wide range of lures. Livebait is also effective. Mullet are the most popular livebait species used in estuaries, while freshwater prawns or 'cherabin' (*Macrobrachium spinipes*) are favoured in billabongs and the upstream portions of rivers.

Gear restrictions apply in the Mary River Fish Management Zone and additional controls, including a prohibition on the use of bait or double and treble hooks, are in place within 100 m of the Shady Camp barrage.

Catch

Recreational fishers target the same species caught by the commercial sector. Many species caught by recreational fishers are released.

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

In 2000, Coleman (2004) identified barramundi as the most popular target species, with an estimated total catch of over 400 000 and an annual harvest of 100 400. The total number of barramundi caught was 67% higher than that recorded in 1995 (240 000), although the actual number of retained fish has remained about the same (Coleman 1998; Coleman 2004). Recreational fishing surveys indicate an increasing trend in catch and release within the recreational sector of the fishery. In 2000, it was estimated that 76% of the barramundi caught were released, an increase from the 58% recorded in the 1995 survey.

Another recreational fishing survey in the NT was initiated in 2009. The results are expected in late 2012.

In 2011, the Daly River Fish Management Zone was established to further protect the area in light of increased recreational use and targeting of barramundi. A specific possession limit of three barramundi per person was introduced. At the same time, the possession limit in the Mary River Fish Management Zone was increased from two to three barramundi per person. Elsewhere in the Territory, a limit of five barramundi per person applies.

A minimum length of 55 cm for barramundi also applies for both the recreational and commercial sectors throughout the NT.

Effort

Recreational fishers often fish for a range of species. Barramundi fishing 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 in the NT, 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 declined from those in 1995 to 788 726.

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 (Coleman 1998) and the National Recreational Fishing Survey: the Northern Territory (Coleman 2004) 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 compared with only 43% of all fish caught in 1995.

Fishing Tour Operator Sector

The number of Fishing Tour Operators (FTOs) utilising the NT's aquatic resources is growing, driven primarily by client demand. More information for the sector can be found in the Fishing Tour Operator Fishery Status Report in this publication.

Area

FTOs have traditionally targeted barramundi in Darwin Harbour, the Daly and Mary rivers and the Tiwi Islands. However, an increase in the use of larger boats has led to recent expansion by this sector into the western coastline of the NT, Anson Bay, Van Diemen Gulf, Cobourg Peninsula and Central Arnhem Land. Generally, FTOs utilise the mouths of rivers to target large barramundi at the end of the wet season and switch to freshwater billabongs during the dry season.

Fishing Method

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

Catch

In 2011, FTO clients caught 63 859 barramundi, representing an increase of 18% on the 2010 FTO catch. According to FTO logbook information, 91% (58 266) of barramundi caught in 2011 were released and 9% (5593) were retained. Assuming a post- release mortality rate of 10% (de Lestang et al. 2004), the FTO sector would have removed around 11 420 barramundi in 2011.

The proportion of fish released by FTO clients has remained relatively stable since 1995. FTO clients generally retain a smaller proportion of caught barramundi than do non-guided recreational fishers. The higher release rate is probably related to more fishing education by guides as well as participation by clients who are generally more interested in the experience of catching a barramundi rather than taking fish home.

The most productive areas where barramundi were caught in 2011 were the Mary and Daly river systems and Arnhem Land.

In 2011, FTO clients caught 1621 king threadfin, representing a decrease of 38% on the 2010 FTO catch. According to FTO logbook information, 54% (881) of king threadfin caught in 2011 were released and 46% (740) were retained. The most productive areas for king threadfin include the Mary River and Darwin/Bynoe harbour areas.

Effort

In 2011, 83 846 line hours were spent targeting barramundi, a decrease from the 85 442 line hours expended in 2010.

Catch Rates

The catch rate remained stable from 1995 to 1998 at 0.5 barramundi per hour. From 1998, it gradually increased to 0.8 barramundi per hour by 2001, but declined to 0.4 barramundi per hour in 2003. In 2011, the catch rate improved to 0.8 barramundi per hour which is among the highest values recorded by this sector in the history of the fishery. The fluctuations in FTO catch rates have followed a similar trend to the commercial fishery. Catch rate fluctuations are likely to be linked to recruitment to the fish

population, which is affected by rainfall and river flows.

Indigenous Sector

Barramundi are harvested by Aboriginal people in coastal and some inland areas of the NT. Barramundi have significant economic, health, cultural and totemic values for Aboriginal people.

Area

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

Fishing Method

Over 90% of all fishing is shore-based, using baited lines or spears.

Catch

Coleman (2004) found that Indigenous fishers harvested 44 134 barramundi in 2000; few fish were released.

Non-retained Species

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

A small percentage of bycatch that is often discarded includes catfish, blue threadfin, queenfish, trevally and some shark species. Bycatch has been noted to increase when nets are set in deep channels rather than over shallow mudflats.

The Barramundi Licensee Committee has agreed on restrictions limiting the take of shark as part of the National Plan of Action 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 commencing their next voyage. Recent declines in the number of sharks taken by commercial fishers indicate that these actions have successfully reduced the number of sharks taken by this fishery.

In 2000, recreational fishers targeting barramundi also caught threadfins, snappers, grunters and catfish. Overall, 35.9% of all these were retained (Coleman 2004). Some species were more likely to be retained than others, as most threadfins were retained, whilst most catfish were released.

FTO logbook returns indicate that blue salmon, tarpon, saratoga, sooty grunter and catfish were all caught while targeting barramundi. Overall, 10% of these were retained, with blue salmon and sooty grunters having the highest retention rate.

Threatened Species Interaction

Data on interactions with threatened, endangered and protected (TEP) species in the fishery has been collected since 2003 as part of the commercial fishing logbook process. Gillnets are relatively selective in catching targeted finfish species; however, the incidental capture of dugongs, crocodiles, sawfish and turtles has been previously recorded in the fishery.

There were a small number of TEP species interactions recorded by onboard observers during 2011; almost all were released alive. To assist in minimising the incidental capture of TEP species in the future, the commercial fishery has conducted a comprehensive review of its Environmental Management System and associated Code of Practice.

To minimise dugong interaction, a Dugong Protection Area is in place in the south-western Gulf of Carpentaria, which effectively excludes commercial fishers from fishing and anchoring in this area.

Ecosystem Impact

The full effects of removing numbers of predators, such as barramundi, and quantities of biomass from such systems are unknown. Previous stock assessment models suggest that less than 10% of the total barramundi stock is harvested annually and byproduct and bycatch levels are low. In addition, gillnets only lightly contact sandy/muddy substrate so have minimal interaction with estuarine/coastal habitat. These

factors suggest this fishery is likely to have minimal ecosystem impacts.

Social Impact

The commercial sector of the fishery employs around 100 people as crew and another 50 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, services equipment and freights the product.

Barramundi fishing is an iconic feature of the NT and a popular recreational pastime. About 30% of the resident population go fishing and most recreational fishers target barramundi at some time. Recreational fishers also purchase gear, bait, fuel and service for equipment from local businesses (Coleman 2004).

Many interstate and overseas tourists come to the NT to catch wild barramundi as the NT has a reputation for providing 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 (Coleman 1998; Coleman 2004).

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

Economic Impact

At the point of first sale in 2011, the overall catch value of the commercial Barramundi Fishery was $5.62 million. In 2011, the barramundi component was $4.45 million and the king threadfin component was $1.01 million. The value of byproduct sold in 2011 was $0.16 million.

The recreational sector contributes to the NT economy, especially in the service and fishing tackle industries. In 2000, it was estimated that over $35 million was spent on recreational fishing in the NT, although this cannot be directly attributed to any one fishery (Coleman 2004).

Whilst the fishery is not the most valuable of the NT's fisheries in terms of catch value at first point of landing, its return to the community is substantial.

STOCK ASSESSMENT

Monitoring

Monitoring of the fishery is largely focused on analysis of catch and effort trends in the commercial fishery based on monthly logbook returns provided by licence holders. The information provided by recreational fishers is also used.

An observer was present on commercial barramundi boats for 10 days in 2011. Of the 570 fish caught during these trips, 27% were barramundi, 50% king threadfin and 15% sharks. Overall, 2% of the catch was discarded comprising mainly sharks and catfish. Pending funding allocations, the current monitoring program will be modified in the future to include annual monitoring trips in all of the major river systems. This will increase the amount of information on size structure of target species across the NT and catch composition of byproduct and bycatch species, thus providing more detailed data for stock assessment models.

Stock Assessment Methods and Reliability

The fishery was first assessed using catch and effort data in 1978 and 1979; it has been assessed a number of times since then. The early assessments were not completely successful due to poor knowledge of barramundi stock structure. However, improved knowledge in this area as well as the development of better modelling techniques have made subsequent models of the fishery more reliable.

Currently, exploitation rate data (from commercial and FTO logbook returns and tag returns) is being examined to assess its suitability as a

substitute for assessing stocks of barramundi across the NT.

Given the near record levels of the current CPUE in the commercial fishery the current level of exploitation in all targeted stocks is considered to be highly sustainable.

Current Harvest Status

Harvest rates in the Darwin Harbour and the Daly, McArthur, Roper and Victoria rivers were all estimated to be less than 10% from tag recaptures. This is an extremely low figure for such a reproductive species and is one of the reasons the NT barramundi stocks are so healthy. The barramundi tagging program was expanded to the Mary and South Alligator rivers during 2011.

None of the management trigger reference points were reached during 2011 (see Table 1) suggesting that target, byproduct and bycatch species are being fished sustainably within the fishery. More refined trigger points and performance measures will be developed and incorporated into the Barramundi Fishery Management Plan. The trigger points will be reviewed annually to assist in setting the harvest rate of the fishery.

Future Assessment Needs

Most barramundi caught by recreational anglers are released including fish that could legally be retained. Research has been conducted on the physiological effects and survival of released juvenile barramundi. However, there is still a need for research on the lethal and sub-lethal effects of catching and releasing large size (>90 cm) barramundi, given that most of them are likely to be females. Specifically, identifying the effect catch and release have on the fecundity of large females is important to determine the effect of recreational fishing on egg production in barramundi.

Given that king threadfin comprise a large proportion of the catch in the fishery, the reproductive biology and habitat use of this species need to be further understood.

Continued assessment of the commercial sector of the fishery is needed to meet the NT and Australian governments' commitment to ecologically sustainable development. This assessment includes identifying the impact of the fishery on bycatch species, byproduct stocks and the environment in general.

RESEARCH

Summary

Research on barramundi in NT waters began in 1972 with sampling and tagging on the Mary River and sampling on the Victoria and Roper river systems. The after effects of Cyclone Tracy prevented barramundi research between 1974 and 1977. Research recommenced in late 1978 with an assessment of the fishery and an extensive sampling program to establish baseline biological information on barramundi stocks. Results of the 1978-79 assessment suggested overfishing was occurring, which led to licence reductions and identified the rising significance of recreational fishing.

During the mid-1980s, concerns were raised about the status of barramundi stocks in the Mary River system. Between 1986 and 1987 a major assessment of the status of barramundi was undertaken in the Mary River system. This included intensive monitoring of both commercial and recreational catches. Results from this study showed evidence of a substantial reduction in the numbers of mature fish. The results of that study forced a seasonal closure to protect spawning fish accompanied by a reduced recreational bag limit (Griffin 2006). The closure was an industry-led initiative to ensure long term viability of the fishery.

In addition, an annual fishery-independent monitoring study has been conducted on Corroboree Billabong since 1987. Results from the study revealed a very consistent pattern of cyclical abundance with high numbers of recruits every second year.

Research effort between 1996 and 2001 focussed on the assessment of the possible impacts of saline intrusion control activity on barramundi in the Mary River wetlands region (de Lestang and Griffin 2000; de Lestang et al. 2001). Placing saline intrusion control walls (barrages) along the wetlands significantly reduced the composition and relative numbers of barramundi and other fish in areas affected by control works. This may possibly reduce growth and survival of juvenile barramundi. Placing spillways that allowed fish to cross the walls reduced these negative effects.

Between 2002 and 2004, research effort concentrated on quantifying the survival and physiological effects of recreational catch-and-release on barramundi in a freshwater habitat. This showed that around 90% of barramundi survive being caught and released in freshwater. Barramundi that had been caught on a line had higher levels of stress hormones (cortisol) and showed signs of muscle fatigue (lactate), which suggests that fish were stressed by being line caught. Survival also varied significantly throughout the year. Those fish sampled in warmer months suffered more stress and lower survival (80%) after three days compared with fish caught in cooler months, which showed 100% survival after three days (de Lestang et al. 2004). Another trial found that "fish-friendly" knotless landing nets caused less damage to fish skin and fins than more traditional knotted mesh landing nets (de Lestang et al. 2008). Knotless landing nets are recommended to minimise injuries and increase the chance of post-release survival.

Incorporation into Management

Monitoring of the barramundi stock in the Mary River during 1986 and 1987 provided vital information to support 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. This has been incorporated into saline intrusion control works.

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

The long term monitoring of barramundi numbers in Corroboree Billabong has led to a greatly improved understanding of the reasons behind fluctuations in the population and informed 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 a management tool in freshwater environments. 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

Ongoing research projects include:

- Annual assessment of barramundi recruitment and populations in the Mary and Daly rivers.
- Onboard monitoring of the commercial Barramundi Fishery.
- Investigations into how different river flow patterns affect barramundi and king threadfin populations.
- Tag-recapture programs on the Daly, Mary, Roper and Victoria rivers.
- Comprehensive survey of recreational fishing catch and effort across the NT.

MANAGEMENT/GOVERNANCE

Management

Objective

Management objectives, performance criteria and trigger points for the fishery will be defined by a future review of the Barramundi Fishery Management Plan. The proposed objectives for the fishery are listed in Table 1. Such measures

will assist in the long term sustainability of the fishery.

History

Conservative management, focussing on the containment of 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.

Current Issues

The Barramundi Fishery Management Advisory Committee (BFMAC) was reformed in 2010 to provide advice to the Executive Director of Fisheries on issues of relevance to the management of barramundi stocks in the NT. BFMAC membership is derived from a wide range of stakeholder interest groups.

The issues currently facing the management of barramundi stocks in the NT relate mainly to resource sharing between the commercial and recreational fishing sectors. Improvements in technology have allowed recreational fishers to travel farther afield in search of barramundi. This has meant that recreational and commercial fishers now often fish for barramundi in the same waters, which has led to conflict in some of the more popular areas, such as Chambers Bay and the Finniss River area.

In 2010, Bynoe Harbour and the Finniss River area were closed to commercial barramundi fishing in line with an appropriate removal of effort from the commercial sector with the buy-back of four licences in 2009. It is anticipated there will be a buy-back of more commercial licences from the fishery in the future.

A review of barramundi (and cherabin) management arrangements in the Daly River area was recently completed for the recreational fishery. As a result, new management measures came into effect in 2011 including the formation of the Daly River Fish Management Zone, in which the barramundi possession limit was limited to three barramundi per person. This reduction in the possession limit was to further protect the important Daly River fishery in light of increasing recreational use; it was fully supported by the Amateur Fishermen's Association of the NT (AFANT). At the same time, the barramundi possession limit in the Mary River Fish Management Zone was increased from two to three barramundi per person. This increase in the possession limit was in response to an increase in barramundi numbers resulting from sound long term management and commendable stewardship by the recreational sector.

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,
- user conflict issues,
- land and sea access issues for pastoral leases, Aboriginal land and Kakadu,
- localised habitat issues, such as saltwater intrusion in the Mary River catchment, and
- minimising interactions with TEP species.

Future Plans

It is expected BFMAC will continue to provide advice to the Executive Director of Fisheries on issues of relevance to management of the fishery. This is likely to include advice on the strategic direction and management objectives for the fishery, and amendments to the Barramundi Fishery Management Plan.

The results of the recreational fishing survey of the NT in 2009-10 will provide valuable information concerning the recreational harvest of barramundi stocks. This data will be incorporated into future modelling and stock assessments to further define the state of the fishery.

Compliance

Monitoring, compliance and enforcement activities are undertaken by the Water Police

Section of the NT Police, Fire and Emergency Services, under the NT *Fisheries Act 1988*. Major issues of concern during 2011 with respect to compliance in the commercial sector were the use of gillnets in excess of entitlement, fishing in closed waters and the inadequate marking of gear. Recreational fishing issues include non-compliance with general possession limits, retaining undersize barramundi, removing skin from fillets and fishing in seasonally closed areas.

Consultation, Communication and Education

Key stakeholder groups, such as the Barramundi Licensee Association, AFANT and the Guided Fishing Industry Association of the NT, are consulted on matters related to the sustainable management of the fishery.

BFMAC consists of representatives from various stakeholder groups and government and provides advice to the Executive Director of Fisheries on issues relevant to the fishery.

A series of Aboriginal Consultative Committees have been formed to enable the NT Fisheries to engage with Aboriginal groups on matters relevant to the sustainable management of fish and aquatic life in the NT.

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 provide the fisher with an understanding of the legislation, status of the fishery, research, management, compliance issues and reporting requirements for interactions with TEP species. In addition, a SeaNet Extension Officer provides information and advice on reducing environmental impacts and works directly with the industry, managers and researchers to develop and implement improved fishing gear technology and methods.

An information package is available for recreational fishers on all aspects of barramundi fishing in the NT. 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 are made to schools, community groups and fishing clubs on best practice handling techniques and issues affecting sustainability of the resource.

Senior Research Scientist – Dr Thor Saunders
Aquatic Resource Management Officer – Mr Steven Matthews

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Table 1. Harvest status against planned management objectives, performance indicators, trigger points and management actions for the Barramundi Fishery

Species or group	Management objective	Performance indicator	Trigger Reference Point (TRP)	Harvest status for 2011	Management action
Target species barramundi, king threadfin.	To maintain the sustainability of the barramundi fishery resource.	Significant decline in the annual catch or a significant increase in fishing effort.	Catch or effort by any sector, or the fishery as a whole, increase (↑) or decrease (↓) by 20% each year for two consecutive years.	**Commercial sector** Barramundi catch ↑ 3% in 2010 and ↑ 10% in 2011 - TRP not reached. King threadfin catch ↑ 6% in 2010 and ↑ 10% in 2011 – TRP not reached Effort ↓ 4% in 2010 and ↑ by 4 % in 2011 - TRP not reached. **FTO sector** Barramundi catch ↑ 13% in 2010 and ↑ 18% in 2011 – TRP not reached. King threadfin catch ↑ 30% in 2010 then ↓ 38% - TRP not reached.	1) Stakeholders to make recommendations to the Executive Director of Fisheries (EDF) regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being reached.
Target species barramundi, king threadfin.	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.	The monetary value of fishing by a fishery sector changes by more than 20% for each year for two consecutive years.	N/A	As per 1) above.
Target species Barramundi.	Maintain and enhance quality fishing experiences for recreational fishers into the future.	A significant number of recreational fishers or FTO clients do not enjoy their barramundi fishing experience.	More than 20% of participants in stakeholder fishing surveys or FTO clients state that they are unsatisfied with their barramundi fishing experience.	N/A	As per 1) above.
Byproduct species: jewfish, shark (all), reef fish, sand bass, tripletail, snappers, queenfish, blue threadfin and, grunter.	Ensure ecological sustainability of byproduct species.	Monitoring of commercial logbook returns and onboard monitoring of commercial vessels.	Byproduct species harvest increases (↑) or decrease (↓) by 50% in each year for two consecutive years.	Catches for all byproduct species remained within TRP limits – TRP not reached.	As per 1) above.

Species or group	Management objective	Performance indicator	Trigger Reference Point (TRP)	Harvest status for 2011	Management action
Bycatch species.	Ensure ecological sustainability of bycatch species.	Monitoring of commercial logbook returns and onboard monitoring of commercial vessels.	Bycatch species increase by more than 50% in each year for two consecutive years.	Bycatch remained within TRP limits – TRP not reached.	As per 1) above.
Threatened endangered or protected (TEP) species and/or communities.	Ensure the continued protection of species and communities listed under EPBC Act and as listed under the NT *Parks and Wildlife Conservation Act 2001.*	TEP species and/or communities are identified in NT waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC Act listed species or communities.	There were no identifiable impacts observed on the EPBC Act listed species or communities – TRP not reached.	Stakeholders to make recommendations to the EDF 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 the effects on the ecosystem components.	Identification of threatening processes.	Identification of significant negative interaction with components of the natural ecosystem.	There were no significant negative interactions within the ecosystem where the Barramundi Fishery occurs– TRP not reached.	As per 1) above.

COASTAL LINE FISHERY STATUS REPORT 2011

INTRODUCTION

The Coastal Line Fishery operates in the nearshore waters of the Northern Territory (NT) and harvests a wide range of species, mostly using hook and line gear. The fishery mainly targets black jewfish (*Protonibea diacanthus*) and golden snapper (*Lutjanus johnii*). Key secondary species include emperors, cods and other snappers.

The fishery comprises commercial, recreational, charter and Indigenous sectors, and there is considerable overlap in the range of species harvested. All sectors are capable of exerting considerable impacts on the fishery and recent sustainability concerns has led to a proposal for new management arrangements by the Fisheries Division of the Department of Primary Industries and Fisheries (NT Fisheries), in consultation with the Coastal Line Fishery Management Advisory Committee (CLFMAC).

PROFILE OF THE FISHERY

Commercial Sector

Area

The fishery extends from the high water mark to 15 nautical miles (nm) from the low water mark along the NT coast. Some finer-scale access restrictions apply around registered Aboriginal sacred sites and protected areas.

Fishing Method

Coastal Line Fishery licensees are permitted to use several gear types. Vertical lines, cast nets (for bait only), scoop nets or gaffs can be used from the high water mark out to 2 nm from the low water mark. Drop lines and a maximum of five fish traps per licence may also be used from 2 nm out to the 15 nm limit. Commercial fishers are permitted to use up to five hooks per vertical line, but most choose to use only two. They may also use up to 40 hooks per drop line, but typically use from six to 20. Vertical lines comprised 99% of the fishing effort in the fishery in 2011.

Catch

The total reported catch for the fishery in 2011 was 146 tonnes (178 tonnes in 2010), a decline from the peak catch of 311 tonnes in 2004 (Figure 1). Historical data indicates that the catch fluctuated between 60 and 138 tonnes from 1990 to 1998 (data not shown), and then steadily increased until 2004.

There have been significant changes in the catch composition of the fishery over time (Figure 1). A mix of reef fish dominated the catch from 1990 to 1998 (data not shown). Since then, the proportion of black jewfish in the catch has steadily increased and now makes up between 85 and 95% of the total catch for the fishery. Over the same period, the catch of golden snapper, as a proportion of the total catch, has declined from an average of around 16% to less than 3% in 2011.

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

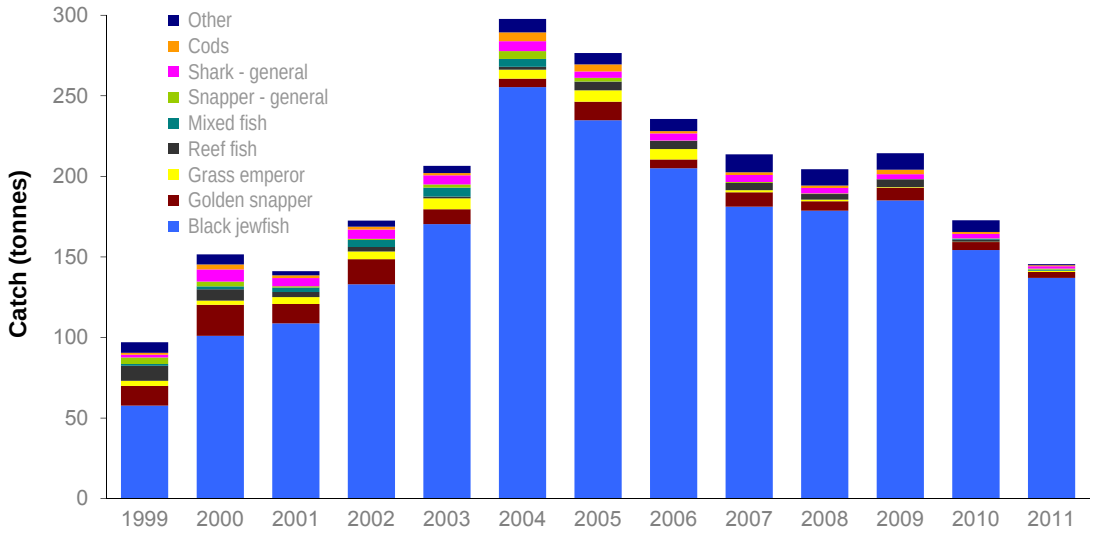

Figure 1. Catch composition (tonnes) for the line-only component of the Coastal Line Fishery, 1999-2011

Figure 2. Catch, effort and catch per unit effort (CPUE) for the line only component of the Coastal Line Fishery, 1999-2011

Catch Rates

The catch per unit effort (CPUE) for the line-only component of the fishery increased steadily from 2.3 kg/hook hour in 2003 to 5.7 kg/hook hour in 2006 (Figure 2). It declined markedly to 1.5 kg/hook hour in 2009, primarily due to the aforementioned exploratory fishing activities by a few new operators. It has since increased to 3.8 kg/hook hour in 2011 from 2.8 kg/hook hour in 2010 It is noted that catch rates for aggregating species (such as black jewfish) can be artificially inflated through fisher behaviour. This phenomenon, known as hyperstability, occurs when an operator fishes until there are no more bites (or the last fish is caught) then moves onto a new area to maintain high catch rates. As such, the effects of variable fisher skill level and hyperstable catch rates may have cumulative or opposing impacts on CPUE estimates. It is hoped that with further research, more reliable indicators of stock abundance will be available.

Marketing

Most fish are sold fresh on ice, usually gilled and gutted, filleted or trunked (whole fish from which the head and viscera have been removed). Trunking is convenient for cold storage of larger fish such as black jewfish. The swim bladder of black jewfish is also sold as a high value product. Due to limited local demand, most of this product is sold to southern markets.

Recreational Sector

Area

Recreational coastal line fishing takes place over most of the nearshore waters of the NT. The most popular regions include the coastal strip from the Daly River to the Alligator rivers and the Nhulunbuy area. In 2000-01, 31% of the total NT recreational fishing catch was from the Darwin area (Coleman 2004).

Fishing Method

A variety of fishing gear is used by the recreational sector of the fishery. Most fishing is by line (84%), using lures or bait. Over 75% of the time spent fishing in the NT takes place from a boat (Coleman 2004).

Catch

The National Recreational and Indigenous Fishing Survey (NRIFS) conducted in 2000-01 indicated that of the ~600 000 fish harvested (i.e. caught and kept) by recreational fishers in the NT, the most common were snappers (23% of the total harvest). Within the snapper group, golden snappers (*Lutjanus johnii*) and stripey snappers (*L. carponotatus*, also known as Spanish flag) accounted for the largest portion of the harvest, estimated at 68 000 and 22 000, respectively (Henry and Lyle 2003; Coleman 2004). Black jewfish (~18 000) and emperors (~12 000) were also significant components of the harvest.

Effort

Line fishing in coastal waters accounts for 30 to 50% of recreational fishing effort in the NT (Coleman 1998; Coleman 2004). These figures include both dedicated reef fishing and non-specific target fishing.

Most of the fishing effort for reef fish and 'non-specific target' fishing in 1995 occurred within the Darwin Harbour area (Coleman 1998). In 2000, the Darwin Harbour area was still the most important fishing area, accounting for 39% of the recreational coastal line fishing effort (Coleman 2004).

A comprehensive 12 month survey of recreational fishing in the NT that commenced in 2009 will provide up to date recreational catch and effort estimates. The results are expected in 2012.

Fishing Tour Operator Sector

Area

Most Fishing Tour Operators (FTOs) operate around Darwin, Bynoe Harbour, Fog Bay to Point Blaze and the Peron Islands. A small number also operate out of Nhulunbuy, Borroloola and across Arnhem Land.

Fishing Method

FTOs are subject to the same gear controls and possession limits as recreational fishers, and use baited hooks 95% of the time spent reef fishing.

Catch

Logbook data for 2011 reveals that the FTO sector catch large numbers of coastal fish, most notably, golden snapper (13 107), stripey snapper (12 157), grass emperor (7487) and cods (4788).

Effort

Reef fishing effort steadily increased between 1995 and 2009, with the total reef fishing line hours in recent years being over six times those recorded in 1995. In 2011, reef fishing effort accounted for 65 072 hours fished by FTO clients, which is a reduction on the 72 159 hours fished in 2010. There has been a decline in activity since 2009, which is consistent with a decline in client numbers since 2009.

More information for the sector can be found in the Fishing Tour Operator Fishery Status Report in this publication.

Indigenous Sector

Area

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

Fishing Method

NRIFS (2001) revealed that over 90% of all Indigenous fishing in the NT was shorebased, with half of fishers using baited lines (Henry and Lyle 2003).

Catch

Mullet and snappers form the bulk of the harvest by Indigenous fishers.

The Indigenous component of NRIFS estimated that 83 000 mullet were harvested by Indigenous subsistence fishers in the NT over a 12 month period. Other harvested species included catfish (60 000), snappers (27 500), sharks and rays (12 000), salmon (8500) and trevally (8000).

Non-retained Species

Whilst the commercial sector of the fishery primarily targets black jewfish and snappers, over 40 different species have been retained in recent years. Fisheries Regulations prohibit Coastal Line Fishery licensees from taking barramundi, king threadfin, Spanish mackerel or mud crabs. Coastal Line Fishery licensees have, at the request of the Offshore Net and Line Fishery Licensee Committee, accepted the introduction of limits on shark catches in the fishery.

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

Threatened Species Interaction

No interactions with threatened, endangered or protected (TEP) species were recorded in 2011. The targeted nature of the fishery minimises the risk of interactions with TEP species.

Ecosystem Impact

There is little information on the direct impact of the fishery on the marine environment. However, the targeted nature of hook and line fishing combined with negligible physical damage to the benthos means that the fishery has minimal impact on the marine habitat.

Social Impact

In 2011, there were 13 active Coastal Line Fishery licences, which provided both direct and indirect local employment. A large proportion of the NT seafood harvest is consumed domestically, with the industry supplying products to major national seafood markets. Subsistence fishing and recreational fishing continue to form an important component of the lifestyle and culture of many NT residents.

Economic Impact

At the point of first sale in 2011, the catch value of the commercial sector of the fishery was $0.35 million. The black jewfish component was $0.33 million and for golden snappers, it was $13 600. The recreational fishing sector's service and tackle industries also contribute to the NT economy.

STOCK ASSESSMENT

Monitoring

Catch and effort trends in the commercial and charter sectors are monitored through analysis of logbook data submitted by fishers on a monthly basis as a condition of their licence. Regular fishery-dependent sampling is also undertaken on commercial and FTO vessels to expand the range of information collected on target species in the fishery, including length, age and sex data.

Stock Assessment Methods and Reliability

Stock assessments have been completed for black jewfish and golden snapper in 1996 and 2011 using Stock Reduction Analysis (SRA) which has been demonstrated as a simple yet reliable assessment method (Walters et al. 2006). However, the critical piece of data missing in these assessments is regular catch and effort information from the recreational sector. Given this sector catches most of the reef fish in the NT, data from the three recreational surveys have had to be extrapolated to get a full time series which limits the veracity of the results.

Current Harvest Status

A major NT fish stock assessment workshop led by world renowned Fisheries scientist Dr Carl Walters was held in 2011 with the final results to be published in 2012. Initial findings indicate that golden snapper stocks are over exploited around the Darwin area to the extent that egg production is approximately 20% of pristine levels. In addition, harvest rates of black jewfish stocks in the same region were found to be fully utilised with a 30% chance of overfishing occurring.

Future Assessment Needs

There is a lack of information on the biology, stock structure and sustainable harvest limits for many of the NT's reef species. Regular monitoring trips on commercial and FTO vessels are providing additional data, which will help describe the size and age structure of fish stocks harvested by the fishery and subsequently confirm the status of the stocks.

A comprehensive 12 month survey of recreational fishing in the NT that commenced in 2009 will provide up-to-date recreational catch estimates. The results are expected late in 2012 and will be included in future fishery assessment reports.

RESEARCH

Summary

Concerns raised by stakeholders in 1995 regarding the sustainability of the fishery resulted in a four-year coastal fish research program. The project documented important biological information on the age and growth of key coastal species and led to several legislative changes. The key findings of this work were:

- Black jewfish have a fast growth rate, reaching sexual maturity at around 97 cm in total length (TL) at three years of age.
- Golden snappers are a long-lived and late-maturing fish. Fifty per cent of females reach sexual maturity at 63 cm TL (eight to ten years old). Males reach maturity at a smaller size, with 50% maturing at 47 cm TL. The oldest golden snapper sampled was 23 years old with a fork length of 82 cm.
- Grass emperors (tricky snapper) undergo a sex change, beginning life as females and developing into functional males at around 37 cm TL, at six years of age.

Since 2005, Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) has taken part in two multi-faceted, collaborative projects funded by the Fisheries Research and Development Corporation (FRDC), focusing on black jewfish. The key findings of the projects are listed below.

Age and Reproduction Studies

Studies of the age/length frequency of some 1000 black jewfish and the reproductive status of 500 black jewfish caught between August 2004 and August 2006 revealed that:

- Black jewfish in NT waters grow extremely fast, reaching around 60 cm TL in their first year and 90 cm in their second year.
- Black jewfish live for at least 12 years (specimens 140–142 cm TL).
- Fifty per cent of black jewfish are sexually mature at 89 cm TL (around two years of age).

- Spawning occurs over several months peaking in December.

Habitat Mapping and Acoustic Tagging Studies

Acoustic Doppler current profiler surveys were conducted for 44 black jewfish at aggregation sites at Chambers Bay and Channel Point in 2006. The studies showed that:

- Black jewfish aggregation sites vary significantly in terms of bottom contour and current profiles as revealed in 2-D and 3-D maps.
- Black jewfish have an affinity for particular aggregation sites, with fish recorded in the same area up to 18 months later.
- Some fish appeared to be permanent residents at the aggregation sites, while others moved away and returned up to nine months later.

Barotrauma Study

Autopsies conducted on 108 black jewfish (obtained from commercial fishers and research fishing) revealed that they were highly susceptible to barotrauma, showing a range of conditions, including, haemorrhage (bleeding) and exopthalmos (bulging of the eyes), hyperinflation or rupturing of the swim bladder (as a consequence of over inflation), displacement and damage to visceral organs and damage to the circulatory system.

Black jewfish landed from water less than 10 m deep showed few signs of barotrauma and were likely to survive if released. Of the black jewfish landed from depths of 10 to15 m and from 15 to 20 m, 46% and 100%, respectively had injuries that rendered them unlikely to survive.

Unlike water depth at capture, the size of the fish, and the method of fishing, did not appear to affect the type or extent of barotrauma.

Ecological Risk Assessment

A risk assessment workshop was held for the fishery in June 2009. Risks to the sustainability of each of the target and primary byproduct species (or group) were identified, providing the foundation for the management and research priorities for the multi-species, multi-sector fishery. Black jewfish and golden snapper showed the highest risk values in both low and high fishing effort areas and were identified as having the highest priority for management.

Incorporation into Management

Early research on NT reef fishes resulted in the implementation of a five fish possession limit for black jewfish and golden snapper (within the general possession limit of 30 fish). The more recent work on black jewfish led to a further reduction in the possession limit for this species to two. The barotrauma project provided advice for recreational fishers on the negative impacts of ‘catch and release’ on black jewfish.

Current Research

Current research projects include a program involving the collection of tropical snapper frames from recreational anglers and FTOs across the NT. The project has been extremely successful, with over 1500 frames collected so far, which will provide important information on the size and age structure of snapper populations. Snapper frames are also being collected by Aboriginal marine ranger groups across the NT.

A golden snapper tagging program has continued in Darwin and Bynoe harbours and the Tiwi Islands, with the support of the Amateur Fishermen’s Association of the NT (AFANT). NT Fisheries staff, selected recreational anglers and FTO operators have tagged over 1600 fish in shallow waters in order to describe the movement and growth of this popular, but data poor species. The tag-recapture information will also aid in the determination of the harvest rate of this important species.

Gill and gut samples are being collected from black jewfish and golden snapper from numerous locations across the NT to determine the types of parasites present. In addition otoliths and genetic samples are being collected to determine the stock structure of these important species. These

results will inform regional management of these species.

MANAGEMENT/GOVERNANCE

Management

Objective

A range of short and long-term management objectives have been agreed by CLFMAC to ensure that the fishery remains sustainable. These include maintaining ecologically sustainable catches in all sectors and protecting key target species in populated regions from overfishing.

History

Prior to the introduction of the NT Fisheries Regulations in 1993, the number of Coastal Line licences (formerly Inshore Reef licences) peaked at around 160. This number was reduced to 65 in the early 1990s through a moratorium on both the renewal of inactive licences and the issuing of new licences.

In 1995, significant amendments to the regulations governing the Coastal Line and Demersal fisheries came into force. These included extending the outer boundary of the fishery from 2 nm to 15 nm and allowing the transfer of Coastal Line licences. To avoid an overlap between fisheries, the inner boundary of the Demersal Fishery was shifted from 2 nm out to 15 nm. Demersal Fishery licensees who did not already hold a Coastal Line licence were issued with one, leading to the creation of 26 additional Coastal Line licences. This measure was accompanied by a two-for-one licence reduction scheme that allowed for the transfer of Coastal Line licences and removed excess fishing capacity. At present, there are 5 Coastal Line licences.

The re-adjustment of the fishery was undertaken to enhance its economic viability and productivity, and assist in the sustainable management of the resource. The need for the licence reduction program was reiterated during an FRDC-funded workshop conducted in 1996. Uncertainties in stock size estimates, excessive amounts of latent effort and increasing recreational and FTO fishing effort were identified as the major issues for the fishery.

Current Issues

The biology and life history traits of many key target species in the fishery make them vulnerable to overfishing and localised depletion. Increasing fishing pressure on inshore fishing grounds has caused significant declines in the abundance of these species. A shortage of detailed biological and stock assessment data on golden snapper also raises their level of risk to overexploitation. CLFMAC is currently in the process of developing a long term management strategy for the fishery to ensure its future sustainability.

Coastal reef species tend to suffer barotrauma related mortality during capture in waters greater than 10 metres in depth. Therefore both the recreational and FTO sectors will need to limit the catch and release of these barotrauma prone species to prevent further stock declines in high use areas.

Future Plans

Ensuring that the harvest of coastal fish by all sectors is sustainable remains a primary management objective. The review of existing management arrangements will continue in 2012.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services is responsible for all fisheries compliance and enforcement in the NT under the *Fisheries Act 1988*.

There have been few reported problems with compliance in the fishery. The primary area of concern is the potential for the black market sale of fish by unlicensed fishers.

Consultation, Communication and Education

The NT Seafood Council, the Coastal Line Fishermen's Association and AFANT take an active role in the formulation of management policy for this fishery. Additionally, there are a number of regional coastal consultative committees, which provide formal advice from Aboriginal constituents on all aspects of fishing, including coastal species.

CLFMAC, which is a forum for key stakeholder groups, was re-established in 2008 to provide advice to government on management strategies and research for the fishery.

Research Scientist - Mr Chris Errity
Aquatic Resource Management Officer – Ms Patti Kuhl

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COASTAL NET FISHERY STATUS REPORT 2011

INTRODUCTION

The Coastal Net Fishery operates within the inshore waters of the Northern Territory (NT) and may harvest a range of species, particularly mullet, blue threadfin, shark and queenfish. Commercial operators are not permitted to retain barramundi, king threadfin, Spanish mackerel or mud crab. They are also required to clear their nets in water not less than 30 cm deep to facilitate the release of bycatch.

Commercial fishing effort in the fishery is relatively small and variable. A voluntary licence buy-back scheme for the fishery (with the purpose of closing Darwin Harbour and Shoal Bay to coastal net fishing) was undertaken in 2007. This reduced the number of licences in the fishery from fourteen to five.

Recreational and Indigenous fishers often target the same species as commercial Coastal Net licensees and are permitted to use amateur drag nets to do so.

PROFILE OF THE FISHERY

Commercial Sector

Area

The inshore fishery extends from the high water mark to 3 nautical miles from the low water mark. The fishery is regionalised, with licensees only able to fish in the single region nominated on their licence. The regions include:

- The Darwin region (from Cape Hotham to Native Point and Cape Ford to Cape Dooley).
- The Gove region (between Cape Arnhem and Cape Wilberforce).
- The Borroloola region (between Bing Bong Creek and Pelican Spit).

Additional access restrictions may apply around registered Aboriginal sacred sites and protected areas.

Fishing Method

Coastal Net Fishery licensees are permitted to use a coastal net of no more than 300 m in length, with a maximum drop of 5 m and mesh size not exceeding 65 mm. Nets may be anchored at one end only. Licensees are also permitted to use a cast net with a diameter of not more than 6 m and mesh size not exceeding 25 mm. Based on historical use, one fishery licensee is permitted to use a gillnet with a mesh size up to 100 mm.

Catch

The total reported catch in 2011 was 4.4 tonnes, a reduction on the 7.4 tonnes caught in 2010 (Figure 1). The fishery averaged around 36 tonnes per year between 2001 and 2007. Much of the interannual variation in catch, effort and catch rate is probably due to licensee business decisions. Many licensees hold licences for other fisheries and alternate between fisheries depending on such factors as catch rates and market demand. A reduction in the number of licences in the fishery has also contributed to the decrease in reported catch and effort.

Over 40 species have been retained by the commercial fishery since the introduction of logbook returns. Whilst mullet, blue threadfin, sharks and queenfish account for the majority of the catch, other common species include garfish, snappers and whiting.

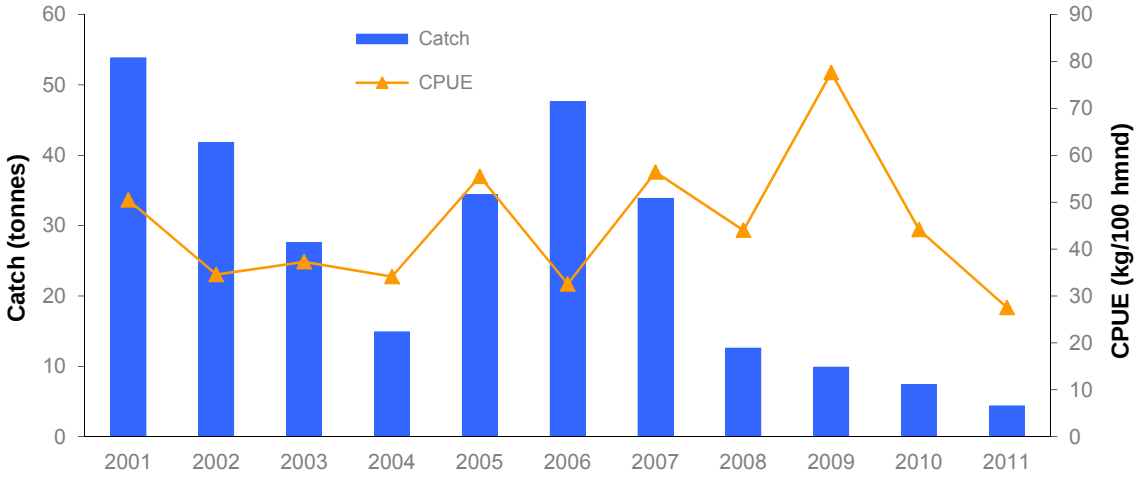

Figure 1. Commercial catch and catch per unit effort (CPUE) for the Coastal Net Fishery, 2001 to 2011

Effort

Two of the five licences in the fishery were active in 2011.

Effort in the fishery is expressed in '100 metre net days' (hmnd). One hmnd equates to 100 m of net used for one day. Fishing effort in 2011 was 159 hmnd, a reduction on the 2010 figure of 168 hmnd and well below the 10 year average of 672 hmnd.

Catch Rates

The CPUE for the fishery has averaged 46.7 kg/hmnd since 2001. The CPUE in 2011 was 27.7 kg/hmnd, which is a decrease from the CPUE of 44.1kg/hmnd in 2010.

Marketing

Most of the fish is sold 'fresh on ice' whole, gilled and gutted or fillets. Most sales are to local markets close to the port of landing.

Recreational Sector

Area

Most recreational fishing effort is concentrated around Darwin, Gove and Borroloola.

Fishing Method

Amateur drag nets are used by some recreational fishers who target small fish and prawns for bait or for human consumption.

The use of amateur drag nets does not require a licence but the net must not exceed 16 m in length, a 2 m drop, or have a mesh size of more than 28 mm. Conditions are also placed on where the nets can be operated (i.e. seaward of the coastline) and how they are retrieved (i.e. by hand hauling only). The NT component of the National Recreational and Indigenous Fishing Survey (NRIFS) conducted in 2000-01, estimated that the total soak time for recreational nets set in NT waters was close to 10 000 hours (Coleman 2004).

Catch

Many of the key species harvested by commercial coastal net operators also form an important component of the recreational fishery of the NT.

Results from NRIFS indicated that mullet and salmon were important recreational fishing species. Sharks, prawns and bait fish are also important.

It is not clear what proportion of the catch of these species is used for human consumption and what proportion as bait.

Fishing Tour Operator Sector

Area

Fishing Tour Operators (FTOs) must have a licence to operate in NT waters and their clients are subject to the same controls as recreational fishers. As such, the use of amateur drag nets by this sector is restricted to waters of tidal influence excluding those in Kakadu National Park.

In 2011, FTOs were active throughout the coastal waters of the NT, with the majority concentrated in and around the Darwin area.

Fishing Method

Although FTO clients are permitted to use amateur drag nets (according to the rules and regulations for recreational fishers) very few choose to do so.

Catch

The FTO catch by drag net is considered negligible.

More information for the sector can be found in the Fishing Tour Operator Fishery Status Report in this publication.

Indigenous Sector

Area

A large number of Aboriginal communities and outstations are located along the NT coastline. Fishing effort is greatest near the large Aboriginal communities on the Tiwi Islands and at Maningrida, Port Keats and Borroloola.

Fishing Method

Aboriginal fishers in the NT typically use drag nets, cast nets and spears to harvest inshore fish and shark species.

Catch

A comparison of NRIFS data suggests a significant overlap in the harvest of primary species by Indigenous, recreational and commercial fishers.

Approximately 83 000 mullet are taken annually by Indigenous fishers (Henry and Lyle 2003). Other fish of importance to Indigenous fishers and the fishery include catfish (60 000), snappers (27 500), sharks (12 000), threadfins (8500) and trevally (8000) (Henry and Lyle 2003).

Non-retained Species

Commercial licensees are prohibited from retaining barramundi, king threadfin, Spanish mackerel or mud crabs. Operators are required to clear their nets in water not less than 30 cm deep to facilitate the release of any bycatch of these or other prohibited species.

Threatened Species Interaction

Fisheries Regulations prohibit the take of aquatic life listed as protected under the NT *Parks and Wildlife Conservation Act 2001*. The species vulnerable to capture in the fishery include dugong, turtles and crocodiles. However, the risk of interaction with these species is reduced through the requirement for all licensees to use only haul or surrounding nets and therefore be in continuous attendance of their gear when it is in use.

In 2011, there were no reported interactions with threatened, endangered and protected species.

Ecosystem Impact

There is little information on the direct impact of the fishery on the marine environment. However, the low level of fishing effort and the geographic extent of the fishery combined with negligible physical damage to the benthos means the fishery is considered to have an insignificant impact on the ecosystem.

Social Impact

Two licences were active in 2011 providing nominal employment opportunities. A large proportion of the NT 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 NT.

Economic Impact

At the point of first sale in 2011, the commercial sector of the fishery was estimated at $19 600.

STOCK ASSESSMENT

Monitoring

Activity in the fishery is monitored through the analysis of information from monthly catch and effort logbook returns submitted as a statutory requirement under the NT *Fisheries Act 1988*.

Stock Assessment Methods and Reliability

No stock assessment has been undertaken in this fishery, primarily because of the small number of operators, limited catch and effort, and wide range of species taken.

Current Harvest Status

Effort in the fishery is relatively low and the combined harvest by all sectors is considered to fall within ecologically sustainable limits.

Future Assessment Needs

Continued monitoring of catch rates and catch (including bycatch) composition of the fishery is required.

RESEARCH

Summary

Gear trials that assessed the suitability of various netting methods were undertaken during the early stages of the fishery. Fishery-dependent monitoring trips were also conducted at that time. A desktop study on the fishery was completed in 1997.

Incorporation into Management

Early gear trials led to changes in fishing methodology, such as modifications to mesh sizes and anchoring techniques.

Current Research

A survey of recreational fishing in the NT began in April 2009. It will quantify resident and visitor catch, harvest, effort and expenditure. Results from this survey will provide an understanding of the recreational harvest of coastal species.

An FRDC project titled 'Defining the Stock Structure of Northern Australia's Threadfin Salmon Species' was completed in 2010. This work found that both king and blue threadfins show limited adult and larval movement between localised stocks separated by as little as several tens of kilometres. These findings suggest that management arrangements for both species need to be reviewed.

MANAGEMENT/GOVERNANCE

Management

Objective

The fishery will be cooperatively managed in such a way that the harvest of aquatic resources is equitable, in line with nationally agreed principles of ecologically sustainable development, which optimises the benefit to the NT community now and in the future.

History

In 1986, four experimental special purpose (Haul Net) licences were issued to ascertain the feasibility of taking mullet and blue threadfin by haul netting. The number of species harvested and the fishing methods used progressively expanded in subsequent years.

The fishery first became regulated following the implementation of the NT Fisheries Regulations. At that time, licences were offered to those persons who held an existing Special Purpose (Haul Net) Fishery licence, or a Bait Fishery licence.

Following an announcement by the NT Government in mid-2000 that Darwin Harbour and Shoal Bay would be closed to the fishery, a review was undertaken of its management arrangements along with the Bait Net and Aboriginal Coastal Net fisheries. Future management options were developed to minimise conflict between these commercial fisheries and the recreational sector, and simultaneously reduce pressure on coastal fish stocks adjacent to Darwin.

Current Issues

1. Economic viability - the industry considers that new areas and new gear are required to increase catches.

2. Aboriginal interest in inshore fisheries may increase pending the outcome of negotiations with land councils following the Blue Mud Bay court decision.

3. Resource conflict with recreational fishers.

Future Plans

Future management options for the fishery may be revised following the outcomes of the Blue Mud Bay negotiations.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services is responsible for compliance and enforcement for all fisheries in the NT *Fisheries Act 1988*. This includes targeting the illegal use of nets by commercial and recreational fishers. There have been few reported compliance problems in the fishery.

Consultation, Communication and Education

Fisheries Division in the Department of Primary Industry and Fisheries (NT Fisheries) has maintained a regular, ongoing dialogue with the Coastal Net Licensee Committee, the NT Seafood Council and the Amateur Fishermen's Association of the NT since the inception of the fishery. Such liaison is central to the sustainable management of the resource.

Research Scientist – Mr Chris Errity
Aquatic Resource Management Officer – Ms Patti Kuhl

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DEMERSAL FISHERY STATUS REPORT 2011

INTRODUCTION

The Demersal Fishery extends between 15 nautical miles (nm) from the coast and the outer edge of the Australian Fishing Zone (AFZ), excluding the waters of the Timor Reef Fishery. The catch is comprised mainly of goldband snappers (*Pristipomoides* spp.) and red snappers (*Lutjanus malabaricus, L. erythropterus*). Red emperor (*L. sebae*) and cods (Family Serranidae) are key byproduct species. Most of the fish taken by the Demersal Fishery licensees were marketed whole 'fresh on ice' on the Australian domestic market. Red snappers and red emperor were also caught by the recreational and Fishing Tour Operator (FTO) sectors, primarily by hook and line. However, there is limited spatial or temporal overlap with commercial operators, given the offshore nature of the fishery. For similar reasons, no Indigenous harvesting has been recorded in this fishery.

The Northern Territory (NT) Fisheries Joint Authority, through the NT *Fisheries Act 1988*, manages all finfish taken in the fishery while the day-to-day management of the fishery is conducted by Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries).

The fishery was assessed in 2009 against the Guidelines for the Ecologically Sustainable Management of Fisheries by the then Australian Government Department of Environment, Water, Heritage and the Arts and received full Export Exempt accreditation under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment demonstrated that the fishery was managed in a manner that did not lead to overfishing, and that fishing operations had minimal impact on the structure, productivity, function and biological diversity of the ecosystem. The fishery is due for reassessment in May 2014.

PROFILE OF THE FISHERY

Commercial Sector

Area

The fishery operates in waters from 15 nm from the coastal baseline to the outer limit of the AFZ, excluding the area of the Timor Reef Fishery (Figure 1). Most of the fishing effort in the fishery occurs in areas east of the Timor Reef Fishery.

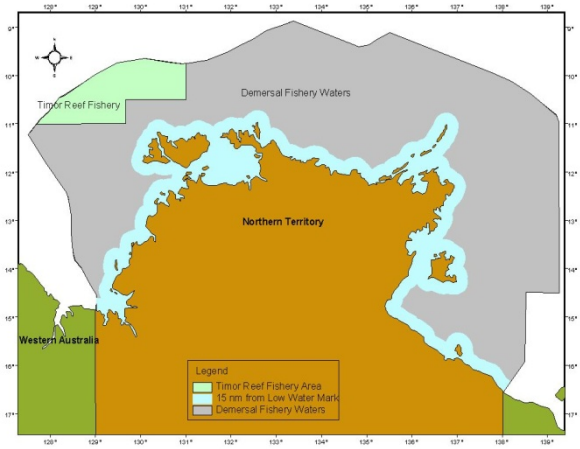

Figure 1. Location of the commercial Demersal Fishery

Fishing Method

Commercial operators are authorised to use baited traps and vertical lines, including hand lines and drop lines. Since 2006, most operators have been using traps. This trend has continued and in 2011 all vessels in the fishery used traps.

Catch

Goldband and red snappers are the two principal target groups in the fishery. There are three goldband snapper species: *Pristipomoides multidens, P. typus* and *P. filamentosus*. Together, they made up 58% of the total catch in 2011, with *P. multidens* the most common (Figure 2).

Red snappers include saddletail snapper (*Lutjanus malabaricus*) and crimson snapper

(*L. erythropterus*). Together, these species made up 37% of the catch in 2011. Other key species caught in the fishery were red emperor (*L. sebae*) and cods (Family Serranidae) (Figure 2).

The total commercial catch from the fishery in 2011 was 438 tonnes, representing an increase of more than 100% in the total catch compared with 2010 (208 tonnes). The goldband snapper catch was 252 tonnes compared with 92 tonnes in 2010 and the combined red snapper catch was 163 tonnes, compared with 92 tonnes in 2010.

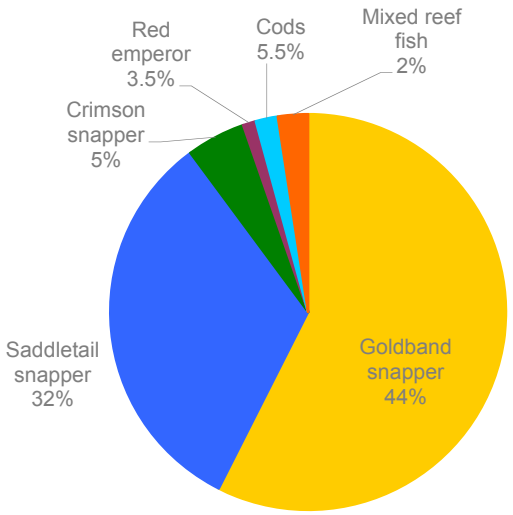

Figure 2. Overall catch composition of the Demersal Fishery in 2011

Byproduct Species

The byproduct catch (comprising mixed reef fish, cod and red emperor) accounted for 5% of the total catch, which is below the 10% trigger value required to undertake a review of management arrangements for the protection of byproduct species.

Effort

Eleven active licences (using 10 vessels) fished for 562 boat days in the fishery in 2011. In comparison, there were 20 licences active in 2010, which fished for 321 boat days (Figure 3). The substantial variability in effort since 2009 most likely reflects business decisions by operators to move between the Demersal Fishery and the nearby Timor Reef Fishery.

Catch Rates

Catch per unit effort (CPUE) has fluctuated considerably over the history of this fishery (Figure 4). Scientific evidence suggests that this is not due to changes in fish abundance or sustainability concerns; rather, the fluctuating CPUE reflects the small number of operators, their developing knowledge of the fishery and environmental factors, such as cyclic weather patterns.

Marketing

Currently, almost all the fish landed in the fishery are sold whole 'fresh on ice', with only a small amount sold as fillets. The small local Darwin market makes it necessary to send most of the product to interstate markets, principally Brisbane and Sydney. Increasingly, operators are developing marketing arrangements outside the wholesale central interstate marketing systems.

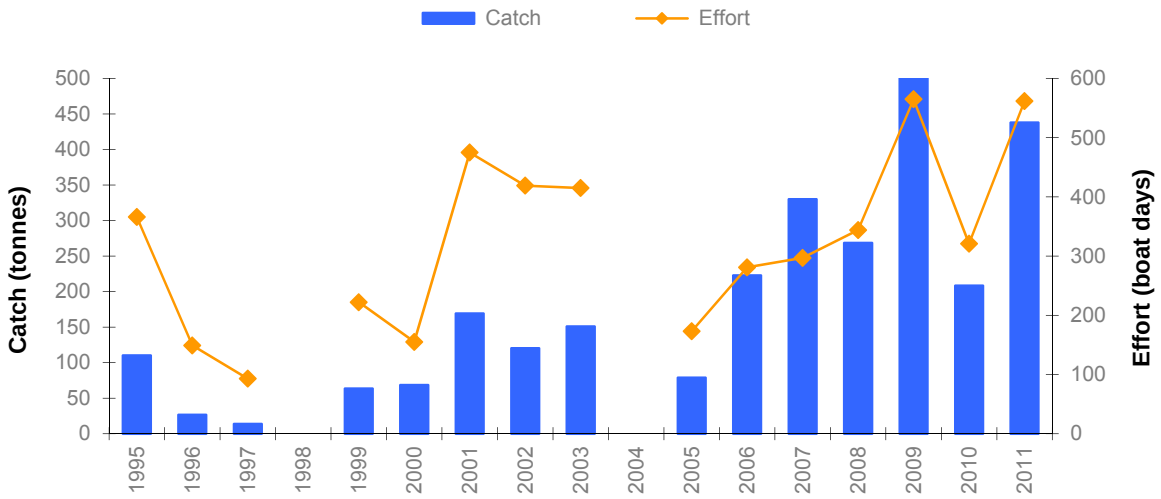

Figure 3. Commercial catch and effort for the Demersal Fishery, 1995 to 2011*

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

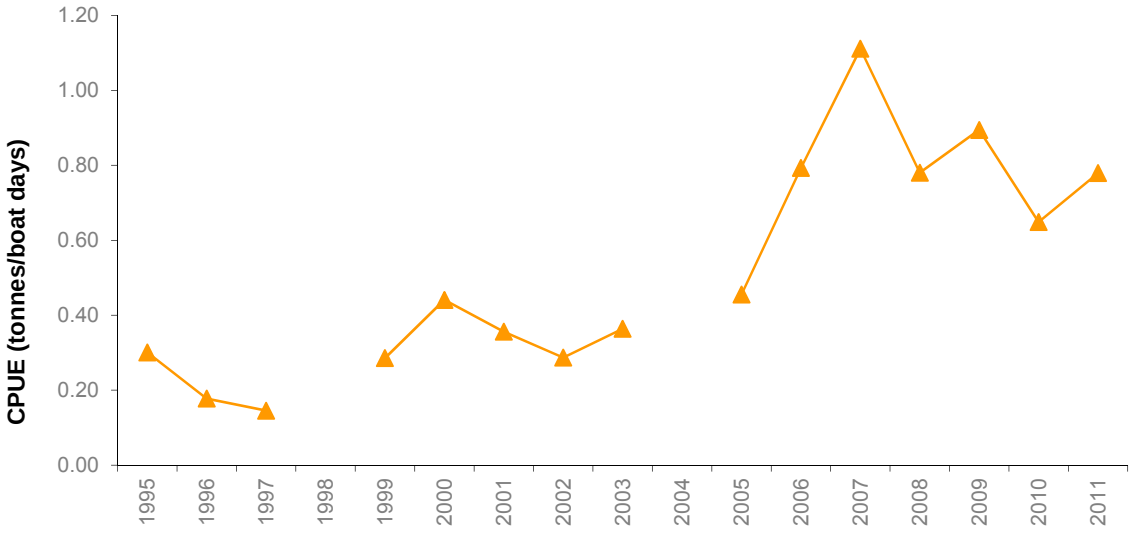

Figure 4. Total catch per unit effort (CPUE) for the commercial Demersal Fishery, 1995 to 2011*

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

Recreational Sector

Recreational fishers operating predominantly in inshore waters catch some of the same species targeted by commercial operators working in the offshore fishery, particularly red snappers and red emperor. Although recreational fishers share the same resource as commercial fishers, their catches are currently considered negligible. Nonetheless, recreational fishers are considered in each review of the fisheries management arrangements to ensure their sector allocations are appropriately set.

Fishing Tour Operator Sector

Very few FTOs are active in the offshore areas typically fished by commercial operators. However, FTO activity is increasing each year. Whilst FTOs share the same resources as commercial operators, their catches are currently less than 1% of those of the commercial sector. FTOs are considered in all reviews of the fisheries management arrangements to ensure their sector allocations are appropriate. More information for the sector can be found in the Fishing Tour Operator Fishery Status Report in this publication.

Non-retained Species

Non-retained species were reported to be less than 4% of the total catch and consisted mainly of trevally (Carangidae) with some sharks. Bycatch in this fishery is well below the 10% trigger value.

Threatened Species Interaction

In 2011, there were no recorded interactions with threatened, endangered or protected species in the fishery. The method of fishing and the location of the fishery generally prevent interaction with these species.

Ecosystem Impact

Operators are authorised to use vertical lines and traps, which are passive fishing gears. Interaction with the habitat is limited to the effects of line weights and traps on the seabed and the effect of anchors. To avoid excessive interaction with the seabed upon hauling, traps must be set separately with an identifying float and not attached to one another. Anchoring is usually limited to overnight stand-down of fishing activity.

The impact of 'ghost fishing' (i.e. the continued fishing by 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 in northern Australia has shown the entry and exit of fish from traps of the same design as used in the fishery.

Social Impact

The commercial sector of the fishery directly employs about 35 people as crew on boats and many others are employed by other related industries, such as transport and boat repairs. Recreational fishermen and FTOs target some of the demersal species. Product from the fishery supplies a healthy source of protein to consumers and ensures an economic return from natural resources to the community.

Economic Impact

The fishery was valued at $2.90 million in 2011. The goldband snapper component was valued at $2.20 million and the red snapper component at $0.60 million.

STOCK ASSESSMENT

Monitoring

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

The most recent monitoring trip for this fishery was conducted in 2009. This trip confirmed the similarity in methods, fishing grounds and catch composition with the Timor Reef Fishery. Given the present level of effort, Demersal Fishery logbook catch and effort information along with monitoring data from the Timor Reef Fishery can be applied to the management of the Demersal Fishery.

Stock Assessment Methods and Reliability

The most recent assessment of goldband snappers, using age structured stock reduction analysis (SRA), was completed in 2011. That assessment used data from the Timor Reef Fishery (TRF) only, but a further assessment using data from both the Timor Reef and the

Demersal fisheries is expected to be completed in 2012.

Previous goldband snapper stock assessments estimated an annual yield of 400 tonnes in the Arafura Sea area of the fishery (Ramm 1994, 1997), but also indicated that an absence of key parameters precluded the estimation of an absolute figure for sustainable harvest. The major recommendations from the recent TRF assessment were to obtain more accurate estimates of the current harvest rate and more complete age information for goldband snapper across both fisheries. Of the methods available to estimate harvest rate, the most practical and effective approach for this fishery is to determine a better estimate of biomass using swept area surveys. A survey of this nature, to derive fishery independent estimates of relative biomass and collect larger samples for ageing, is planned for 2013.

An assessment of red snappers, including both *Lutjanus malabaricus* and *L. erythropterus*, was conducted in 1996. Data from an independent trawl survey were used to provide a red snapper biomass estimate of 24 000 tonnes and a conservative annual sustainable harvest of 1500 to 2500 tonnes from the Arafura Sea area of the fishery (Ramm 1997). A stock assessment for red snapper, using the SRA model, is expected to be completed in the near future and, to assist in future assessments, biomass and age data for red snappers will be collected in the swept area survey planned for 2013.

Current Harvest Status

Catches in Australian waters of the Arafura Sea are below current triggers set for a review of management arrangements. The combined harvest of red snappers, from both the Demersal Fishery and the Finfish Trawl Fishery, was less than 950 tonnes, which is well below the lowest limit for sustainable harvest.

Future Assessment Needs

Goldband and red snapper stock assessments will be completed in 2012. Some key parameters still required for both goldband and red snappers include:

- A more accurate estimate of current Australian harvest rate.
- More complete age information.
- Information on the movement of red snappers prior to recruitment to the fishery.
- Indonesian catch and effort information.

RESEARCH

Summary

Monitoring and managing red snapper species (including goldband snapper) across northern Australia was addressed in a project completed this year (O'Neill et al. 2011). The project assessed current monitoring and logbook datasets across three jurisdictions (Queensland, Western Australia and Northern Territory) and confirmed the value of collecting fine scale data from the fishery. A population modelling tool was also developed to evaluate potential management strategies and provided information for the development of a biological survey program using commercial vessels.

Geographic information system spatial statistical methods have shown that there is a relationship between bathymetry and geomorphology, and high catches of goldband snappers (Lloyd and Puig 2010). Although this work was undertaken in the Timor Reef Fishery, the results from this project have shown that there is an extensive area of potential high productivity in the Demersal Fishery, which is largely underexploited at present.

Genetic studies conducted as part of an Australian Centre for International Agricultural Research (ACIAR) project provided some evidence indicating that separate stocks of *L. malabaricus* exist between Australia and Indonesia, but that it was difficult to separate stocks of *L. erythropterus* genetically, especially in the eastern areas of the Arafura Sea (Salini et al. 2006).

The stock structure of goldband snappers (*P. multidens*) has been determined by using both genetic methods and otolith microchemistry (Newman et al. 2000; Ovenden et al. 2002). 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 northwest Australian site. These sites were located less than 200 nm from each other on either side of the Timor Trench (Ovenden et al. 2002). Otolith microchemistry revealed distinct populations for all sites sampled, indicating that substantial movement of adults between sites is unlikely (Newman et al. 2000).

Incorporation into Management

Research findings up to now suggest that the current harvest targets are appropriate for the ecologically sustainable development of the fishery. Collaboration with Queensland, Western Australia and Indonesia will continue to provide information on the management of tropical stocks.

Current Research

Current research is focussed on developing a monitoring program that will provide regular spatially-referenced age data and an index of relative abundance for the offshore snapper species across northern Australia. The data will provide essential information for establishing annual harvest rates and, in turn, ensure greater reliability of stock assessments.

NT Fisheries is currently collaborating with Indonesia and Timor Leste in the Arafura and Timor Seas Ecosystem Action Program, which aims to characterise the biological and socioeconomic profile of the Arafura and Timor seas (ATS) region and identify cross boundary issues, including exploitation of fisheries. It is expected that this project will strengthen links between each of the countries bordering the ATS and improve the flow of information necessary to accurately assess offshore snapper fisheries.

MANAGEMENT/GOVERNANCE

Management

Objective

The overall management objective for the fishery is to maintain catches of goldband snapper and red snappers by all sectors within acceptable ranges. Should landings of these species from the Timor and Arafura seas, and from the Gulf of Carpentaria, 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

The NT and Australian governments jointly manage the fishery through the NT Fisheries Joint Authority. Day-to-day management is the responsibility of NT Fisheries in accordance with the NT *Fisheries Act 1988*.

Current Issues

The development of this fishery (particularly the red snapper component) and the encouragement of operators to fish in the entire fishery area in an ecologically sustainable manner continue to be the management focus for this fishery.

The impact of illegal, unreported and unregulated (IUU) fishing in northern Australian waters, primarily by foreign fishers, remains uncertain. The NT Government continues to work with the Australian Government to ensure appropriate measures are applied to mitigate the impact of IUU fishing on the sustainability of red snapper stocks.

Catches in the fishery have slowly increased with operators committing more expertise and resources to the development of the fishery. As a result, the NT Government informed fishers in 2006 that it was exploring mechanisms to stimulate the less active licence effort in the fishery, to secure goldband snapper grounds for non-trawl fishing methods and expand the Finfish Trawl Fishery (which also fishes in the area of the Demersal Fishery). An Offshore Snapper

Advisory Group (OSAG), comprising members from the industry, recreational fisher and FTO representatives, compliance and departmental officers was established in 2010 to develop a comprehensive policy and management framework incorporating a mechanism to better utilise the offshore snapper resources, focussing primarily on red snappers as the resource is thought to have the greatest potential for growth.

OSAG considered public comments received from stakeholders and interested parties during 2008-09, which indicated support for the following alternative proposal to facilitate the development of the offshore snapper fisheries:

- An agreement for the Finfish Trawl and Demersal fisheries to be managed within a quota management framework.
- The allocation of units of entitlement (as individual transferable quota) to existing licences in the Finfish Trawl and Demersal fisheries.
- The exclusion of the goldband habitat area from the Finfish Trawl Fishery and inclusion of a similar sized new ground to the Finfish Trawl Fishery. This will require OSAG to liaise with other fisheries, including those managed by the Australian Government.
- Development of a management framework by OSAG incorporating a mechanism to better utilise the red snapper resources.

Future Plans

A draft management framework addressing the above points has been developed by OSAG and was out for an extended public comment, ending in late January 2011. Comments received from this process will facilitate the further development of the framework.

The NT and Australian governments continue to work closely with the Indonesian Government to develop a bilateral management guide for shared red snapper stocks in the Arafura Sea.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services, is responsible for fisheries compliance and enforcement in the NT under the NT *Fisheries Act 1988*.

Arriving and departing vessels are inspected at the Port of Darwin, which is the only catch landing point currently used by fishery operators. Logbook returns submitted by fishery operators are validated against market returns. All operators are required to specify in their market returns where they are selling their product. Where required, returns submitted by traders/processors are also analysed and used to validate fishery logbook returns.

In 2010, there were no recorded compliance issues.

Consultation, Communication and Education

Regular consultation occurs between NT Fisheries, the NT Demersal Fishermen's Association and the NT Seafood Council. In addition, NT Fisheries staff regularly visit the wharf to speak informally with fishers.

The low number of active participants in the fishery allows all stakeholders to be directly involved in discussions on any proposed management arrangements.

NT Fisheries also produces publications, such as Fishery Reports, Fishnotes and newsletters to inform and educate stakeholders.

Senior Research Scientist – Dr Julie Martin
Aquatic Resource Manager – Mr David McKey

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Table 1. Management objectives and status against performance indicators for the Demersal Fishery

Species or group	Management objectives	Performance indicator	Trigger reference point (TRP)	Current status review	Management response to be taken
Goldband snapper	Ensure intergenerational equity by maintaining ecologically sustainable annual catches in all sectors.	Optimal sustainable yield estimates.	Catch levels increase (↑) to 90% of estimated sustainable annual yield.	Goldband snapper catch in 2011 was 252 tonnes - TRP not reached.	1) Demersal Fishery Management Advisory Committee (DFMAC) to review fishery and make recommendations to the Executive Director of Fisheries (EDF) regarding appropriate measures to ensure annual catches do not exceed estimated sustainable yields and on-board monitoring if not already in place, to commence at earliest practical opportunity. Amended arrangements to be implemented within 12 months of trigger being released.
Red snappers	Optimal sustainable yield estimates met.	Optimal sustainable yield estimates.	Catch levels ↑ to 90% of estimated sustainable annual yield.	The combined red snapper catch in 2011 was 163 tonnes - TRP not reached.	
Byproduct species (including red emperor and cods)	Ensure sustainability of byproduct species taken in the Demersal Fishery.	Monitoring of commercial logbook returns. Significant change in catch composition on Demersal Fishery grounds.	Annual catch increase in proportion of the total catch by more than 10% above the five year average.	Combined byproduct species in 2011 was 23.3 tonnes (5%) - TRP not reached.	2) DFMAC to review fishery and make recommendations to the EDF and on-board monitoring to commence at the earliest practical opportunity. Amended arrangements to be implemented within 12 months of trigger being released.
Bycatch species	Ensure sustainability of bycatch species taken in the Demersal Fishery.	Onboard monitoring of the adjacent 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.	Total bycatch in 2011 was 8% in the Timor Reef Fishery - TRP not reached. Onboard monitoring to continue annually.	As per 2) above.
Threatened, endangered or protected species and/or communities.	Maintain the present level of interaction between demersal fishing operations and species and communities listed under the EPBC Act.	Threatened, endangered or protected species and/or communities are identified in Northern Territory waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding the EPBC Act listed species or communities.	No identifiable impacts observed in 2011 - TRP not reached.	As per 2) above.

Species or group	Management objectives	Performance indicator	Trigger reference point (TRP)	Current status review	Management response to be taken
Ecosystem components.	Minimise the effects of fishing on ecosystem components.	Identification of threatening processes.	Identification of significant negative interaction with components of the natural ecosystem present on demersal fishing grounds.	No negative ecosystem interactions identified in 2011 - TRP not reached.	DFMAC to make recommendations to the EDF regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being released.

DEVELOPMENT FISHERY STATUS REPORT 2011

INTRODUCTION

The commercial fishing industry is characterised by evolving technologies and changing market opportunities. To conduct trials of new fishing gear, or to encourage the sustainable harvest of aquatic resources currently not utilised by existing fisheries, commercial operators are required to apply for a development permit or licence.

Fishers who wish to conduct development trials are required to lodge written applications providing detailed information about their proposed activities. Each application is assessed on a case-by-case basis, with relevant input from fishery stakeholders.

Applicants that are approved by the Executive Director of Fisheries are issued a development permit valid within the licensing year commencing in July. Performance criteria are assigned to each permit so that the feasibility of the trials may be assessed. Permit holders who have satisfied all aspects of the performance criteria may re-apply for a development permit or, if appropriate, 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. Where licence holders meet all performance criteria and remain able to demonstrate that the fishery and/or gear is both ecologically and economically sustainable, the fishery and/or gear in question may progress to a managed fishery.

DEVELOPMENT PERMITS

No development permits were issued in 2011.

DEVELOPMENT LICENCES

In 2011, two development licences were issued to trial the harvest of squid and bait fish, using alternative gear types. One was for the use of lift net and drop net gear, while the other was for the use of a small purse seine net and drop net gear.

The development of a local, ecologically sustainable bait fishing industry to supply bait for use by all fishery sectors would be advantageous to the Northern Territory (NT). Most of the bait currently sold in the NT is imported from interstate and overseas.

Fishing Method

A lift net is a small net that is opened alongside the vessel. Lights are used to encourage fish into the net before the net is closed and lifted aboard.

A drop net operates similarly to a cast net. Fish are encouraged under the net by the use of lights, and then the net is dropped and then hauled on board.

The purse seine method of fishing involves surrounding a school of fish with a net and then pulling the bottom of the net together to form a purse or pouch around the fish.

Catch

Confidentiality constraints prevent the publication of specific catch and effort data for the two development licences. However, the composition of catch harvested in the Development Bait Fishery during 2011 primarily consisted of spotted sardine (previously known as northern pilchard, *Amblygaster sirm*), smallspotted herring (*Herklotsichthys lippa*), and mouth mackerel (*Rastrelliger kanagurta*) (Figure 1).

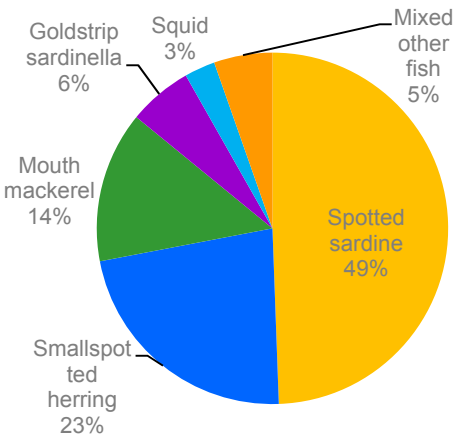

Figure 1. Catch composition in the Development Bait Fishery in 2011 (based on monitoring data)

Non-retained Species

A small number of mackerels comprising Spanish mackerel, grey mackerel, spotted mackerel and unidentified mackerel were taken during trials in 2011.

Ecosystem Impact

The impact of a proposed development trial on the ecosystem is considered when assessing an application for a permit or licence. 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. Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) encourages fishing practices that cause minimal impact on the ecosystem. The conditions on permits and licences in the fishery ensure that only permitted gear is used, fishing occurs in appropriate locations, conservative catch volumes are taken from the target stock and any interactions with non-target species are reported.

Monitoring

Permit and licence holders are required to provide records of the daily catch and annual activity reports as required by permit/licence conditions.

NT Fisheries scientists conducted onboard monitoring of fisheries operations during three trips while the vessel operated the development licences for squid and bait fish. The purpose of the monitoring was to independently validate the catch, assist with accurate species identification and observe any interactions with non-target species.

MANAGEMENT/GOVERNANCE

The activities permitted in the fishery are governed by the conditions of the permit or licence. Such conditions often include restrictions on the type of gear allowed, the time and place in which trials may occur and specifications on the target and bycatch species. Formal performance criteria are applied to all development permits and licences.

Research Scientist – Mr Grant Johnson
Aquatic Resource Management Officer – Ms Wendy Banta

FINFISH TRAWL FISHERY STATUS REPORT 201

INTRODUCTION

The principal species landed in the Finfish Trawl Fishery are red snappers (*Lutjanus malabaricus* and *L. erythropterus*). Products from this fishery are marketed primarily as whole fresh fish, mostly on the Australian domestic market. The fishery is comprised of a single trawl operator fishing in offshore waters east of Darwin, including the northern region of the Gulf of Carpentaria.

The Northern Territory (NT) Fisheries Joint Authority (NTFJA), through the NT *Fisheries Act 1988*, manages all finfish taken in the fishery while the day-to-day management of the fishery is conducted by Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries).

The fishery was assessed in 2009 against the Guidelines for the Ecologically Sustainable Management of Fisheries by the then Australian Government Department of Environment, Water, Heritage and the Arts. Full Export Exempt accreditation was subsequently issued under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment demonstrated that the fishery was managed in a manner that did not lead to overfishing, and that fishing operations had minimal impact on the structure, productivity, function and biological diversity of the ecosystem. The fishery is due for reassessment in May 2014.

PROFILE OF THE FISHERY

Commercial Sector

Area

The fishery operates in offshore waters east of Darwin to the outer limit of the Australian Fishing Zone (AFZ), excluding the area of the Timor Reef Fishery (Figure 1).

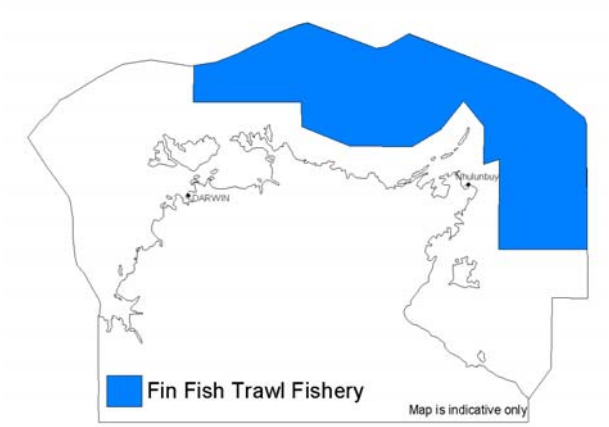

Figure 1. Fishing area available to the commercial Finfish Trawl Fishery

Within this overall area of approximately 202 000 km^2, 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 Fishery operator does not presently fish the same grounds as the Demersal Fishery licensees.

Fishing Method

Fishing operations are conducted using a semi-pelagic demersal trawl. The trawl net was developed cooperatively by the 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.

The operator is currently using bycatch reduction devices (BRDs) and a square mesh funnel in order to increase the value of the landed product, rather than increase catch volume.

Catch

Saddletail snapper (*Lutjanus malabaricus*) and crimson snapper (*L. erythropterus*) are the target species of the fishery comprising 75% of the total catch (Figure 2).

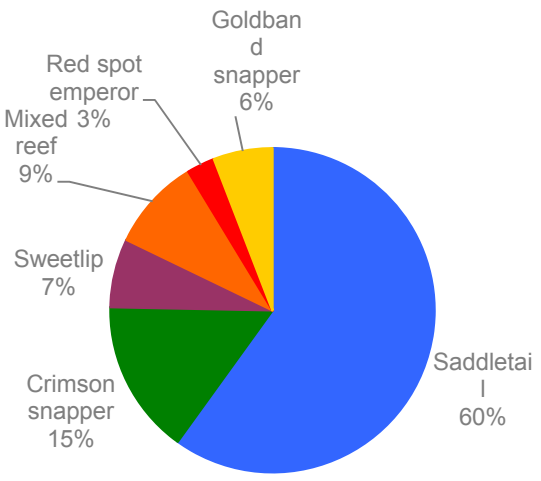

Figure 2. Catch composition for the Finfish Trawl Fishery in 2011

Since 1995, catches have increased steadily (Figure 3). In 2011, the catch was 1038 tonnes, 34 tonnes less than 2010. 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 fish abundance.

In 2011, the byproduct species comprised 256 tonnes, comprising mainly of painted sweetlips (*Diagramma labiosum*), redspot emperor (*Lethrinus lentjan*), and goldband snappers (*Pristipomoides multidens* and *P. typus*).

Effort

Fishing effort has increased steadily from 158 boat days in 1995 to 306 boat days in 2011, down from 325 boat days in 2010 (Figure 3). As with interpreting catch, there are many reasons for changes to effort in a single operator fishery.

Catch Rates

Since 1997, the catch per unit effort (CPUE) has shown little change, ranging from 3.0 to 3.9 tonnes per boat day (Figure 4). CPUE for 2011 was 3.4 tonnes per boat day.

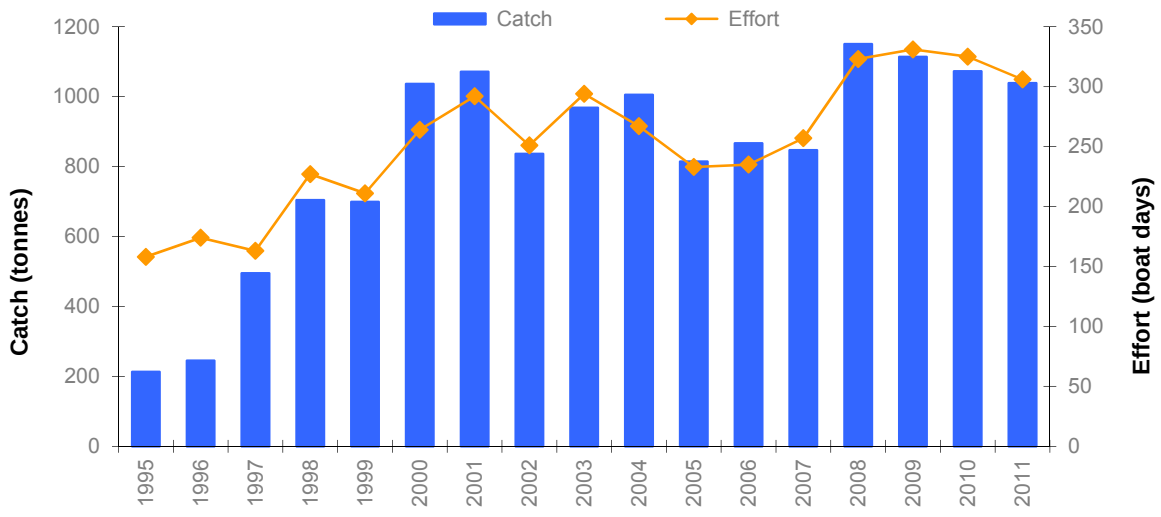

Figure 3. Total catch and effort within the commercial Finfish Trawl Fishery, 1995 to 2011

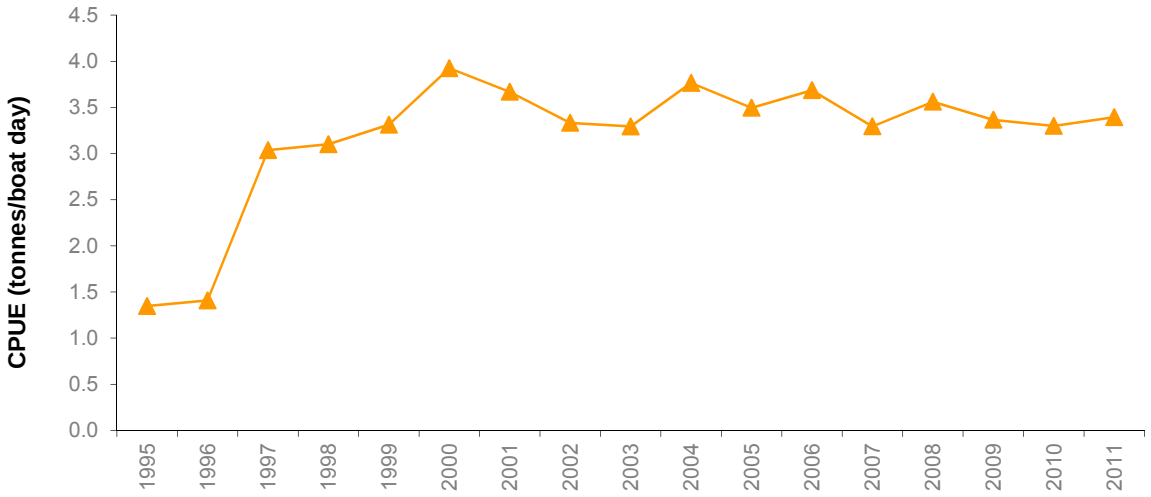

Figure 4. Commercial catch per unit effort (CPUE) for the Finfish Trawl Fishery, 1995 to 2011

Marketing

The product is transported from Darwin in refrigerated trucks to southern markets where 80% of it is sold as fresh fish. The remaining 20% is exported to Asia and North America.

Recreational Sector

Recreational fishers take some of the same species from inshore waters, particularly saddletail snapper, crimson snapper and red emperor. Due to the spatial separation the interaction between recreational fishers and the Finfish Trawl licensee is negligible.

Fishing Tour Operator Sector

The majority of Fishing Tour Operator (FTO) activity occurs in inshore waters where small catches of the same species are taken particularly saddletail snapper, crimson snapper and red emperor. Again, due to the spatial separation the interaction between recreational fishers and the Finfish Trawl licensee is negligible.

Non-retained Species

On average 13% of the total catch was discarded in 2011. NT Fisheries monitoring indicate that the discarded species are mainly from the Carangidae family (trevally and scads).

The presence of larger species, such as sharks and rays, has declined coincidental with improvements in design of the Bycatch Reduction Device (BRD). The operator has developed a system comprising grids and rails on the fish hopper to enable sharks and rays to be returned alive to the water via a chute. The hopper system is being evaluated by other trawl fisheries interstate with the intention of incorporating its use as standard operating practice. Additionally, the operator has been refining the design of the BRD to exclude large sharks and rays from the landed catch and assist in improving product quality.

Threatened Species Interaction

In 2011, there was only one interaction with a threatened, endangered or protected (TEP) species and the relevant Territory and Australian government agencies were notified. This event was unusual as there have been typically no, or very few, TEP interactions since the introduction of the BRD.

Ecosystem Impact

NT Fisheries has encouraged fishing practices that cause minimal impact to the ecosystem.

The semi-pelagic demersal trawl net developed in conjunction with the industry minimises seabed disturbance and reduces the amount of bycatch and environmental impact in the fishery. The use of a BRD in conjunction with the square-mesh funnel/codend is expected to further reduce any broader ecosystem impacts.

Social Impact

This fishery directly employs fewer than 10 people. However, there are flow-on benefits from the fishery for other industries, such as freight haulage, gear storage and vessel repairs. Recreational fishers also target some of the same species (from inshore waters) and recreational fishing forms an important component of the lifestyles and culture of a large proportion of people residing in the NT.

Economic Impact

Confidentiality constraints prevent the publication of the economic value of this fishery.

STOCK ASSESSMENT

Monitoring

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

In addition to logbooks, NT Fisheries researchers conduct onboard monitoring of commercial fishing trips. While on board, researchers document vessel and gear information, location, depth, fishing practices, catch composition (including bycatch), and where possible, measure most landed species.

One monitoring trip was undertaken in 2011. This level of monitoring is considered adequate given the single operator, relatively low levels of bycatch and the proactive approach to reduce the level of bycatch.

Stock Assessment Methods and Reliability

Stock assessments for the fishery were conducted in 1996 and 2004. The initial assessment used a stock reduction analysis model developed by Professor Carl Walters (Ramm 1997). The more recent assessment used yield per recruit and biomass dynamics models, which incorporated updated biological parameters (Blaber et al. 2005).

Despite genetic studies showing some separation of saddletail snapper (*L. malabaricus*) stocks between Australia and Indonesia, separation of crimson snapper (*L. erythropterus*) stocks is less certain, especially in the eastern Arafura Sea. Some stocks are currently fished by both countries (Blaber et al. 2005; Salini et al. 2006). An absolute figure cannot be placed on sustainable harvest for the fishery because some key parameters (Indonesian catch and effort and level of interchange of fish and recruits) are not well known.

For the Australian sector of the Arafura Sea, the biomass of red snappers was estimated by a fishery-independent survey in 1990 to be 24 000 tonnes. It has been agreed that a harvest level trigger of 10% of this estimate be implemented for management purposes. Additional age data are currently being collected for inclusion in stock assessment models to assist in determining more refined sustainable yield estimates for the red snapper species group (see Current Research).

Current Harvest Status

The high level of Indonesian trawl fishing in the Arafura Sea adjacent to the AFZ should not imply that the Australian sector is unsustainable. The future sustainability of the Australian sector of this fishery depends on where recruitment occurs

and the level of movement of fish between the two countries. However, there is lack of information on recruitment and the movement of snappers prior to recruitment (larval and juvenile stages). Better information on juvenile habitats, movements and biological characteristics will assist in determining the interaction between Australian and Indonesian fishing on red snapper populations.

Over the past 10 years, CPUE has remained relatively constant (Figure 4) and harvest levels in the Australian sector of the Arafura Sea are below current reference points (Table 1).

Future Assessment Needs

The future assessment needs for red snapper research have been identified at a national level through the Northern Australian Fisheries Management Forum.

The following areas were assessed as of high priority:

- Completing an updated red snapper stock assessment
- Warehousing for historical data
- Conducting fishery-independent surveys
- Identifying juvenile habitats
- Investigating the degree of movement of red snappers
- Investigating the effect of illegal, unreported and unregulated fishing on red snapper stocks

Several of these priorities have been addressed through a collaborative project led by Fisheries Queensland, a division of the Queensland Department of Employment, Economic Development and Innovation (O'Neill et al. 2011). The project evaluated the utility of current monitoring and logbook datasets for stock assessment and provided background information to enable the development of a survey program to provide fishery-independent data for red snapper assessment. The first NT survey is expected to commence in 2013.

Assessments on the status of red snapper species, that incorporate logbook and biological data as well as the fishery-independent data gathered in forthcoming surveys, will be conducted in the near future.

RESEARCH

Summary

A joint project between NT Fisheries, CSIRO and Indonesia, funded by ACIAR, investigated the biology, life history and sustainability of the target species (*Lutjanus malabaricus* and *L. erythropterus*) for this fishery, which account for 75% of the Finfish Trawl Fishery catch. Genetic studies conducted as part of this project provide some evidence that separate stocks of *L. malabaricus* exist between Australia and Indonesia, but that stocks of *L. erythropterus* are less able to be separated genetically, especially in the eastern areas of the Arafura Sea (Salini et al. 2006). Future research will need to consider that although there appears to be some separation of stocks, in some instances the same stocks are fished by both countries. In addition, information on the movement of snappers prior to recruitment to the fishery (larval and juvenile stages) is lacking. Better information on juvenile habitats, movements and biological characteristics will extend our knowledge of the poorly-understood early life history of red snapper species (Salini et al. 2006).

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. Collaboration with Queensland, Western Australia and Indonesia will continue to provide information on the management of snapper stocks.

Current Research

Current research is focussed on obtaining more comprehensive age data for the red snapper species. The survey program (noted above) is expected to provide annual, spatially-referenced age data and an index of relative abundance for the offshore snapper species across northern Australia. The data will provide essential information for establishing annual harvest rates and, in turn, ensure greater certainty in stock assessments.

On-going research on the effectiveness of bycatch reduction devices is being conducted by the Finfish Trawl Fishery operator.

MANAGEMENT/GOVERNANCE

Management

Objective

The management of the fishery seeks to ensure the ecological sustainability of target, byproduct and bycatch species. Trigger points and management actions for the 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 of 1995, management of the trawl, net and line fishing and trapping in waters adjacent to the NT passed to NTFJA.

NTFJA provides for the Australian and NT governments to jointly manage the fishery given the likelihood of shared resources with adjacent national and international jurisdictions. NT Fisheries conducts the day-to-day management of the fishery on behalf of NTFJA.

Current Issues

The impacts of illegal, unreported and unregulated (IUU) fishing in northern Australian waters, primarily by foreign fishers remain poorly understood. NT Fisheries continues to work with the Australian Government to ensure appropriate programs are implemented to mitigate IUU impacts on the sustainability of red snapper stocks. It is not yet possible to determine the potential effect IUU fishing is having on the tightly-regulated domestic fishery.

An Offshore Snapper Advisory Group (OSAG), comprising members from industry, recreational and FTO representatives, compliance and departmental officers was established in 2010 to develop a comprehensive policy and management framework incorporating a mechanism to better utilise the red snapper resources.

OSAG considered public comments received from stakeholders and interested parties during 2008-09, which in the main indicated support for the introduction of Individual Transferable Quotas to facilitate the development of the offshore snapper fisheries.

Future Plans

A management framework addressing the above points has been developed by OSAG and was endorsed for implementation by the NTFJA in November 2011. Amended regulations, incorporating the amalgamation of gears in this fishery into the Demersal Fishery (with which it shares stocks) have been drafted and the administrative processes to embed them in legislation are underway. It is expected the draft regulations would be approved and implemented in early 2012.

The NT and Australian governments continue to work closely with the Indonesian Government to develop a bilateral management plan for shared red snapper stocks in the Arafura Sea.

Compliance

The Water Police Section (WPS) of the NT Police, Fire and Emergency Services is responsible for compliance and enforcement for all fisheries in the NT *Fisheries Act 1988*. WPS inspect vessels on arrival and departure through the port of Darwin, and verify catch returns

against processor returns. If necessary, WPS has the power to investigate the records of wholesalers and licensees.

The Commissioner of Police is currently considering engaging the Australian Fisheries Management Authority (AFMA) to undertake specific compliance services on their behalf in relation to the Finfish Trawl Fishery. It is the intention that the administrative, operational and 'day to day' compliance aspects of the fishery be undertaken by AFMA.

A compliance risk assessment has been undertaken for the fishery. No major domestic fishery issues were identified.

In 2011, there were no recorded compliance issues in this fishery.

Consultation, Communication and Education

Joint industry/government forums are used to consult with the single Finfish Trawl Fishery operator. NT Fisheries also produces publications, such as Fishery Reports, Fishnotes and newsletters, to inform stakeholders.

NT Fisheries staff regularly visit the wharf to speak informally with fishers on operational matters.

Senior Research Scientist - Dr Julie Martin
Aquatic Resource Manager – Mr David McKey

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Table 1. Management objectives and harvest status against performance indicators for the Finfish Trawl Fishery for 2011

Species or group	Management objectives	Performance indicator	Trigger reference point (TRP)	Current status review	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.	Combined Finfish Trawl and Demersal fisheries catch levels increase to 2500 tonnes over the next calendar year. Catch levels decline by 30% over the next calendar year (Finfish Trawl only).	Combined red snapper catches in 2011 were 779 tonnes - TRP not reached.	Stakeholders are currently reviewing the fishery (refer 'Future Plans' section) and making recommendations to the Executive Director of Fisheries (EDF) 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 by-product 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%.	Byproduct accounted for 25% of the harvest in 2011: 25% - TRP not reached.	Stakeholders to review fishery and make recommendations to the EDF. 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.	Bycatch at 13% in 2011 and no identifiable decline in a species relative numbers observed - TRP not reached.	1) Stakeholders to make recommendations to the EDF regarding appropriate remedial action. Amended arrangements to be implemented within 12 months of trigger being released.
Threatened, endangered or protected species and/or communities	Ensure the continued protection of species and communities listed under the EPBC Act and the *Territory Wildlife and Conservation Act 2001*.	Threatened, endangered or protected species and or communities are identified in NT waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC Act listed species or communities.	No identifiable impacts have been observed in 2011 - TRP not reached.	As per 1) above.
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.	No negative ecosystem interactions were identified - TRP not reached.	As per 1) above.

MUD CRAB FISHERY STATUS REPORT 2011

INTRODUCTION

The Mud Crab Fishery is one of the key Northern Territory (NT) wild harvest fisheries. In 2011, the commercial wild harvest sector caught 397 tonnes of mud crabs valued at $7.9 million.

Surveys conducted in 2000 and 2001 also highlighted the importance of the mud crab resource to recreational and Indigenous fishers, who harvested 82 000 and 86 500 crabs respectively (with a combined weight of about 135 tonnes) in a 12-month period (Henry and Lyle 2003).

Four species of mud crabs have been identified from the Indo-west Pacific region, two of which are found in NT waters. The giant mud crab (*Scylla serrata*) accounts for over 99% of the catch from all sectors, while the orange mud crab (*S. olivacea*) constitutes the remainder. There is little byproduct or bycatch in this fishery due to the highly selective gear used to target large mud crabs.

The fishery was assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in 2007. Full export exempt accreditation was subsequently granted under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment demonstrated that the fishery is managed in a manner that does not lead to overfishing, and that fishing operations have minimal impact on the structure, function, productivity and biological diversity of the ecosystem. The fishery is due for reassessment in 2012.

PROFILE OF THE FISHERY

Commercial Sector

Area

The fishery operates in tidal waters between the Queensland and Western Australian borders, with most activity concentrated in the Gulf of Carpentaria. Some fishers also operate along the north Arnhem coast, Van Diemen Gulf, Chambers Bay and west to Anson Bay. Crabbing operations are confined to coastal and estuarine areas, predominantly on mud flats. Commercial mud crab fishing is not permitted in Darwin Harbour, in most creeks adjoining Shoal Bay, Leaders Creek or the waterways of Kakadu National Park.

Small mesh nets may be used under a restricted bait net entitlement to harvest fish for use as crab bait. The nets may only be set in the open sea within 3 nautical miles of the coast and the fisher must attend the net at all times. The use of bait nets is prohibited between Bing Bong and the Queensland border and in a number of other areas around the coast. Commercial fishers appear to be increasing the use of purchased bait and decreasing the amount of time spent netting for bait.

Fishing Method

Many commercial crab fishers work from isolated, rudimentary land-based camps, although some access remote waters using mother-ships or permanently-moored pontoons. Crabbers may travel more than 100 km to set their pots and then stay in the same area for a number of days before returning to their base to unload the catch.

Crab pots are baited with fresh meat or fish and set in estuarine and coastal waters. Pots must have a float (with unit number inscribed) attached and must not exceed 0.5 m³ in volume or 1 m in any dimension. Commercial fishers adopted 75 mm x 50 mm galvanised wire mesh as a pot construction material during the early development of the fishery. Whilst legislation was

later passed to set the minimum mesh dimensions for pots used by this sector at 65 mm x 45 mm, the aforementioned wire mesh remains the industry standard.

Pots are generally checked on each daylight high tide. However, if tides and other conditions are favourable, they may be checked again later that day or even at night. Such events are referred to below as 'double potlift days.

Pots are manually hauled into dinghies and each crab is checked to ensure that it is above the minimum legal size, not berried (i.e. with eggs attached) and is commercially suitable. The last condition is an industry initiative to ensure that no empty (i.e. low meat content) mud crabs are harvested and to reduce mortality during transport, thereby maintaining the reputation and high market value of NT mud crabs.

Catch

In 2011, 397 tonnes of mud crabs were harvested by the commercial fishery (Figure 1). Ten years earlier, the annual commercial mud crab catch exceeded 1000 tonnes. It is believed that those exceptional catches were due to high recruitment during favourable environmental conditions. The introduction of the commercially unsuitable crab rule, or 'soft crab', in 2001 also explains some of the decline in catch and catch per unit effort (CPUE) since that time.

Both male and female mud crabs can be retained in the NT. The minimum legal size (MLS) - measured across the widest part of the carapace - for commercially harvested mud crabs was increased in May 2006 from 13 cm to 14 cm for males and from 14 cm to 15 cm for females. This measure was taken in response to recommendations in the 2004 NT Mud Crab Stock Assessment Report (Haddon et al. 2004). The change resulted in a decline in the 2006 catch compared with that in 2005 (noting that the new MLS was in place for the last eight months of 2006). The 2011 catch was almost identical to that in 2010 (393 tonnes), the difference being just over 1%.

Byproduct of commercial crabbing operations in 2011 accounted for 84 kg of cod, 21 kg of catfish, 12 kg of bream, 9 kg of snapper and 2 kg of sharks, the bulk of which was used to bait pots. No bycatch was reported in the 2011 logbook returns. Refer to the Non-retained Species Section for further information on byproduct and bycatch.

Effort

The commercial sector of the fishery is restricted to 49 individual licences and each is allocated two units of entitlement valued at 30 pots each. Fishers can now lease any number of these units (although four appears to be the practical maximum) but can only fish once they have at least two units attached to a licence. This system is more cost effective for crabbers wishing to use 90 pots as they no longer need to lease or purchase two licences to do so. There has been no additional effort introduced into the fishery. All licences were fully utilised in 2011.

Total reported effort in 2011 was 683 729 potlifts (Figure 1), which represented a 7% decline on the 2010 figure. The proportion of double potlift days ranged from 15% to 18% between 2000 and 2004, but has since dropped to about half that level, fluctuating between 4% and 9% for the period 2005 to 2011.

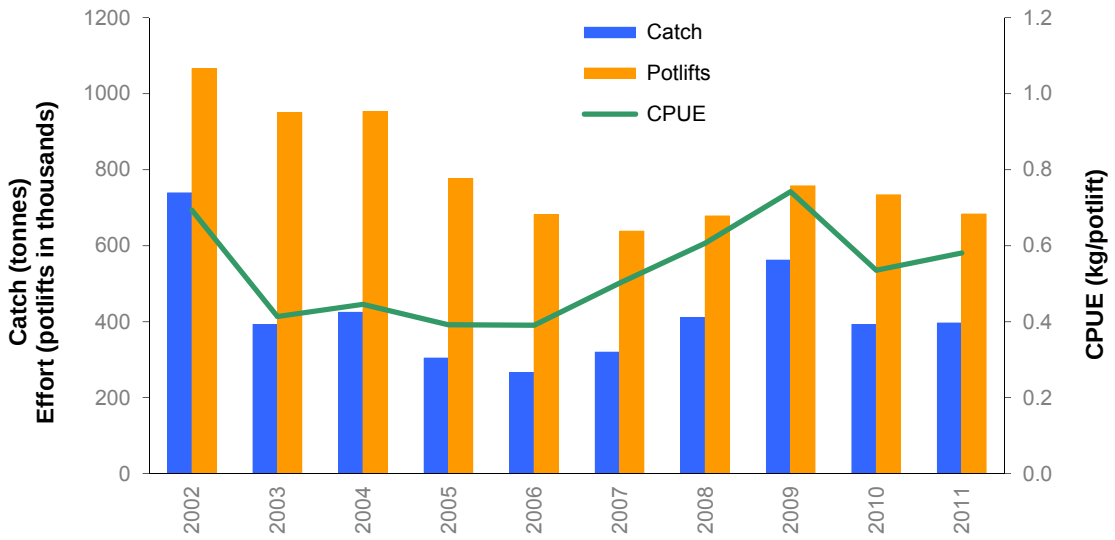

Figure 1. Catch and per unit effort (CPUE) for the NT commercial Mud Crab Fishery, 2002 to 2011

Catch Rates

CPUE in 2011 equated to 0.58 kg per pot-lift (Figure 1), which represents a 7% increase on the 2010 figure. During the first decade of the fishery, catch rates remained relatively stable with an average of 0.35 kg per potlift (data prior to 2002 is not shown). CPUE increased to 0.65 kg per potlift in 1996, eventually reaching 1.12 kg per potlift in 2001. That peak was followed by a decline and then a plateau (at around 0.40 kg per potlift) from 2003 to 2006. CPUE has remained at, or above, 0.50 kg per potlift since 2007.

Marketing

Mud crabs are premium seafood, with a strong demand for live product from Sydney and Melbourne markets. Live mud crabs are transported to Darwin from around the NT coast (at least weekly, by truck), cleaned and sorted by size, sex and condition, then air-freighted to southern markets. Whilst the fishery does have export approval domestic demand typically exceeds supply and profit margins are generally greater for product sold interstate rather than overseas. For this reason, very little of the NT mud crab catch has been sent to overseas markets in the last decade.

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 of recreational anglers in 1995 and 2000 found that most of the crabbing activity occurred in the Darwin Harbour/Shoal Bay area, the McArthur River and the Roper River (Coleman 1998; Coleman 2004).

Fishing Method

Recreational mud crab fishers are subject to similar gear controls (in terms of markings and pot dimensions) as commercial fishers but there is no restriction on pot mesh size for this sector. Most recreational mud crab fishers use collapsible polyethylene (PE) mesh pots with mesh sizes ranging from 25 mm x 25 mm to 50 mm x 50 mm.

Dillies, which consist of a panel of mesh on a steel frame that is baited and set on substrate, may also be used, but must not be constructed in such a way that would cause entanglement of mud crabs or other aquatic life.

A gear restriction of five pots (or dillies) 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

The MLS for recreational mud crabbers is 13 cm for males and 14 cm for females. Berried female mud crabs cannot be taken and must be released at the point of capture.

There are no restrictions on the take of 'soft' (or empty) mud crabs by the recreational sector; however, Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) has produced extension material (*Fishnote* 28) that encourages the testing and release of such crabs.

The 2001 National Recreational and Indigenous Fishing Survey (Henry and Lyle 2003) indicated that recreational fishers harvested over 82 000 mud crabs (about 65 tonnes) from January to December 2000, with 74% (or about 61 000) of them caught in the Darwin Harbour/Shoal Bay area (Coleman 2004).

Effort

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

In 2000, recreational fishing for 'non fish' species (e.g. shellfish, crabs and squid) totalled 303 033 hours and accounted for 17% of the total recreational fishing effort. However, targeted fishing for mud crabs was not quantified. Over 50% of the total fishing effort for 'non fish' species occurred in the Darwin Harbour area (Coleman 2004).

Catch Rates

The catch rate when fishing for species 'other than fish' (including mud crabs) was 0.4 individuals per hour in 2000 (Henry and Lyle 2003).

Fishing Tour Operator Sector

Area

Fishing Tour Operators (FTOs) must have a licence to operate in NT waters and their clients are subject to the same controls as recreational fishers. They are restricted to waters of tidal influence, excluding those in Kakadu National Park.

Fishing Method

FTO clients employ the same harvest methods and are subject to the same MLS, pot and possession limits as recreational fishers. Over 94% of all crabs caught by FTO clients are taken using pots.

Catch

In 2011, the FTO sector landed 1948 mud crabs, of which 1267 (or 65%) were harvested. While the number of crabs caught and harvested by this sector can vary by more than 100% from year to year, the harvest rate has been relatively stable, ranging from 55 to 70% over the past 10 years. Excluding the year 2006 (i.e. when the annual catch for commercial fishers was comparatively low) narrows the range of harvest rate estimates for this period from 62 to 70%.

Effort

In 2011, FTO clients spent 3846 hours of fishing effort targeting mud crabs. This represents a 14% increase on the 2010 figure of 3387 hours but a 30% decrease on the 2009 estimate of 5539 hours. Such interannual variability in mud crab fishing effort is not uncommon in the FTO sector and is influenced by several factors, which may or may not include the abundance of mud crabs.

It should also be noted that targeted fishing for mud crabs by FTO clients is considered a secondary activity, accounting for just 2 to 4% of the total time spent fishing by this group.

Catch Rates

CPUE and harvest per unit effort of mud crabs by FTO clients in 2011 was 0.51 and 0.33 crabs per hour, respectively. Both estimates are the highest reported in the last ten years.

More information for the sector can be found in the Fishing Tour Operator Fishery Status Report in this publication.

Indigenous Sector

Area

Most fishing effort is localised and centred close to Aboriginal 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 favourite food of coastal Aboriginal Australians, who consume most of their catch. The Indigenous harvest over a 12 month period in 2000-01 was approximately 86 000 crabs or about 69 tonnes (Henry and Lyle 2003). Aboriginal groups now own a number of commercial licences, thereby providing employment, income and fresh food for local communities.

Non-retained Species

Rigid galvanised wire mesh pots (as used to varying degrees by all sectors) retain little bycatch. For example, recent potting trials by NT Fisheries caught just 19 individual fishes (90% of which were catfish) from 1471 hauls of this gear in the Roper River (Grubert, unpublished). This equates to a bycatch rate of 1.3 fishes per 100 potlifts.

Much of the piscine bycatch (such as catfish and cods) retained in commercial pots is subsequently used to bait pots so there is little if any wastage.

Bycatch retention in collapsible PE mesh pots (mesh size 25 mm x 25 mm), as used by many recreational fishers, appears to be higher. A total of 393 individual fish (primarily toadfish [48%] and catfish [35%]) were retained in 2713 hauls of this gear in the Adelaide and Roper rivers (Grubert, unpublished). This equates to a bycatch rate of 14 fishes per 100 potlifts; however, it must be noted that the bulk of the crabbing using PE mesh pots was undertaken in the Adelaide River (as opposed to the Roper River in the previous example) and so location effects may have a bearing on the above comparison.

Some other invertebrates (mostly other crab species) are also retained in mud crab pots. Examples include blue swimmer crabs, hermit crabs and mangrove crabs (Hay et al. 2005; Grubert unpublished). Of these, only blue swimmer crabs are harvested for consumption.

The primary methods used by Aboriginal fishers to catch mud crabs (i.e. hand collection and spearing) are extremely selective, with negligible bycatch.

Threatened Species Interaction

There were no reported interactions with threatened, endangered or protected species in the fishery in 2011.

Ecosystem Impact

The fishery has minimal impact on the benthic environment due to passive fishing methods that effectively target large mud crabs.

SEWPaC has reviewed the impacts of the fishery and considers that the current level of mud crab harvest is unlikely to significantly impact on the ecosystem.

Social Impact

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

Crabbing operations may also benefit landholders, as crabbing camps may incur access fees, 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. Whilst difficult to quantify, money spent by recreational fishers in

the pursuit of mud crabs contributes to employment in the FTO, tackle and hospitality sectors.

Economic Impact

In 2011, the NT commercial mud crab catch was 397 tonnes, valued at $7.93 million.

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

STOCK ASSESSMENT

Monitoring

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

Time series analysis of carapace width data collected from the commercial fishery reveals a small decline in the mean size of both male and female crabs harvested in most regions. Such trends are often observed in harvested stocks, thereby necessitating the use of MLS to ensure that a sufficient proportion of the stock has the opportunity to reproduce prior to removal.

Stock Assessment Methods and Reliability

Various modelling approaches have been applied to the NT Mud Crab Fishery during six stock assessment workshops held between 1996 and 2011.

The first assessment (Walters et al. 1997) found that exploitation rates in fished areas were as high as 70 to 90% of the available stock, leading the authors to describe the fishery as fully developed from a management perspective.

The assessment by Haddon et al. (2004) revealed that catch rates in 2004 were similar to those prior to 1996; however, effort had spread along more of the coastline and the number of fishing days had increased, thereby creating a greater reliance on new recruits to the fishery.

Ward et al. (2007) examined the effect of the 10 mm increase in MLS for the commercial sector (which came into effect on 1 May 2006) using data to December 2006. Their analyses suggested that a 10 mm increase was warranted and protected about four times as many small crabs as the alternative 5 mm increase in MLS. The authors also stressed that the eight month sampling interval following the change in MLS was insufficient to allow full expression of the effects of the management intervention.

The most recent assessment (Walters, unpublished) produced estimates of fishing mortality (*F*) between 1.0 and 2.0 per year (similar to those derived in earlier assessments). Reversion to the previous MLSs for the commercial fishery was discouraged based on the likelihood of compromising egg production for a minor increase in yield per recruit.

Current Harvest Status

All recent assessments indicate that the NT Mud Crab Fishery is fully developed.

Future Assessment

The results of the 2011 NT Mud Crab Fishery stock assessment will be published in 2012. Another stock assessment will take place within the next five years.

RESEARCH

Summary

Mud crab research in the NT began in the early 1990s and gathered momentum as the catch and value of the fishery grew. The PhD thesis by Knuckey (1999) provides a detailed overview of the reproductive biology and population dynamics of mud crabs in several NT river systems and serves as a valuable reference work for comparison with contemporary studies.

The next major project developed methods to estimate the relative abundance of mud crabs in two different habitat types (i.e. coastal mud flats and mangrove lined rivers) using a combination of depletion and tag-recapture experiments (Hay et al. 2005). Total mud crab abundance was then estimated by multiplying the relative abundance of mud crabs in each habitat by the total area of habitat (derived from satellite imagery). Much of the data collected during this work has been utilised in subsequent stock assessments.

More recent work (undertaken in the last five years) has focused on developing methods to survey juvenile mud crabs, evaluating durometers as a means of quantifying shell hardness of early inter-moult crabs, describing links between mud crab catches and environmental drivers, such as rainfall and temperature (Meynecke 2011), and reducing bycatch of undersized mud crabs and non-target species through the use of escape vents.

Incorporation into Management

NT Fisheries reviews results of all research programs annually. Any pertinent issues identified by research will be discussed by the Mud Crab Fishery Management Advisory Committee (MCFMAC). Pending discussions with key stakeholders, changes to the regulatory controls in the Mud Crab Fishery Management Plan (MCFMP) may be required for one or all fishing sectors.

Current Research

The NT Fisheries and FRDC project "Improving gear selectivity in Australian mud crab fisheries" continued into 2011. Field work was completed in May, with the final project report due for publication in 2012. Preliminary results from this work suggest that fitting two escape vents to crab pots can decrease the retention of under-sized mud crabs by as much as 40%, depending on the size structure of the local crab population (Grubert unpublished). The use of these devices can increase the catch of legal-sized crabs by up to 15%. The likely mechanism for this is a reduction in trap saturation effects which occur where captive crabs that are just below the MLS may deter the entry of crabs that are just above the MLS.

A survey of recreational fishing in the NT began in April 2009. It will quantify resident and visitor catch, harvest, effort and expenditure. Results from this survey will be available in 2012 and provide a more current understanding of the recreational harvest of mud crabs.

MANAGEMENT/GOVERNANCE

Management

Objective

A range of fishery objectives with performance indicators have been agreed by MCFMAC to ensure that the fishery remains sustainable. Trigger reference points and status of the fishery against the performance indicators are presented in Table 1.

History

Conservative management, focusing on containing fishing effort and protection of breeding stocks through an MLS, has been adopted in the fishery. Since 1991, the fishery has been controlled under MCFMP. Amendments were made to MCFMP in 1993 relating to non-retention of berried females and again in 1995 relating to a 10 mm increase in MLS for females to protect breeding stocks. An "in possession" limit of a maximum of 10 mud crabs per person applies in the recreational sector, with a vessel limit of 30 mud crabs if there are three or more people on board. The MLS for both sexes of commercially harvested mud crabs was increased by 10 mm on 1 May 2006.

The main trigger points for this fishery relate to pronounced changes in catch, effort or mean size of crabs. Management arrangements will be reviewed under the following circumstances: the catch declines by 50% in any one year or by 10% per year over two consecutive years; total effort increases by 10% per year over two consecutive years; or median carapace width decreases by 5 mm per year over two consecutive years. Should any such changes occur, MCFMAC will assess

the situation and provide advice to the Executive Director of Fisheries.

Current Issues

The fishery appears to have entered a stabilisation phase with catches around 400 to 500 tonnes and CPUE around 0.50 to 0.75 kg per potlift for the last five years. As such, the main issues in the fishery at present relate to non-compliance and licensing arrangements, as opposed to the status of the stock.

Based on advice from MCFMAC, management arrangements were revised in 2010 to unitise entitlements in the fishery and strengthen penalties for non-compliance with MCFMP. Each of the existing licences was allocated two units of entitlement (currently valued at 30 pots each), which are transferable on a temporary basis to other licences in the fishery. The arrangement provides greater flexibility for operators to increase their individual pot entitlements, while the fishery overall continues to be managed within existing sustainability limits. A stronger penalty regime was also introduced with respect to the take of undersized and commercially unsuitable crabs and for over potting.

In late 2007, the fishery was reassessed by SEWPaC against the Guidelines for the Ecologically Sustainable Management of Fisheries. As a result, the fishery received full export exempt accreditation under the EPBC Act. The assessment demonstrated that the fishery was managed in a manner that does not lead to overfishing and that fishing operations have minimal impact on the structure, productivity, function and biological diversity of the ecosystem. SEWPaC has recommended that a range of additional tasks and measures be implemented before the next assessment in 2012. These include an ecological risk assessment and a review of the compliance risk assessment for the fishery.

Future Plans

MCFMAC will meet as necessary to discuss future research needs and management arrangements for the fishery.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services is responsible for all fisheries compliance and enforcement in the NT. Key compliance issues in the fishery include the illegal take of undersized and commercially unsuitable crabs.

Consultation, Communication and Education

MCFMAC consists of representatives from NT Fisheries, the Mud Crab Licensee Committee, the Amateur Fishermen's Association of the NT, the NT Guided Fishing Industry Association and the Northern Land Council. It provides advice on issues relevant to the fishery.

Prior to commencing fishing operations, all new entrants to the commercial fishery must attend an interview with the Aquatic Resource Management Officer responsible for the fishery. The 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.

Senior Research Scientist - Dr Mark Grubert
Aquatic Resource Management Officer – Ms Patti Kuhl

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Table 1. Management objectives and harvest status against performance indicators for the Mud Crab Fishery for 2011

Ecosystem component	Management objective	Performance indicator	Trigger reference point/s (TRP)	Status of ecosystem components in 2011	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 ↓ by 50% in any one year.	Commercial catch ↑ 1% between 2010 and 2011 - TRP not reached.	MCFMAC to review fishery and make recommendations to the Executive Director of Fisheries (EDF) to ensure that the mud crab resource is harvested in an ecologically sustainable manner. Within three months of becoming aware of the TRP being reached, a timetable for appropriate management responses will be developed.
		Significant increase in fishing effort.	Commercial fishing effort increases by (↑) 10% per annum for two or more consecutive years.	Commercial fishing effort ↓ 7% between 2010 and 2011 - TRP not reached.	
		Significant decrease in the median size of mud crabs.	Median size of mud crabs ↓ by 5 mm per annum for two or more consecutive years.	Size monitoring of commercial catch found no change in median size - TRP not reached.	
Byproduct species	1) Ensure ecological sustainability of byproduct species.	Monitoring of commercial logbook returns.	Byproduct ↑ by more than 0.5 t in any one year period.	Total byproduct harvest was less than 0.2 t in 2011 - TRP not reached.	2) MCFMAC to review fishery and make recommendations to the EDF regarding appropriate remedial action. Within three months of becoming aware of the TRP being reached, a timetable for appropriate management responses will be developed.
Bycatch species	As per 1) above.	Monitoring of commercial crabbing operations.	Bycatch ↑ by more than 50% in any one year or more than 100% in any three year period.	No bycatch reported in 2011 (see notes in non-retained species) - TRP not reached.	As per 2) above.
Threatened, endangered 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.	Threatened, endangered or protected species and/or communities are identified in NT waters.	Identifiable impacts observed by commercial fishers, fisheries observers or other agencies regarding EPBC Act listed species or communities.	No identifiable impacts reported or observed in 2011 - TRP not reached.	MCFMAC to make recommendations to the EDF regarding implementation of a threat abatement plan if required. Within three months of becoming aware of the TRP being reached, a timetable for appropriate management responses will be developed.
Ecosystem components	Minimise effects on ecosystem components.	Identification of threatening processes.	Identification of significant negative interaction with the natural ecosystem within mud crab fishing grounds.	No significant negative interactions reported or observed in 2011 - TRP not reached.	As per 2) above.

OFFSHORE NET AND LINE FISHERY STATUS REPORT 2011

INTRODUCTION

The commercial Offshore Net and Line Fishery (ONLF) targets blacktip sharks (*Carcharhinus tilstoni, C. limbatus and C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*). A variety of other sharks and pelagic finfish are also caught as byproduct.

The fishery was assessed against the Guidelines for the Sustainable Management of Fisheries by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in late 2007. An approved Wildlife Trade Operation (WTO) was subsequently issued under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The assessment demonstrated that the fishery was managed in a way that did not lead to overfishing and that fishing operations had minimal impact on the structure, productivity, function and biological diversity of the ecosystem. The fishery is due for reassessed in late 2012.

The NT actively supports the implementation of the National Plan of Action for Sharks (NPOA Sharks) and coordinates the northern response for the requirements of the Operational Plan for the Sustainable Use of Northern Australian Shark Resources. Cooperative research efforts are being conducted with Western Australia and Queensland. Information and samples collected from this fishery also support a number of universities and Government-sponsored research projects.

PROFILE OF THE FISHERY

Commercial Sector

Area

Licensees are authorised to fish in NT waters from the high water mark to the boundary of the Australian Fishing Zone (AFZ), an area of more than 522 000 km^2, with spatial restrictions placed on the use of certain gear. Demersal long lines may be used from the coastline to the AFZ; pelagic long lines may be used from 3 nm from the coast to the boundary of the AFZ and pelagic nets from 2 nm from the low water mark to the boundary of the AFZ. Most of the fishing is undertaken in the coastal zone (within 12 nm of the coast or baseline) and immediately offshore in the Gulf of Carpentaria. As in previous years, little fishing was undertaken in the offshore area of the fishery during 2011.

Fishing Method

Operators may use demersal or pelagic long lines or pelagic nets. The use of bottom-set gillnets is prohibited and pelagic long lines are currently not used by any operator. Most of the fishing is undertaken by pelagic gillnets. Although the legal maximum length of nets is 2000 m, for operational reasons, they are generally 1000 to 2000 m long, with a mesh size of 160 mm to 185 mm. Most nets are made of monofilament nylon, with a drop of 50 to a maximum 100 meshes. The nets are weighted and have a buoyed headline. The total length of long lines must not exceed 15 nm at any time and must have no more than 1000 snoods (hooks). Automated baiting gear is prohibited.

Catch

Operators in the fishery target blacktip sharks (*Carcharhinus tilstoni, C. limbatus* and *C sorrah*) and grey mackerel. Logbook records indicate a total catch of 1191 tonnes in 2011, a 1.5% decline over the 2010 catch of 1240 tonnes.

In 2011, the *C tilstoni* and *C. limbatus* catch of 217 tonnes represent 18% of total landings, a 37% decline over the 342 tonnes taken in 2010 (Figure 1). The *C. sorrah* catch of 83 tonnes (7% of the total catch) represents a 35% decrease over the 127 tonnes taken in 2009 (Figure 1). While blacktip sharks were the principal target species in 2007 and 2008, grey mackerel were caught in substantially higher numbers during 2009, 2010 and 2011; the 2011 grey mackerel catch of 423 tonnes represents 35% of the total

landings, a 6% increase over the 401 tonnes taken in 2010 (Figure 1).

Operators reported that market forces and other operational considerations, such as weather conditions and dedicated shark targeting vessels in 2011 were the main causes of variation in *C. tilstoni, C. limbatus and C, sorrah* catches, thus indicating that variations in catch largely reflect variations in targeting.

A prohibition exists on the possession of sharks and shark products for the Timor Reef, Demersal, Finfish Trawl, and Spanish Mackerel fisheries. Sharks are taken as a limited byproduct in a range of fisheries targeting other species. Such incidental catch of sharks in NT fisheries other than the ONLF is around 1% of the total combined fisheries shark catch across all NT fisheries.

Byproduct Species

The recorded catch of sharks other than blacktip increased by 28% from 332 tonnes in 2010 to 426 tonnes in 2011. Byproduct species principally comprised 143 tonnes of bull sharks (*C. leucas,* 12% of the total catch), 141 tonnes of hammerhead sharks (*Sphyrna* spp., 12% of total catch), 50 tonnes of tiger sharks (*Galeocerdo cuvie,* 4% of the total catch), 45 tonnes of lemon sharks (*Negaprion acutidens,* 4% of the total catch), and 21 tonnes of winghead sharks (*Eusphyra blochii*, 2% of the total catch).

A requirement to explicitly record catches of bull sharks in logbook returns was first made in 2009. Until that time, fishers probably ascribed catches of bull sharks to the pigeye shark or 'other shark' categories. Changes to the logbook created an apparent increase in the catch of bull sharks and a corresponding decline in the catch of the similar looking pigeye sharks. In 2010 and 2011, there were only small catches of pigeye sharks recorded. Based on habitat distribution and fishery monitoring data, it appears that pigeye sharks are being misidentified and recorded as bull sharks. Other byproduct shark species included dusky sharks (*C. obscurus),* milk sharks (*Rhizoprionodon acutus*) and a variety of other carcharhinids (Figure 2).

Non-shark byproduct species landed in 2011 consisted of 26 tonnes of Spanish mackerel (*Scomberomorus commerson)* exceeded the 13.5 tonnes allocated for the fishery, 6 tonnes of longtail tuna (*Thunnus tonggol*); 3.7 tonnes of queenfish (*Scomberoides* spp.); and a combined weight of 10.5 tonnes of other fish species, mainly black pomfret (*Parastromateus niger*) and blue threadfin (*Eleutheronema tetradactylum*) (Figure 2).

Effort

A total of 808 boat days were spent fishing during 2011. This reflects a 1% decline compared with 2010; the effort was well below the peak of 1538 boat days recorded in 2003, which precipitated the introduction of precautionary measures to contain domestic effort in the fishery in 2005 (Figure 1).

It is also important to note that in very remote areas, such as the Top End and the western Gulf of Carpentaria, operational considerations, such as weather and fuel availability, are important contributors to variation in effort.

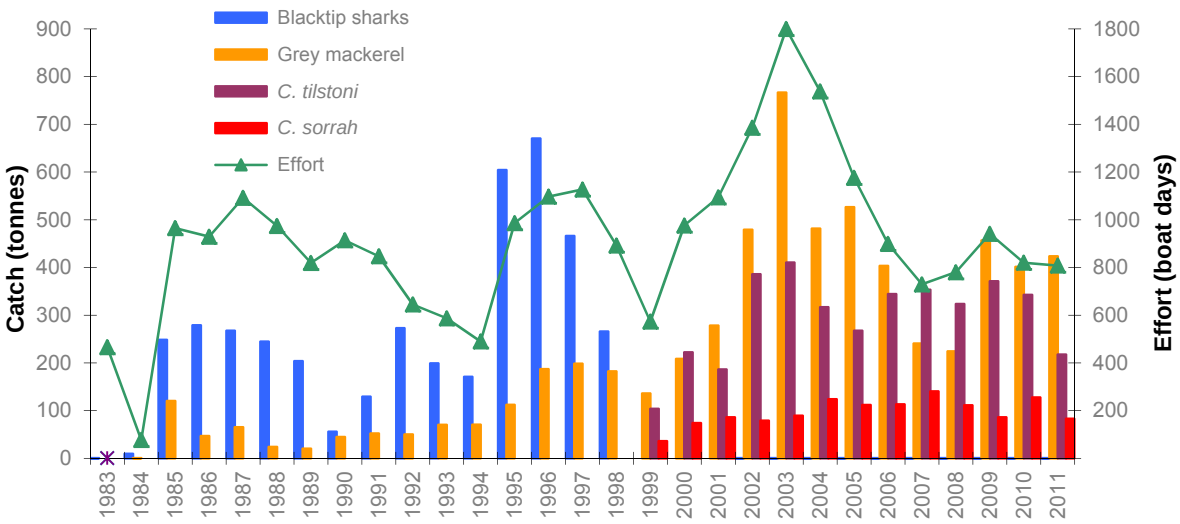

Figure 1. Catches and effort for the target species in the commercial Offshore Net and Line Fishery, 1983 to 2011*

*Note: Black-tip sharks were identified as separate species in commercial logbooks only from 1999. Catches reported for *C. tilstoni* are likely to include *C. limbatus*.

Catch Rates

Catch per unit effort (CPUE) in 2011 was 269 kg/boat day for *C. tilstoni* and *C. limbatus*, and 101 kg/boat day for *C. sorrah,* showing a decrease over the previous year's figure (Figure 3). This decrease is due to a shift away from targeting sharks in 2010 to targeting grey mackerel in 2011.

Grey mackerel catch rates have generally followed a pattern of steady increase from the early 1990s, but experienced a decline in 2007 and 2008. However, CPUE for grey mackerel increased during 2009 to 485 kg/boat day and remained relatively stable in 2010 at 479 kg/boat day and increased again in 2011 at 521 kg/boat day (Figure 3).

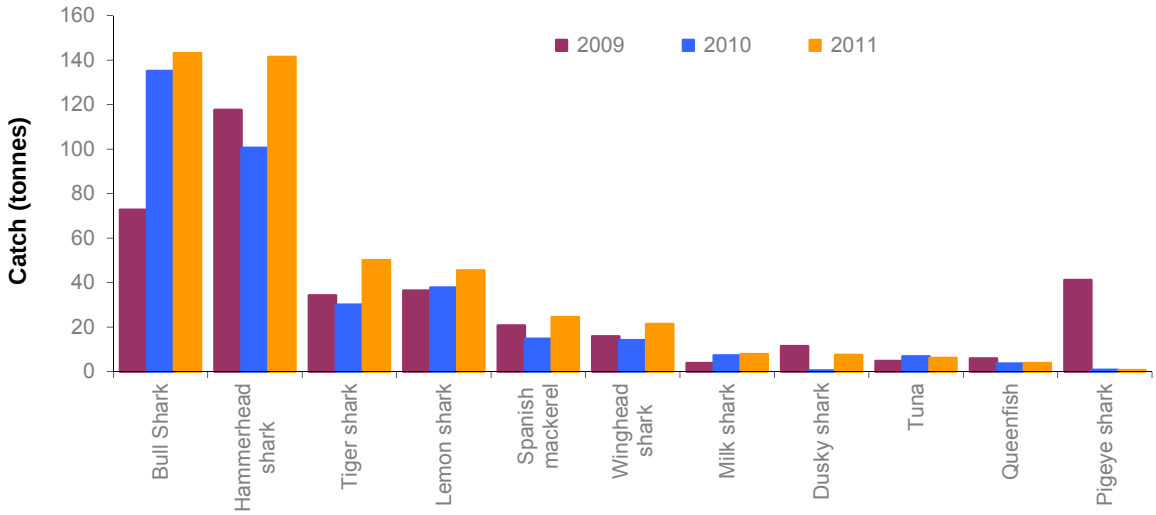

Figure 2. Composition of byproduct species in the Offshore Net and Line Fishery's commercial catch for 2009, 2010 and 2011

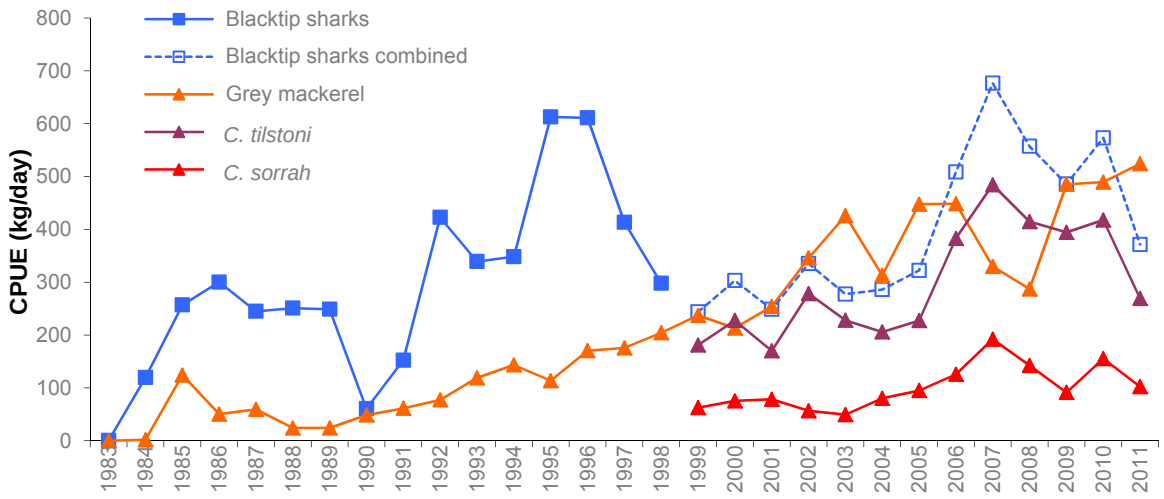

Figure 3. Commercial catch per unit effort (CPUE) for the Offshore Net and Line Fishery target species between 1983 and 2011*

*Note: Black-tip sharks were identified as separate species in commercial logbooks only from 1999.Catches reported for *C. tilstoni* are likely to include *C. limbatus.*

Marketing

Sharks are marketed in trunk, fillet and whole forms, both as fresh and frozen product. Fins are a valuable product but must be landed with a prescribed proportion of shark meat. This condition 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 reportedly earmarked for direct export to overseas markets.

Grey mackerel are marketed domestically as fillet, trunks and whole fish.

Recreational Sector

Area

The significant areas for recreational shark catches are Darwin Harbour, McArthur River and Cobourg Peninsula (Coleman 2004).

For grey mackerel, most of the recreational catch comes from the Vernon Islands, Dundee, Lorna Shoal and the Gove area (Coleman 2004).

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. Grey mackerel are fished by jigging or taken as an incidental catch by anglers trolling lures over reef targeting Spanish mackerel.

Catch

Sharks are generally not targeted by recreational fishers in the NT, but are caught during other targeted fishing activities.

In 2000-01, a survey of recreational fishers found that over 76 000 sharks were caught, with 8000 harvested and the remainder released (Coleman 2004). This indicates a 47% reduction in the proportion harvested compared with 1995. In 1995, over 80 000 individuals were caught; 18% were retained, resulting in a harvest of 15 000 (Coleman 1998).

The survey indicated that barramundi fishing, reef fishing and non-target fishing accounted for 14%, 26% and 52% of the total shark catch, respectively. In 1995, reef fishing and non-target fishing accounted for 74% and 18% of the total

shark catch, respectively. The proportion of sharks harvested depends on the type of fishing undertaken. During non-target fishing, 34% of sharks caught are harvested, whilst reef fishers only harvest 12% (Coleman 2004).

Grey mackerels were not identified as a specific catch in either the 1995 or 2000 recreational fishing surveys. All species of mackerel were reported as one group, including Spanish, grey and spotted mackerel. In 2000-01, the total mackerel catch was 25 233 individuals; 64% of which were released (Coleman 2004).

A comprehensive 12 month survey of recreational fishing in the NT commenced in 2009 and will provide current recreational catch estimates. The results are expected in 2012.

Fishing Tour Operator Sector

Area

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

Catch

In 2011, 6151 sharks were caught by FTOs, representing a 17% increase from the 2010 catch. All of these sharks were released. The species of sharks caught and harvested were not recorded.

In 2011, 864 mackerels (other than Spanish mackerel) were caught by FTOs. Observations from operators suggest that most of them were grey mackerel. Seventy per cent (604) were released. The 2011 mackerel catch represents a 40% decrease from the 1446 caught in 2010.

More information for the sector can be found in the Fishing Tour Operators Fishery Status Report in this publication.

Indigenous Sector

Area

Most Indigenous fishing activity occurs close to communities and outstations, inland or near coastal waters.

Catch

Sharks and rays are among the more important groups of fish caught by Aboriginal 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 (Henry and Lyle 2003). The species of sharks and rays caught and harvested were not identified.

As grey mackerel tend to exist on offshore reefs, they are rarely caught via traditional means by Aboriginal people.

Non-retained Species

Although gillnets are often regarded as non-selective fishing gear, when used by a skilled operator, they are very effective at taking the targeted catch. The amount of bycatch depends strongly on location and season. Most shark species are now retained, apart from the tawny shark (*Nebrius ferrugineus)*, for which there is no market, and protected species. Rays are an uncommon bycatch in the surface-set nets and are usually released alive. Some finfish, for example trevally and queenfish, may be retained.

Threatened Species Interaction

There were two recorded interactions with threatened species in 2011 in this fishery. One hawksbill turtle and one dwarf sawfish were reported captured; were released alive. Data on interactions with threatened, endangered and protected (TEP) species in the fishery has been collected since 2003 as part of the commercial logbook returns process. Gillnets are relatively selective in catching targeted species; however, in the past, incidental captures of some TEP species have been recorded in the fishery.

The NT Seafood Council has developed a Code of Conduct and Code of Practice to assist in minimising the incidental capture of TEP species.

Continued monitoring trips by NT Fisheries researchers will assist in providing more information on the distribution and status of sawfish populations, and obtain better

information on fishing operation interactions with TEP species.

Ecosystem Impact

Controls on fishing gear have been introduced to minimise any possible physical impact on the seabed. A prohibition on the use of bottom-set gillnets was introduced to minimise interactions with turtles and to reduce the catch of rays.

Social Impact

In 2011, 9 licences were operating in the fishery. Most vessels employ a skipper and have two or three crew members.

Economic Impact

At the point of first sale in 2011, the overall catch value of the fishery was $3.6 million. The blacktip shark component was valued at $0.53 million, $1.63 million for other sharks and $1.46 million for grey mackerel.

STOCK ASSESSMENT

Monitoring

Routine monitoring information for the fishery comes from compulsory catch and effort logbook returns. Monthly returns for the commercial fishery form a time series from 1983 onwards. A transition from monthly summary returns to recording each gear set has been implemented since the late 1990s. From July 2005, the target species has also been recorded. This reflects a policy of improving the quality and utility of the collected logbook information.

Scientific monitoring trips provide additional information regarding species composition, and other biological and ecological data. Three monitoring trips totalling 26 days and covering 63 individual shots were conducted onboard commercial boats during 2011. While at sea, NT Fisheries researchers routinely collect information on catch composition, interactions with TEP species, biological data such as fish length and sex, and collect vertebrae from sharks and otoliths (ear bones) from mackerel for aging.

During scientific monitoring trips in 2011, grey mackerel were the dominant species in the catch, comprising 60% of the catch in terms of the number of fish caught. *Carchcharhinus tilstoni* and *C. limbatus* comprised 9% of the catch with *C. sorrah* accounting for 6% of the catch. The most common byproduct species recorded included Spanish mackerel (*Scomberomorus commerson,* 3.2% of the catch), black pomfret (*Parastromateus nige,* 3% of the catch), milk sharks (*R. acutus,* 3% of the catch*)* and longtail tuna (*T. tonggol,* 2.5% of the catch).

Research has continued since 2006 to develop a tagging protocol for monitoring harvest rates of the target shark and indicator species. The project, jointly funded by the Australian Research Council Linkage Program and the NT Fishing Industry Research and Development Fund, is entitled ‘Estimating fishing-related mortality and designing sustainable management protocols for shark fisheries in northern Australia’. It is led by Charles Darwin University (CDU) in collaboration with the fishing industry, NT Fisheries and the Australian Institute of Marine Science (AIMS). The project aims to estimate fishing-related fish mortality in the fishery and evaluate various combinations of monitoring and management regimes for the fishery.

Over the four years of the project, 3964 sharks of all species were tagged, mostly during scientific monitoring trips aboard commercial fishing vessels operating in the fishery. Most of the sharks tagged were the commercially important species. The results are expected to be published in late 2012, however preliminary analysis suggests that *C. tilstoni* and *C. limbatus* are being harvested at below sustainable levels. However, the confidence in this result is subject to the exact composition of the *C. tilstoni* and *C. limbatus* in the ‘blacktip’ catch. The greater the proportion of the less productive species *C. limbatus* in the catch composition then the less certainty there is about the sustainability of the current ‘blacktip catch.

Stock Assessment Methods and Reliability

The fishery has a history of continual assessment. In the 1980s, a joint assessment was conducted by NT Fisheries, CSIRO and the Australian Fisheries Management Authority (AFMA). The Pelagic Fish Stock Assessment Program estimated that, in waters adjacent to the NT, the maximum sustainable yield for blacktip sharks (*C. limbatus*, *C. tilstoni* and *C. sorrah),* was 3400 tonnes annually: 1900 tonnes in the Arafura and Gulf of Carpentaria zones, and 1500 tonnes in the NT zone.

Assessment in the mid-1990s (Walters and Buckworth 1997) suggested a potential yield estimate for Western Australia, the NT and Queensland of at least 2000 tonnes per year. The optimum annual harvest rate is 6% to 7% of the component of the stock vulnerable to gillnet fishing. The age structure modeling (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 NT gillnet fishery to 1995 (on which the assessment was based) suggested a decline in relative abundance since the mid-1980s, for which several potential, unquantified sources were identified. Those sources included losses to other fisheries across the northern border (AFZ), undeclared catches within other Australian fisheries (which, it was calculated, could account for up to 1500 tonnes of catch), and localised depletion effects. The unreliability of the assessment was emphasised.

A 2005 update of the age structured model by the Northern Australia Science and Management Working Group noted that the declining trend shown to 1995 in the previous assessment was no longer a feature of the time series. Nevertheless, the status of the stock remained uncertain. The model incorporated the additional eight years of CPUE data available since Walters and Buckworth (1997). The dominant characteristic of the CPUE data is strong variation. It was recognised that CPUE statistics were a poor index of abundance, particularly given a high level of uncertainty in the catches of the Taiwanese-Australian joint venture fishery.

The problem with CPUE, as an index of abundance, is that it may reflect other factors, such as the ways in which fishers respond to markets and cost structures, more so than to the abundance of the fish. This is illustrated by the targeted fishing apparent within the fishery. The very strongly increasing trend in the catch rate of grey mackerel during 2000-06 suggests that this species has been increasingly targeted, rather than the abundance of stocks increasing steadily. The subsequent downturn probably reflected a switch to targeting of sharks during recent years in response to market pressures. The catch rate variations among blacktip sharks and grey mackerel (Figure 3) are substantially in counterpoint: those years in which catch rates of grey mackerel peaked, shark catch rates generally declined and vice versa. Although existing logbook effort data could not be allocated among the target groups, the inference from these observations is that catch rate trends presented for sharks and mackerels in this fishery are unlikely to match all but the strongest trends in abundance. The slight variations evident in blacktip shark catch rates in Figure 3 may simply reflect a diversion of effort by operators to generate the largest economic return 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 estimates of sustainable yield and is a small fraction of the catch taken by the Taiwanese-Australian joint venture fishery of the 1970s and 1980s, or current estimated landings by Indonesia (Blaber 2006).

In 2011, Trigger Reference Points (TRPs) for annual catch were exceeded. *C. tilstoni* and *C. limbatus* declined by 37% and *C. sorrah* declined by 35%. The decline in the shark catch is most likely in response to a shifting from

targeting of sharks in 2010 to grey mackerel in 2011. Two byproduct species exceeded the trigger of 10% of the total catch. Bull and hammerhead sharks were both 12% of the total catch, and summed together bycatch species also exceeded 35% of the total catch. As such, TRPs for target species and bycatch species have been exceeded. The Management Advisory Committee will now review the trigger breach and provide advice to the Executive Director of Fisheries for appropriate action.

In 2011 Professor Carl Walters was invited to run a series of stock assessments on key target species in the Northern Territory including grey mackerel, spot tail sharks and blacktip sharks. The stock assessments found all three species are being fished well below sustainable levels. In addition the two grey mackerel stocks in the NT (Gulf of Carpentaria and Western NT) were assessed as being fished well within sustainability limits. The assessments support the contention that changes in the percentages of target species over the years is a result of a shift in targeting rather than changes in abundance.

Future Assessment Needs

A key recommendation from previous assessments has been to establish sources of information on harvest rates or abundance levels of NT shark stocks, independent of logbook data. Consequently, research to develop mark-recapture methods (tagging) to provide an ongoing index of harvest levels for the NT shark fishery has been undertaken as described above.

There is little information available as yet on the magnitude and impact on northern Australian shark and finfish stocks of illegal, unregulated and unreported (IUU) fishing by foreign vessels operating in northern Australian waters. CSIRO and AFMA are completing projects considering the magnitude of IUU fishing, as well as ecosystem impacts. The consequences of IUU fishing on the Australian fishery are difficult to predict without this information.

In addition, a greater understanding is required of the ecological effects arising as a result of fishing down many of the top predatory fish from the offshore area of the fishery.

Movement rates and life history linkages between inshore (where most Australian fishery effort is directed) and offshore (most IUU fishing) are poorly understood for most species. A greater understanding of these factors for key species is required for future assessments.

Further assessment is planned for 2012.

RESEARCH

Summary to Date

In the mid-1980s, the NT Shark Fishery (now known as ONLF) was the subject of a major joint Commonwealth, NT, Queensland and WA 'Pelagic Fish Stock Assessment Program', sampling extensively around the NT 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 occurred in 2011.

Research during the 1990s was mostly limited to monitoring 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 shark species taken in northern Australia prompted a series of national projects on the sustainability of sharks and rays in northern Australia (Stobutzki et al. 2003; Rose et al. 2003; Salini et al. 2007). The projects characterised catches, species composition and gear types across all northern Australian fisheries that take sharks. The projects developed monitoring programs and provided a substantial body of biological knowledge on sharks and rays in northern Australian fisheries. The principal outputs of the series of projects included risk analyses that indicated knowledge gaps yet to be

addressed and the need for sustainable management.

The stock structure of shark species has been investigated in an Australian Centre for International Agricultural Research (ACIAR)-sponsored project (FIS/2003/037) led by CSIRO. The results indicated that Australian and Indonesian populations of *Carcharhinus sorrah* and *Rhizoprionodon acutus* were genetically separate, so that these stocks can be managed separately. However, populations of *Sphynra lewini* and *C. obscurus* were genetically not distinguishable across the geopolitical boundaries, and caution and cooperation in their management was suggested. Although this study indicated that blacktip sharks form a single large genetic stock across northern Australia, mark-recapture studies show that movement rates both alongshore and offshore were relatively restricted between the northern Australian Arafura Sea, the Gulf of Carpentaria and the Joseph Bonaparte Gulf. Mixing is sufficient to ensure a genetically-homogeneous population but, at the same time, interactions were 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).

The Natural Heritage Trust-funded research project, 'Pilot Study to develop Methodology to determine Indigenous Fishing Impacts on Sharks and Rays in the Northern Territory', was completed in 2009. This project developed a successful protocol for collecting information on the quantity and species composition of harvest of sharks and rays by the Indigenous sector.

Information on stock structure, movements and age structure of the grey mackerel population was provided by the Fisheries Research and Development Corporation (FRDC) project 2005/010, 'Determination of Management Units for Grey Mackerel Fisheries in Queensland and the Northern Territory' which was completed in 2009 (Welch et al. 2009). Results from the project have provided valuable direction in managing the multi-stock species. For assessment and management purposes, the project indicated that there were at least five stocks of grey mackerel across northern Australia: in Western Australia, the Timor Sea (NT), the Gulf of Carpentaria, and northern and southern coasts of Queensland. The project also provided valuable life history information on growth and reproduction.

Incorporation into Management

The NT hosted the Northern Australian Science and Management Working Group on Sharks in May 2008 to discuss shark research projects. Fisheries managers and researchers from across northern Australia discussed the incorporation of research results into current management strategies and prioritised the research needs for northern Australian sharks. Results of the subsequent research have allowed informed and conservative management regimes to be implemented for the fishery.

Commitment was made to formulate a joint harvest strategy and develop comparable catch reporting processes at a meeting held in 2011 at which joint management arrangements for both grey mackerel and shark stocks across northern Australia were discussed.

Current Research

A scientific monitoring program is in place to yield information on catch composition, an important basis for monitoring biodiversity, as well as size and reproductive status of the catch species. Although the blacktip species are well known biologically, this has not been true for many of the species that are less frequently caught.

A collaborative tagging program with commercial fishers, as described above, is in place with the intention of delivering a protocol for monitoring harvest rates of the principal shark species. In 2011, 430 sharks were tagged and 24 were re-captured.

The participation of CDU and AIMS has expanded the scope of projects undertaken on sharks in the NT. The projects conducted in 2008 and 2009 included studies on the distribution and

abundance of *Glyphis* species, and the genetics and biology of bull and pigeye sharks (*C. leucas* and *C. amboinensis*, respectively).

The identification of Carcharhinid sharks, particularly juvenile animals, at the species level is an ongoing problem. NT Fisheries recently commenced research to provide a key with which to reliably identify and distinguish between *C. tilstoni* and *C. limbatus* based on field measurement. Although genetic analysis is currently the only reliable method to distinguish between the two species, *C. tilstoni* and *C. limbatus* have very different biological parameters as *C. tilstoni* grows faster and matures at a much smaller size than *C. limbatus*, with potential management implications. Consequently, SEWPaC identified the need to address the problem as a condition on which to support WTO accreditation. The need has again been highlighted in recent stock assessments and analysis of the tag recapture data.

Given the value of grey mackerel in the fishery, there remains a need for more information on the species. NT Fisheries continues to routinely collect information on length and sex composition of the catch and otoliths for age structure analysis.

MANAGEMENT/GOVERNANCE

Management

Management of the fishery seeks to maintain shark and grey mackerel catches within appropriate ranges, dictated by the scientific understanding of sustainable harvest levels and the underlying value of the fishery in providing food and income. This is achieved through a range of input and output controls and containment of fishing capacity.

This fishery is managed by individually transferable effort allocations. The total allowable effort (TAE) is set at 1599 days for pelagic net fishing gear and 234 days for long line fishing gear. Each licensee has been issued an allocation of TAE, which can be fished each year or transferred in full, or part, to another licensee. A licensee must cease fishing once the allocation for the licensing year has been used or transferred.

TAE may be revised up or down from year to year depending on the best available information on the sustainable catch and effort limits in the fishery.

A 'three-for-one' licence reduction program is in place. This program requires new entrants to acquire and transfer three restricted ONLF licences to NT Fisheries for the issue of one unrestricted licence. Of the17 licences currently in the fishery, 6 are restricted and 11 are unrestricted.

Fin ratio licence conditions apply in the fishery, which require a proportionate amount of fin and trunk to be landed. These arrangements are in place to deter the targeting of large sharks for their fins only. 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.

No shark product is allowed on board a vessel upon commencement of the next voyage.

A review of fin ratios was conducted in late 2008. Changes to fishery logbooks and reporting procedures were subsequently introduced during the 2009 licensing year.

Catch restrictions apply to the harvest of Spanish mackerel in the fishery. Only 30 trunks/whole Spanish mackerel may be taken by fishers in the fishery per trip with no more than 10 additional trunks per tonne of grey mackerel. The limit is intended to link landings of Spanish mackerel to grey mackerel catches to address concerns by other sectors regarding pelagic net fishers targeting Spanish mackerel while recognising that incidental catches did occur when fishing for grey mackerel.

A prohibition on the possession of sharks and shark product is in place for the Demersal, Finfish Trawl, Spanish Mackerel and Timor Reef fisheries. The Barramundi, Coastal Net and Coastal Line fisheries have allowances for incidental catches of shark. The 'fin to meat' ratios also apply to these fisheries in addition to trip limits.

In 2007, the fishery was subjected to an ecological risk assessment of management arrangements by SEWPaC against the Guidelines for Ecological Sustainable Fisheries under the EPBC Act. The fishery was found to be operating in an appropriately precautionary manner and was accredited with a WTO, permitting export of shark products until November 2010. SEWPaC has since granted an extension to ONLF until late 2012 with the intention of negotiating the recommendations for the fishery in conjunction with the Queensland fishery.

The NT is signatory to a multi-jurisdictional 'operational plan' for northern Australian shark fisheries to achieve the outcomes of NPOA Sharks. The Shark Implementation and Review Committee was established by the Natural Resource Management Marine and Coastal Committee to oversee the implementation and review of NPOA Sharks. In 2009 NPOA Sharks was under review with a revised plan to be developed and released for public comment in 2011.

History

A large commercial shark fishery commenced throughout northern Australia in the early 1970s. At that time, a Taiwanese gillnet fleet targeted a range of pelagic shark and finfish species (as a Taiwanese-Australian joint venture), with foreign fishing vessels working as close as 12 nm off the coast prior to 1978. Foreign fishing vessels were excluded from the Gulf of Carpentaria in 1979.

With the declaration of AFZ in 1979, the foreign fishing fleet's exclusion zone adjacent to Arnhem Land and the Wessel Islands increased to between 40 and 50 nm offshore. A bilateral agreement between Australia and Taiwan permitted continued access for 30 gillnetters to land up to 7000 tonnes of sharks 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 gillnets to not more than 2.5 km, thereby rendering foreign gillnetting uneconomic. Despite the permitted use of baited long lines, 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 NT 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 at established markets throughout southern Australia.

In 2004, the fishery was initially assessed against the Guidelines for the Sustainable Management of Fisheries under the Commonwealth EPBC Act. The fishery was accredited with a WTO facilitating the continued export of shark products.

In 2006, NT Fisheries reviewed the catch logbook program as part of the requirements of WTO. Logbooks were amended to include the capacity to record bycatch by weight on a 'shot by shot' basis.

In 2007, NT Fisheries conducted a review of the management arrangements, objectives, performance indicators and trigger points using the latest available verified data. The review determined that the current management objectives and performance indicators for the fishery were being met and trigger points were yet to be reached. Management actions and responses to triggers were considered appropriate and in line with a conservative approach. The outcomes of the review were provided to SEWPaC as part of the WTO conditions.

The completion of the FRDC report 'Northern Australian Sharks and Rays: the Sustainability of Target and Bycatch Species, Phase II' in 2007 further supported the outcomes of the NT Fisheries review and provided additional information to assist in the identification of species of potentially higher risk and to guide the development of some species-specific measures (Table 1). Since 2004, a number of mitigation measures have been implemented based on a conservative regime.

The fishery was reassessed and received an approved WTO in November 2007. The management arrangements of the fishery were recognised by the Australian Government to be operating in an appropriately precautionary manner and the fishery is exempt from export regulations for a further three years. SEWPaC granted an extension to ONLF until late 2012 with the intention of negotiating the recommendations for the fishery in conjunction with the Queensland fishery.

To improve the identification and quantification of shark catches on a species-specific basis, NT Fisheries developed a shark identification guide booklet, which has been provided to each vessel in the fleet.

Current Issues

The changes in catch levels for grey mackerel may have been caused by a spatial shift due to the unavailability of fuel in certain regional areas in combination with rising fuel prices. The increase in the catch of some of the shark species is believed to have been caused by changes in one licensee's activities. These matters will be considered by the ONLF Management Advisory Committee (ONLFMAC). In addition, NT Fisheries is undertaking more targeted research to obtain a better understanding of the species, more specifically the commercial fishing sector's interaction with them.

An ecological risk assessment of the fishery involving stakeholders and scientific experts was conducted in 2009. The main outcome of the workshop was that all shark species were considered to be fished well within sustainable limits due to the small catches taken by the small number of operators in the fishery. Grey mackerel were also considered to be fished within sustainable limits; however, increasing catches of this species by Queensland fishers in the Gulf of Carpentaria led the group to suggest that the species is being fished close to maximum limits within this area. Outcomes of the workshop were provided to SEWPaC.

Future Plans

A review of the shark fin ratios has resulted in the development of new information requirements in the logbooks and amendment to the existing reporting procedures to both tighten the process and facilitate compliance checks. Changes to this process are being conducted in consultation with the industry and the Water Police Section (WPS) of the NT Police, Fire and Emergency Services.

The NT will continue to play an active part in the revision of NPOA Sharks which is scheduled for development in 2011.

Compliance

The WPS is responsible for all fisheries compliance and enforcement in the NT under the *Fisheries Act 1988*. Water Police monitor and enforce management arrangements for the fishery through the inspection of vessels arriving and departing through the single Port of Darwin. This includes verification of catch returns against fish trader/processor returns. When necessary, Water Police have the power to investigate the records of wholesalers and licensees.

In 2011, no significant domestic compliance issues were 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 NT Offshore Net and Line Licensee Committee, the NT Seafood

Council, neighbouring jurisdictions, other fishing stakeholders and wider interest groups.

ONLFMAC membership is derived from a wide range of stakeholder interest groups to provide expert advice to the Executive Director of Fisheries. The committee meets to work through relevant issues to ensure the fishery continues to be sustainably managed in an open and transparent manner.

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Table 1. Management objectives and status against performance indicators for the Offshore Net and Line Fishery for 2011

Species or group	Management objective	Performance indicator	Performance measure	Harvest status for 2011	Management action
Target species: Blacktip sharks	Ensure inter-generational equity by maintaining ecologically sustainable annual catches in all sectors.	Sustainable yield estimates.	Catch levels increase by (↑) to 2000 t over the next calendar year.	*C. tilstoni*/*C. limbatus* 217 tonnes; *C. sorrah* 82 tonnes in 2011 – TRP not reached.	MACs to review fisheries annually and make recommendations to the Executive Director of Fisheries (EDF).
			Catch levels decrease by (↓) 30% over the previous two calendar years.	*C. tilstoni*/*C. limbatus* ↓ 37% from 2010 following a ↓ 8% in 2010 from 2009 catch – TRP reached. *C. sorrah* ↓ 36% from 2010 catch following ↑ 48% from 2009 – TRP reached.	Any amended arrangements will be implemented within 12 months of trigger being reached.
Grey mackerel			Catch levels decrease by (↓) 30% over the previous two calendar years.	Grey mackerel catch ↑ 6% from 2010 following ↓ 12% from 2009 catch – TRP not reached.	
Byproduct species: Bull shark Dusky shark Hammerhead sharks (great and scalloped) Lemon shark Milk shark Pigeye shark Spinner shark Tiger shark Winghead shark Queensfish Spanish mackerel Tuna	Ensure ecological sustainability of these species in all fisheries.	Monitoring of commercial logbook returns.	The byproduct proportion of the total catch increases by (↑) >35% in the calendar year.	The proportion of byproduct species in the total catch rose to 40% of the total catch in 2011 – TRP reached.	As for target species above.
		Onboard monitoring of ONLF.	Catch of any byproduct species increases to (↑) >10%of the total catch in the calendar year.	Majority of byproduct species, were within acceptable limits. *Carcharhinus leucas* catch comprised 12% of the total catch – TRP reached. Hammerhead sharks (comprising both great, *Sphyrna mokarran* and scalloped, *S. lewini*) comprised 12% of the total catch – TRP reached.	MAC to review the trigger point and catch levels of bull sharks (*C. leucas*). NT Fisheries to further investigate corresponding fluctuations in catch between pigeye (*C. amboinensis*) and bull sharks (*C. leucas*). Advice to be provided to the EDF for appropriate action. Logbook arrangements to be implemented to cater for species specific reporting of each hammerhead shark species.

Species or group	Management objective	Performance indicator	Performance measure	Harvest status for 2011	Management action
Bycatch species	Ensure ecological sustainability of bycatch species in all fisheries.	Monitoring of commercial logbook returns. Onboard monitoring of ONLF.	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.	Total bycatch in the fishery was <1% of the total catch in 2011 – TRP not reached.	As for Target Species above
Threatened, endangered or protected (TEP) soecies including: Sawfish: *Pristis clavata* *P. microdon* *P. zijsron* Turtles: *Caretta caretta, Chelonia mydas, Eretmochelys imbricata*	Ensure the continued protection of species and communities listed under the EPBC Act and the *Territory Wildlife and Conservation Act 2000*.	TEP species and or communities are identified in NT waters.	Identifiable impacts observed by commercial fishers, NT Fisheries staff or other agencies regarding the EPBC Act listed species or communities.	There were 2 interactions with TEP species in 2011. One hawksbill turtle (*Eretmochelys imbricata*) and one dwarf sawfish (*P. clavata*) were reported captured and released alive – TRP not reached.	MACs to review fisheries annually and make recommendations to the EDF. Fishery logbooks to be amended to include records of any interaction with endangered, threatened or protected species.
Ecosystem components	Minimise effects on ecosystem components	Identification of threatening processes	Identification of significant negative interaction with components of the natural ecosystem present on fishing grounds.	No negative interactions with environment reported – TRP not reached.	MACs to review fisheries annually and make recommendations to the EDF.

SPANISH MACKEREL FISHERY STATUS REPORT 2011

INTRODUCTION

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

The Northern Territory (NT) Spanish Mackerel Fishery is based on the Spanish mackerel (*Scomberomorus commerson*), which is caught using trolled lures or baited lines. Spanish mackerel are also landed as an incidental catch in the Offshore Net and Line Fishery (ONLF) and the Finfish Trawl Fishery (FTF). Spanish mackerel are also keenly sought by recreational and Fishing Tour Operator (FTO) anglers. Catch limits are set for all sectors.

Historically, there were significant landings of Spanish mackerel by the Taiwanese gillnet fleet off northern Australia between 1974 and 1986, with annual catches as high as 1000 tonnes reported in the late 1970s. Annual catches by foreign fishing vessels were around 400 to 500 tonnes through the late 1970s and early 1980s. Since the mid-1990s, the fishery has stabilised as a small, tightly-controlled NT-based troll fishery that has since grown steadily.

The fishery has been assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Government Department of Sustainability, Environment, Water, Population and Communities. The fishery received the highest level of export accreditation under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The assessment demonstrated that the fishery was managed in a manner that does not lead to overfishing and that fishing operations have minimal impact on the structure, productivity, function and biological diversity of the ecosystem.

The Export Exempt accredited fishery is due for reassessment in 2013.

The Spanish Mackerel Fishery Management Advisory Committee (SMFMAC), in consultation with the industry, has identified management options to ensure environmental sustainability and profitability of the commercial fishery into the future. A discussion paper regarding possible management options was provided to industry licensees in 2008. At the request of the industry, a subsequent paper, detailing different allocation models and administrative arrangements under an Individual Transferable Quota management regime, was provided to industry in 2011.

PROFILE OF THE FISHERY

Commercial Sector

Area

Spanish Mackerel Fishery licensees may fish in NT waters seaward off the coast and river mouths, to the outer limit of the Australian Fishing Zone (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 around reefs, headlands and shoals.

Fishing Method

Fishers in the fishery may operate from a mothership with up to two dories. They may use any number or combination of troll lines, floating hand lines and rods. It is common for fishers to troll two to four lines behind a dory and up to eight lines from a mother boat. Using more than one licence, some operators use up to four dories with one mothership.

Most commercial fishers purchase bait (usually southern Australian garfish). However, a small number of operators 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.

Catch

The key target species in the fishery is the Spanish mackerel (*Scomberomorus commerson*). Small numbers of other *Scomberomorus* species are included in the catch in some years, as are various other species that might take a trolled lure or bait.

The commercial Spanish mackerel catch in 2011 was 274 tonnes, increasing from the 254 tonnes caught in 2010 and the 233 tonnes caught in 2009 (Figure 1). The fluctuation in total annual catch largely reflects annual effort, which is influenced by prices and various operational factors each year. Operators have indicated that in 2011, factors affecting catch and effort included fuel price and availability in remote ports, wind strength and crew availability. The low availability of skilled skippers and crew is a continuing issue for operators in this fishery, which, at times, prevents fishing.

There were no records of bycatch for this fishery in 2011. 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 previous years the species typically discarded included trevallies (Family Caranginae), queenfish (Family Carangidae) and barracudas (*Sphyraena* spp.).

Landings of Spanish mackerel as byproduct in the ONLF increased to 26 tonnes in 2011 which is a substantial rise from the 2010 catch of 15 tonnes. The FTF catch of Spanish mackerel in 2011 was less than 1 tonne, which is lower than the 2010 catch of 3 tonnes

Effort

In 2011, there were 16 Spanish Mackerel Fishery licences, 11 of which were actively operating.

Fishing effort in the fishery was 813 boat days in 2011, a considerable increase from the 672 boat days in 2010 and the 680 boat days in 2009 (Figure 1). Historically, a maximum effort of 1817 boat days was recorded in 1990 (Figure 1).

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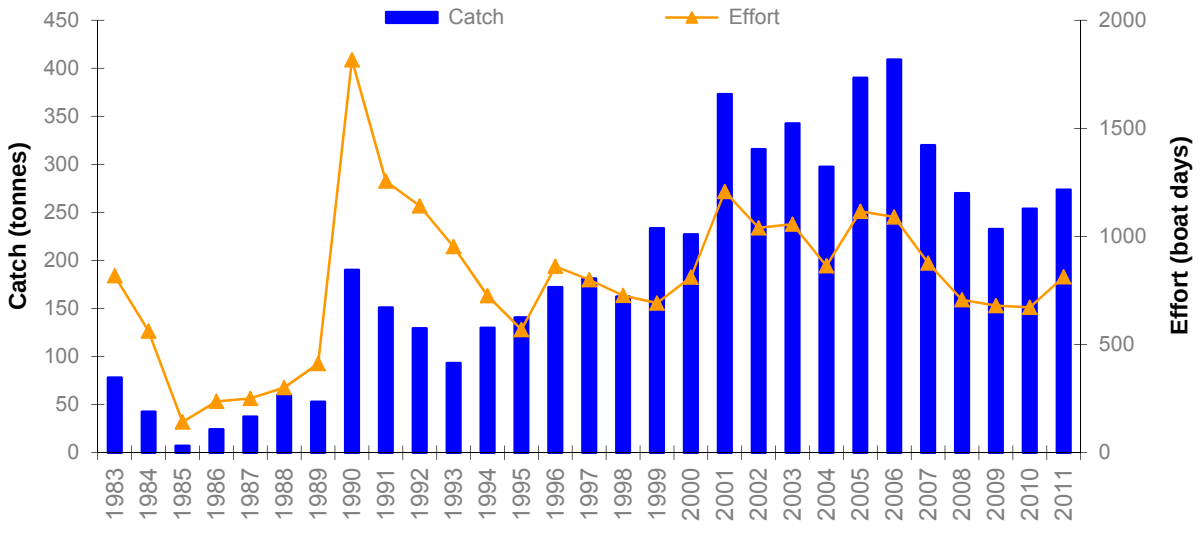

Figure 1. Annual catch (tonnes) and effort (boat-days) in the NT Spanish Mackerel Fishery, 1983 to 2011

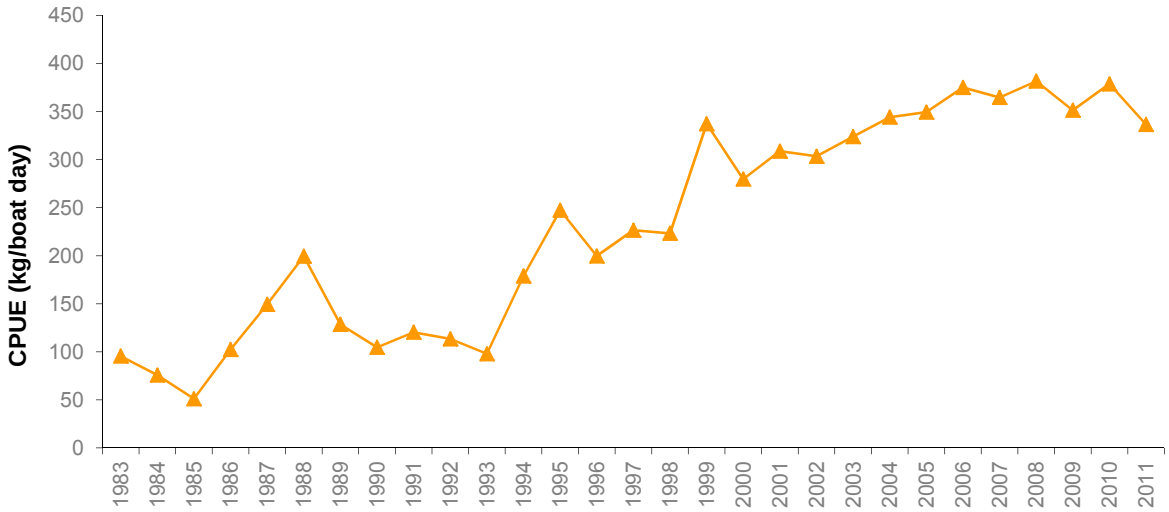

Figure 2. Catch per unit effort (CPUE) for the NT Spanish Mackerel Fishery, 1983 to 2011

Catch Rates

The catch per unit of effort (CPUE) for the commercial sector of the fishery has followed a strong increasing trend through the past two decades. CPUE since 1999 increased to at least twice that of the 1980s (Figure 2). A gross catch rate of 336.6 kg/boat day was achieved during 2011, which was slightly lower than the 378.8 kg/boat day during 2010 and the 351.5 kg/boat day in 2009. The long term trend may reflect improved efficiency in fishing operations and thus should be interpreted with care. However, part of the trend might include the recovery of the Spanish mackerel population from historical overfishing by the licensed Taiwanese-Australia joint venture fishery of the 1970s and 1980s.

Marketing

Spanish mackerel are usually filleted onboard 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 usually frozen after processing and stored onboard; some operations land their fish fresh on ice. 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 2000-01 found that most (47%) of the targeted effort for game fish, such as mackerel, occurred in the Gove region.

Fishing Method

Fishing gear and methods employed by recreational fishers targeting Spanish mackerel are similar to those used 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 (diced bait and continuously tossed from the fishing vessel) to entice mackerel. A proportion of the catch is also taken when fishing for other species, where fishing methods may vary.

Catch

A recreational fishing survey conducted in 1995, estimated the total recreational catch of all mackerel to be around 24 500 individuals (Coleman 1998). Almost all of these fish were

harvested, weighing perhaps 170 tonnes. The proportion of Spanish mackerel within the recreational mackerel catch was not identified.

The National Indigenous and Recreational Fishing Survey conducted in 2000-01 found that the annual catch of all mackerels by the recreational sector in the NT numbered 25 233 fish (Coleman 2004), suggesting that the recreational catch was fairly stable between that survey and the FISHCOUNT survey conducted in 1995. Over half of the mackerel catch was not identified by species. However, during a recent survey with recreational fishers, 49% of the mackerel catch was thought to be Spanish mackerel. The survey also indicated that the average weight of individual Spanish mackerel was estimated to be about 5.9 kg, with an estimated release mortality of 54%. A comprehensive 12 month survey of recreational fishing in the NT commenced in 2009 and will provide up-to-date recreational catch estimates. The results are expected in 2012.

Effort

In 1995, targeted game fishing accounted for only a small proportion (2%) of the total recreational fishing effort of over 37 000 hours (Coleman 1998). In 2000, targeted game fishing increased to nearly 8% of the total recreational fishing effort of over 139 313 hours (Coleman 2004).

Fishing Tour Operator Sector

Area

Fishing Tour Operators (FTOs) can fish in all areas of the fishery.

Fishing Method

Fishing gear and methods used by FTOs targeting Spanish mackerel are similar to those found in the recreational and commercial sectors. 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

In 2011, 2567 Spanish mackerel were caught and 1155 of these were released (45%). These figures indicate a decline from the 3378 Spanish mackerel caught in 2010 of which 1697 were released (50%).

Effort

FTOs catch Spanish mackerel predominantly while targeting game fish, but they also take them when fishing for barramundi and reef fish.

Targeted game fishing by FTOs is a small component of the industry. There were 272 trips undertaken in 2011, which is largely reduced from the 593 trips undertaken in 2010, the 874 trips undertaken in 2009 and the 999 trips undertaken in 2008. While effort fluctuates from year to year due to numerous factors, such as the weather and flight costs, there has been a strong increasing trend in FTO game fishing effort over the previous two decades. A peak of 1010 trips was observed in 2005.

More information for the sector can be found in the Fishing Tour Operator Fishery Status Report in this publication.

Indigenous Sector

Very few (1400) mackerels were captured by Indigenous fishers according to the National Recreational and Indigenous Fishing Survey of 2000-01 (Henry and Lyle 2003). Species identities were not recorded.

Non-retained Species

Monitoring of the commercial fishery identified very low levels of bycatch, illustrating the highly targeted nature of the fishery. Low value species that are not retained as byproduct are usually released alive.

Apart from 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 them are released.

Threatened Species Interaction

Due to the highly targeted nature of the troll fishing method, interactions with threatened, endangered and protected (TEP) species are highly unlikely. No TEP species interactions were reported in 2011.

Ecosystem Impact

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

Social Impact

There are 16 Spanish Mackerel Fishery licences. A vessel typically operates with a skipper and two crew members, with most processing done onboard. Although some fish are processed for sale and consumption locally, most Spanish mackerel are sold interstate.

Spanish mackerels are highly regarded by the recreational and FTO sectors.

Economic Impact

At the point of first sale in 2011, the value of the catch from the commercial sector of the fishery was $2.11 million.

The recreational fishing sector contributed to the NT economy, especially the service and tackle industries, and provided high quality food.

STOCK ASSESSMENT

Monitoring

Monitoring of the fishery comprises two main elements:

- The collection of detailed information on catch and effort from the commercial and FTO sectors via fishery logbooks. Operators are required to report this information for each fishing session for every day that fishing occurs. Some fishers also routinely provide information for further monitoring of the fishery, such as length measurements of the fish taken.
- Information obtained from regular monitoring of catches onboard commercial vessels. The information collected includes length of the fish and biological information, such as sex and maturity.

Stock Assessment Methods and Reliability

Various stock assessment methods have been applied to the fishery. Equilibrium analyses (Buckworth 2004) indicate the underlying resilience of Spanish mackerel stocks in the NT fishery. This resilience is due to rapid growth and fish maturing before being harvested.

Age structured models developed using catch and effort time series data in combination with mean size and age composition data have provided assessments of the impact of fishing. They have indicated that the fishery is sustainable at current levels but the data is considered to be only moderately reliable in defining further potential for the fishery.

In the absence of more information for alternative assessments, the management of the fishery has 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 methods, which contain fishing effort, have been adopted to ensure the protection of the resource.

Current Harvest Status

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. Outputs of these workshops, as well as Buckworth (2004), indicated that the fishery is probably nearing sustainable catch levels. Analysis of data on catches taken during the Taiwanese fishery (1974-1986), in conjunction with NT 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 NT 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 most recent assessment conducted during 2011 indicated that Spanish mackerel stocks have recovered from a period of overexploitation by Taiwanese drift netting during the 1980s (unpublished data). The results of the modelling estimated that Spanish mackerel egg production is 85% of pristine levels and that the current harvest rate is approximately 30% of that required to achieve maximum sustainable yield.

In addition, none of the management objective trigger reference points were exceeded during 2011.

Future Assessment Needs

The fine stock division of Spanish mackerel means any future assessments need to ensure that localised declines are not occurring despite jurisdictional harvest rates being within acceptable limits.

RESEARCH

Summary

Recent research in the fishery has focused on spatial stock structure and the measurement of harvest rates. Cooperative research undertaken with the commercial and recreational sectors, as well as with other fisheries research and management agencies, contributes to the success of these projects.

A project funded by the Fisheries Research and Development Corporation (FRDC) 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. The 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 three to six years old, with NT Spanish mackerel 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 were usually larger than males for any given age.

A study to describe the geographic structure of the Spanish mackerel stocks across northern Australia was completed in 2002. Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries), the Queensland Department of Agriculture, Fisheries and Forestry, the Western Australian 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. 2007). The study used three stock discrimination methods: genetics, parasite abundance and otolith isotope chemistry.

The FRDC-funded work showed that Spanish mackerel across northern Australia were not highly migratory but were actually divided into a mosaic of separate adult groups. Little interaction between groups was evident from both the parasite and otolith isotope analyses, which

demonstrated that the fish do not mix much over distances as small as 100 km. However, just three distinct genetic stocks were identified: one on the east coast, one across northern and western Australia and a distinct stock lying between the two in the Torres Strait area. The amount of gene flow could be maintained by larval or juvenile interchange, or straying by a small number of adults. Fish sampled from Kupang (Indonesia) were found to be distinct from the three Australian stocks in this study; movement from Australia was not supported by either parasite or genetic analyses. There may be some mixing between these four genetic stock units, but they have distinctive seasonal migration and historical fishing patterns. Any analysis of catch information and management must take into account fine spatial scales.

Incorporation into Management

Results of all research programs are reviewed annually and if they indicate significant change in any aspect of the fishery, a review of the management arrangements is undertaken.

Current Research

Current projects include:

- Tag/recapture studies on Spanish mackerels to determine exploitation rates of this species.
- Research funded by FRDC initiated in 2002 “Genetag: Genetic Mark-Recapture for Real-Time Harvest Rate Monitoring. - Pilot Studies in Northern Australia’s Spanish Mackerel Fisheries (FRDC project 2002/011) was completed in 2011.

The Genetag method relies on tagging fish remotely in the water where a specially designed hook collects a tissue sample from the fish which can then be analysed allowing that fish to be given a unique genetic identity. Any individuals of that species that are subsequently harvested can be identified in the same way. The advantages of genetag are that it does not harm the fish during the initial tagging and it provides the only method of tagging deepwater species that cannot be brought to the surface and tagged because they suffer severe pressure injuries. For these reasons the genetag method has been explored in several fisheries around the world.

MANAGEMENT/GOVERNANCE

Management

Objective

The overall management objective of the fishery is to ensure its long term sustainability by maintaining landings within acceptable ranges. This is achieved primarily through strict limit controls implemented in the fishery, the low level of commercial fishing activity allowed over a large fishing area, effort reduction programs, the monitoring of catches and regular reviews of the fishery.

The fishery is managed under a catch-sharing arrangement with all user groups: commercial, recreational, FTOs and Aboriginal stakeholders. The catch shares have been established to provide greater certainty for each fishing sector. The allocation of catch shares was based on historical harvest levels identified from the compulsory commercial logbook program and the National Recreational and Indigenous Fishing Survey (Table 1).

The management framework seeks to maintain all landings of Spanish mackerel by all sectors within the allowable catch of 450 tonnes per year. This is not a total allowable catch (i.e. it is not linked to a maximum sustainable yield) but rather it is a precautionary harvest level.

Table 1. Allocation of allowable catch of Spanish mackerel amongst sectors.

Sector	Sector allocation (%)	Weight (tonnes)
Commercial Spanish Mackerel licensees	76	342
Commercial Offshore Net and Line licensees	3	13.5
Commercial Finfish Trawl licensees	1	4.5
FTO licensees	3	13.5
Recreational fishers	16	72
Aboriginals	1	4.5
Total	100	450

In addition, management objectives, performance criteria and trigger points for the fishery have been developed and implemented (see Table 2). A review of management arrangements must commence should estimated aggregate landings by all sectors reach 405 tonnes (being 90% of the allowable catch) or total catch declines by 30% over 12 months. Should the estimated allocated catch share by any stakeholder group vary by more than 20% over 12 months, a review of the management regime will commence. Depending on the outcomes of the review, mitigation management measures may be implemented. Current arrangements also seek to ensure the sustainability of byproduct taken in the fishery by maintaining its contribution to less than 10% of the total catch.

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 gillnet fleet commenced fishing for pelagic species, including Spanish mackerel, in 1974. Recorded overall catches from the AFZ by this fleet 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 nm of the NT 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 in 1986 in response to declining shark catch rates and concerns about the incidental capture of dolphins. These controls resulted in the closure of foreign fishing operations in northern Australian waters late that year.

In 1980, commercial mackerel fishers were issued with a Reef and Mackerel Fishery licence, which superseded the previously issued Net and Line Fishery licence. In 1984, the licensing scheme was further refined, with pelagic, inshore reef fish or offshore reef fish fishery endorsements authorising 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 Australian Government managed all fish species in northern Australian waters beyond 3 nm of the coast until 1988. Following ratification of the Offshore Constitutional Settlement Agreement in 1988, the NT Government assumed responsibility for the management of Spanish mackerel at this time for all waters adjacent to the NT coast to the outer boundary of the AFZ.

A ceiling on the number of licences in the Pelagic Fishery was introduced in 1990. Advice was provided in a public announcement on 1 April 1991 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 formation of the Spanish Mackerel Fishery in 1991, only those licensees able to demonstrate a reliance on the fishery maintained

access. The number of licences in the fishery was reduced to 28. An active licence reduction scheme was introduced in 1993 (and is still in place) with new entrants required to either surrender two pre-existing licences or acquire a licence previously issued on the surrender of two licences.

In 2004, a Byproduct Action Plan was developed and implemented for all the non-target Spanish mackerel fisheries. The plan introduced stringent restrictions on the incidental harvest of Spanish mackerel in ONLF and FTF and a 'no take' requirement for all other NT fisheries.

In recognition of the incidental catch of Spanish mackerel when targeting grey mackerel in ONLF, an ONLF licensee is restricted to only 30 whole trunks of Spanish mackerels during a voyage. In addition to the 30 fish, for each tonne of grey mackerel harvested in ONLF, the licensee may take an additional 10 trunks or whole Spanish mackerel. In the FTF, a licensee must not possess more than 50 Spanish mackerel onboard.

On 1 January 2005 amendments were made to the Spanish Mackerel Fishery Management Plan, which introduced catch share arrangements. The plan outlined the necessary input controls designed to limit overall harvest capacity and complement the catch sharing arrangement with other user groups, including commercial, recreational, FTO and Aboriginal stakeholders.

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. A review of management arrangements in 2005 determined that catches were not sufficiently high to warrant any immediate concern or urgent management responses. The review concluded that continuous monitoring and a review of 2006 catches should be conducted. In 2006 the total commercial catch of Spanish mackerels once again exceeded the commercial allocation.

Due to these high catch levels, SMFMAC was asked to provide advice to the Executive Director of Fisheries on whether changes to current management arrangements were required to maintain catches within the allowable catch.

Following advice from NT Fisheries on the status of the Spanish mackerel stocks in 2008, a discussion paper, which considered future management options for the commercial take in the Spanish Mackerel Fishery, was released for comment.

In December 2008, the NT Seafood Council and the Spanish Mackerel Fishery Licensee Committee provided in principle support for the introduction of Individual Transferable Quotas (ITQs). However, there was no agreement on a preferred allocation method. As a result, NT Fisheries developed a discussion paper to investigate a possible framework surrounding ITQs for the fishery which was released to the industry in 2011. Work will continue on developing appropriate future management arrangements for the NT Spanish Mackerel Fishery.

An Ecological Risk Assessment (ERA) workshop was held in Darwin on 17 June 2011 involving a broad range of fisheries stakeholders. The ERA was based upon the National Ecologically Sustainable Development (ESD) reporting framework 'How to guide' (Fletcher et al., 2002). The ERA determined that due to the precautionary sector allocations and management measures in place, the robust nature of the stock and low harvest levels, the fishery is currently well below full exploitation.

Future Plans

Following the release of the ITQ framework discussion paper to industry, SMFMAC will continue to work through issues associated with the need to ensure the regulatory framework can control harvest levels in the fishery. The SMFMAC is expected to meet in relation to this matter in 2011/12.

NT Fisheries will continue to work with Spanish mackerel licensees and SMFMAC to ensure the

conditions of export exemption accreditation are met. The fishery is scheduled for reassessment early in 2013.

Compliance

A risk assessment of compliance issues in the fishery was conducted in May 2006. The objective of the assessment was to identify and assess the severity of the compliance risks and formulate compliance strategies, policies and management to obviate the risks identified. The compliance risk assessment analysed several aspects within the fishery, with five out of the nine issues being ranked as 'moderate' and one as 'extreme', namely illegal unreported and unregulated (IUU) fishing primarily by foreign fishers. Management responses will continue to be developed and implemented for risks ranked as 'moderate' in the compliance risk assessment.

There is little information available on the magnitude and impact of IUU fishing by foreign vessels operating in northern Australian waters on Australian Spanish mackerel stocks. The consequences of IUU fishing for the fishery are difficult to predict as we do not know the magnitude and composition of the fishing over time, or the nature of the linkage between Australian and Indonesian Spanish mackerel stocks. While currently low, IUU fishing may have been sufficient in the past to have had some impact on the status of NT Spanish mackerel stocks. Consultation with other relevant State and Australian government agencies will be maintained to minimise the risk posed by IUU. In addition, estimates of the level of take from illegal fishing parties will continue to be incorporated into stock assessments and management arrangements for the fishery.

The Water Police Section of the NT Police, Fire and Emergency Services is responsible for all fisheries compliance and enforcement activities under the NT *Fisheries Act 1988*.

In 2011, there were no significant compliance issues in this fishery.

Consultation, Communication and Education

SMFMAC provides advice to the Executive Director of Fisheries and the Minister on the management of the fishery.

Regular consultation occurs between NT Fisheries, the Spanish Mackerel Licensee Committee of the NT Seafood Council, the Amateur Fishermen's Association of the NT and other stakeholders to discuss matters of relevance to the management of the fishery.

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Aquatic Resource Management Officer - Mrs Tricia Beatty

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Table 2. Management objectives and status against performance indicators for the Spanish Mackerel Fishery for 2011

Species or group	Management objective	Performance indicator	Trigger Reference Point (TRP)	Harvest status for 2011	Management action
Spanish mackerel	Ensure the sustainability of Spanish mackerel stocks.	Estimated catch by all sectors does not exceed the estimated sustainable yield of Spanish mackerel (450 tonnes).	Aggregate landings by all sectors reach 90% of the sustainable yield (405 t) and/or total fishery catch declines by 30% (based on whole weight) over the calendar year.	The total catch from the commercial and FTO sectors was 70% of the estimated sustainable yield. Had the Recreational and Indigenous sectors caught their full allocation the figure would account for only 87% of the estimated sustainable yield – TRP not reached.	1) Within three months of becoming aware of a triggered performance measure, NT Fisheries will review and consider appropriate management responses if necessary, including a clear timetable for implementation of management action.
		Sustainable yield estimates are reviewed annually.	Annual review.		Continue existing research and review alternative yield estimate methodologies annually.
Spanish mackerel	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 any stakeholder group changes over the calendar year by more than 20% (based on whole weight).		As per 1) above.

Species or group	Management objective	Performance indicator	Trigger Reference Point (TRP)	Harvest status for 2011	Management action
Byproduct	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 (based on whole weight).	There was no byproduct caught in 2011 – TRP not reached.	As per 1) above.
Bycatch	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).	There was no bycatch recorded during 2011 in this fishery – TRP not reached.	As per 1) above.
Threatened, endangered or protected (TEP) species	Minimise effects of fishing operations on TEP species or communities.	TEP species or communities are identified in NT waters.	Impacts are observed by commercial fishers or fisheries observers.	No TEP species interaction in – TRP not reached.	As per 1) above.

TIMOR REEF FISHERY STATUS REPORT 2011

INTRODUCTION

Commercial fishing plays a dominant role in the remote Timor Reef Fishery, primarily targeting the higher value goldband snapper (*Pristipomoides multidens)* and other *Pristipomoides* species. Significant quantities of red snappers (encompassing *Lutjanus malabaricus* and *L. erythropterus*), red emperors (*L. sebae*) and cods (Family Serranidae) are also harvested. Most of the catch from this fishery is sold on the Australian domestic market as 'fresh on ice' whole fish. There is little activity by recreational fishers and Fishing Tour Operators in the fishery due to the remote offshore location of the fishery. For similar reasons, no Aboriginal harvesting has been recorded from this fishery.

With the passage of revised jurisdictional arrangements in 1995, the management of the fishery was passed on to the Northern Territory (NT) Fisheries Joint Authority (NTFJA). Through the NT *Fisheries Act 1988*, NTFJA manages all the finfish taken from the fishery, while Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) conducts its day-to-day management.

In February, Individual Transferable Quotas (ITQ's) were implemented into the management arrangements of the fishery. The new arrangements better address sustainability risks to goldband, red snapper, and all other retained fish ('group' species) taken in the fishery by setting total allowable catches (TAC) for these species and removing unnecessary operating restrictions. The changes provided for equitable distribution of the TAC to existing operators and also provided the capacity to transfer the units.

The fishery has been assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The fishery received full Export Exempt accreditation under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The assessment demonstrated that the fishery is managed in a manner that does not lead to overfishing, and that fishing operations have minimal impact on the structure, productivity, function and biological diversity of the ecosystem. The fishery is due for reassessment in 2013.

PROFILE OF THE FISHERY

Commercial Sector

Area

The fishery operates well offshore in the Timor Sea, in a remote region extending north-west of Darwin to the Western Australia/NT border and to the outer limit of the Australian Fishing Zone. The fishery has an area of approximately 8400 square nautical miles (nm) (Figure 1).

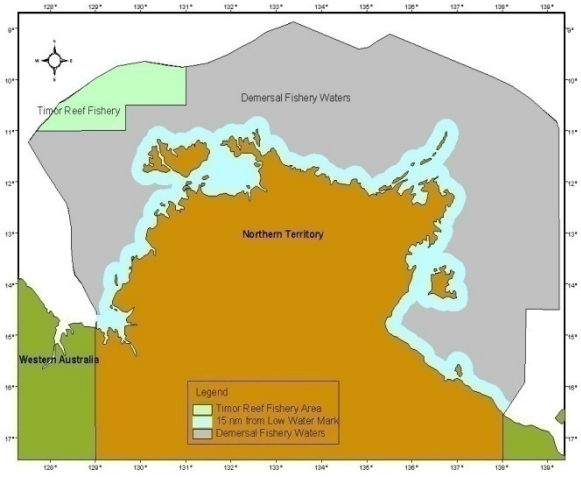

Figure 1. Area of the Timor Reef Fishery

Fishing Method

Commercial operators are authorised to use baited traps and lines, including hand lines, drop lines and finfish long lines. Prior to 1999, most operators in the fishery used drop lines. Trap fishing was introduced in 1999 and since then both gears have been in use, although the number of vessels using traps has increased since 2005 and for the last two years more than 80% of the catch has come from trap vessels. In

2011, one vessel used drop lines, five vessels used traps and two vessels used finfish long lines.

Catch

Goldband snappers are the principal target of the fishery, comprising the three species *Pristipomoides multidens*, *P. typus* and *P. filamentosus*. Together, they made up 48% of the total catch in 2011, with *P. multidens* being the most common (Figure 2). Other key species caught in the fishery were saddletail snapper (*Lutjanus malabaricus*), crimson snapper (*L. erythropterus*), red emperor (*L. sebae*) and cods (Family Serranidae). There was very little change in the species composition from 2010.

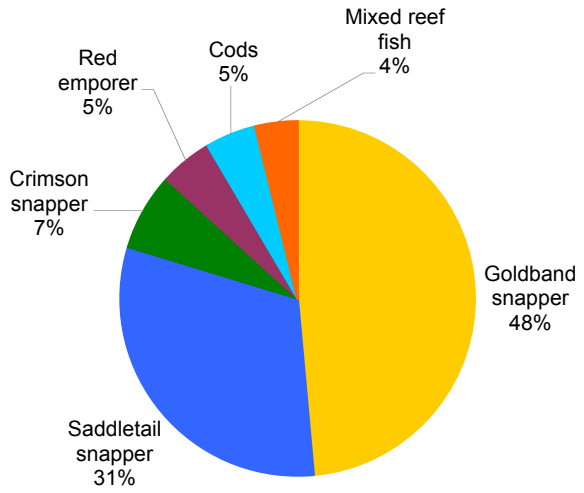

Figure 2. Catch composition of the commercial Timor Reef Fishery, 2011

The species composition of the catch has historically been gear-dependent. Drop liners generally catch a higher proportion of goldband snappers, compared with trap boats. This year was no exception, with the drop line vessel catching a higher proportion (59%) of goldband snapper than the trap boats (48%). Long line gear, which contributed to less than 2% of the total catch, caught a similar proportion of goldband as the trap vessels but a greater proportion of 'group' species (32%).

The total allowable commercial catch (TACC) for all species combined is 2615 tonnes. This is made up of 900 tonnes for combined goldband snapper species, 1300 tonnes for combined red snapper species, and 415 tonnes for all other retained species ('group' species).

In 2011, the total fishery catch was 716 tonnes, of which 347 tonnes were goldband snappers (Figure 3). This represented a decrease of 21% in total catch compared with 2010 (907 tonnes), with a commensurate decrease of 26% in the goldband snapper catch from 470 tonnes caught in 2010. The combined red snapper catch was 273 tonnes.

Total catch of group species was 95 tonnes. As well as red emperor (*Lutjanus sebae*), the group species included various species of rock cod, sea bream, grouper, emperor and tropical snapper.

Effort

During 2011, 16 licensees actively fished over a period of 924 boat days, a decrease of 596 boat days (39%) from the previous year (Figure 3).

Catch Rates

Catch per unit effort has steadily increased since 1999, which reflects the introduction of traps and increasing investment and efficiency in the fishery (Figure 4).

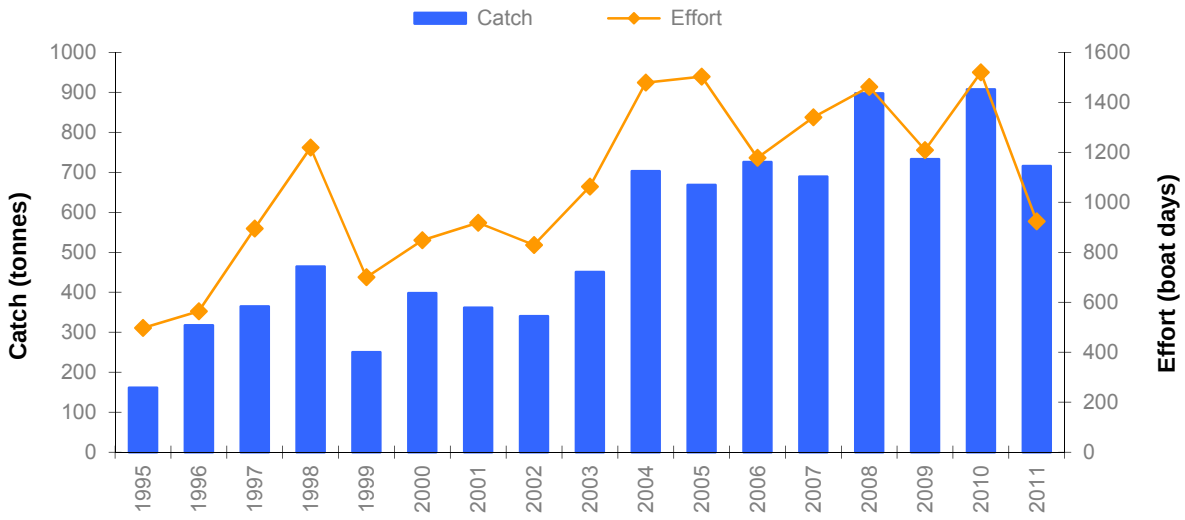

Figure 3. Commercial catch and effort for the Timor Reef Fishery, 1995 to 2011

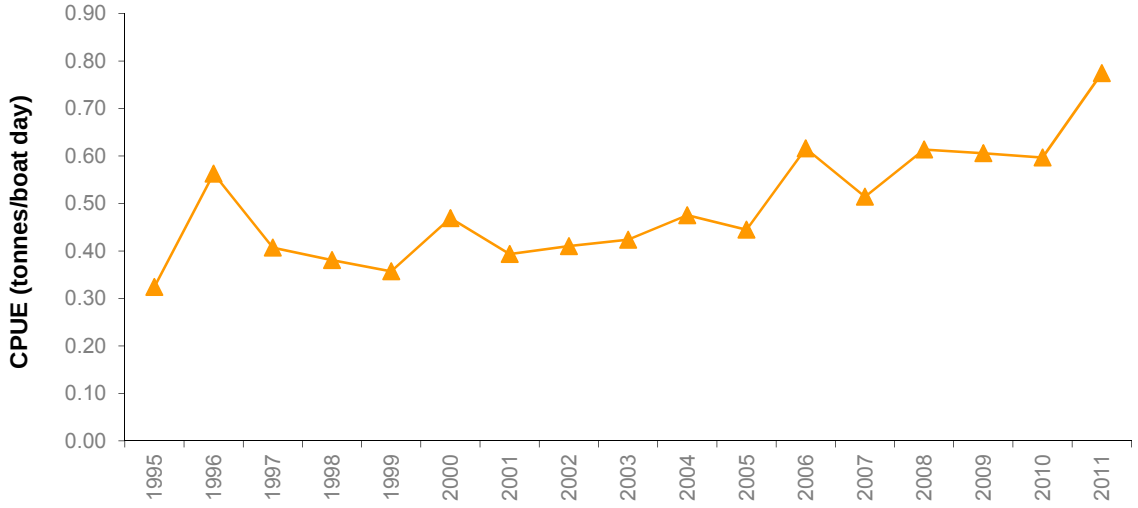

Figure 4. Commercial catch per unit effort (CPUE) for the Timor Reef Fishery, 1995 to 2011

Marketing

Currently, most snappers landed in the fishery 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 of the 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 coordinate consignments to east coast markets. At least one operator independently markets catch from his two vessels.

Non-retained Species

Non-retained species included hussar (*Lutjanus adetii*), starry triggerfish (*Abalistes stellatus*), trevally (Carangidae) and sharks. The recorded

amount of bycatch (non-retained species) in the fishery was around 8% of the total catch which is well within the objectives of the management framework.

Threatened Species Interaction

In 2011, no interaction between fishing gear and protected species was reported or observed in the fishery. Such interactions are not expected to occur in a deepwater line and trap fishery.

Ecosystem Impact

Operators are authorised to use lines and traps, which are passive fishing gears. Interaction with the habitat is limited to the effects of line weights and traps on the seabed, and the effect of anchors. To avoid excessive interaction with the seabed upon hauling, traps must be set separately with an identifying float and not attached to one another. Anchoring is usually limited to overnight standdown of fishing activity.

Fish trawling within the area of the fishery was prohibited in the late 1980s. Such a declaration sought to provide greater protection to the then emerging fishery from the impacts of demersal fish trawling. The Northern Prawn Fishery, managed by the Australian Government, operates year round in offshore waters throughout northern Australia. Prawn and scampi (deepwater shellfish) trawling activity is generally limited to water more 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, packers and marketers, and in other support industries, including transport, ice manufacturing, packaging, boat repairs and electrical maintenance services.

Economic Impact

At the point of first sale in 2011, the overall catch value of the fishery was $4.51 million. The goldband snapper component was valued at $2.98 million and the combined red snapper component was valued at $0.94 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. The logbooks provide detailed catch and effort information, as well as information on the spatial distribution of the fishery. Logbooks are required to be submitted along with monthly marketing information by the 28th day of the following month.

In addition to catch and effort logbooks, fishers are required to notify authorities when and where they intend to fish and with what gear prior to leaving port. Upon return to port fishers report the amount of fish by species group unloaded and who they sold it to. This information enables effective tracking of quota and reduces compliance costs significantly.

During 2011, a NT Fisheries researcher conducted one on-board monitoring trip. The researcher documented vessel and gear information, location, depth, fishing practices, catch composition (including bycatch) and, where possible, measured landed species. Information gathered during monitoring trips is used to crosscheck logbook returns, monitor bycatch, and provide biological data to assist in research and stock assessments.

Stock Assessment Methods and Reliability

A stock assessment of goldband snappers, using age structured stock reduction analysis (SRA), was completed in 2011. The model output predicted that goldband snapper has not been overfished and that harvest rate is approaching F_{msy} (the level of fishing mortality required to reach the maximum sustainable yield). The model also predicted that under current harvest rates, the chance of overfishing is around 10%. However, there was a high level of uncertainty surrounding these estimates and the major recommendations from the assessment were to obtain more accurate estimates of the current

harvest rate and more complete age information for goldband snapper. Of the methods available to estimate harvest rate, the most practical and effective for this fishery is to determine a better estimate of biomass using swept area surveys. A survey of this nature, to derive a time series of fishery independent estimates of relative biomass and collect larger samples for ageing, is planned for 2013. Stakeholder agreed Operational Decision Rules (ODR) are in place to ensure the harvest rate is appropriate at all levels of harvest up to the TACC (http://www.nt.gov.au/d/Content/File/p/Fish_Rep/TRF_DECISION%20RULES.pdf).

The most recent assessment of red snapper stocks was conducted in 1994, using surplus production and yield per recruit models (Ramm 1994, 1997). The assessment estimated a conservative annual yield of 1300 tonnes from the fishery. A stock assessment for red snapper, using the SRA model, will be completed in the near future and, to assist in future assessments, biomass and age data for red snappers will be collected in the swept area survey planned for 2013.

Current Status

Catches in the Australian sector of the Timor Sea are below current TACCs. In the Indonesian-controlled area of the Timor Sea, goldband snappers are targeted by Indonesian long line vessels and limited information exists on Indonesian catch and effort. However, genetic studies have shown a significant difference between goldband snapper in Kupang (West Timor) and the northwest Australian site (Ovenden et al. 2002). Otolith microchemistry also revealed distinct populations for all sites sampled across northern Australia and Indonesia (Newman et al. 2000). This suggests that fishing effort in Indonesia may have little impact on the stocks of goldband snapper in Australian waters.

Future Assessment Needs

Despite the results of the genetic studies on goldband snappers, some information is still required to enable a more accurate assessment of the fishery, including:

- A more accurate estimate of current Australian harvest rate.
- More complete age information for goldband snapper.
- Indonesian catch and effort information.

Given the proportion of red snappers in the catch, similar parameters are required for future assessment of those species.

RESEARCH

Summary

The stock structure of goldband snappers (*P. multidens*) has been determined by using both genetic methods and otolith microchemistry (Newman et al. 2000; Ovenden et al. 2002). These were collaborative projects between NT Fisheries, the Western Australian Department of Fisheries and Fisheries Queensland, which is a part of the Queensland Department of Employment, Economic Development and Innovation. 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 northwest Australian site. These sites were located less than 200 nm from each other on either side of the Timor Trench (Ovenden et al. 2002). Otolith microchemistry revealed distinct populations for all sites sampled, indicating that substantial movement of adults between sites is unlikely (Newman et al. 2000).

Fine scale spatial analysis of this fishery was conducted as part of a Fisheries Research and Development Corporation project, which commenced in October 2005 (Lloyd and Puig 2009). The project used GIS spatial statistical methods to investigate new ways to incorporate the very diverse forms of physical and environmental data, often on different scales, with fishery logbook data. This study showed that bathymetry and geomorphology strongly influenced catches of goldband snappers.

Monitoring and managing red snapper species (including goldband snapper) across northern Australia was addressed in a project completed this year (O'Neill et al. 2011). The project assessed current monitoring and logbook datasets across three jurisdictions (Queensland, Western Australia and Northern Territory) and confirmed the value of collecting fine scale data from the fishery. The project also developed a population modelling tool to evaluate potential management strategies and provided information for the development of a monitoring survey program using commercial vessels.

A project to ascertain if hearing damage occurred in goldband snappers due to seismic survey exposure was conducted by Curtain University in conjunction with NT Fisheries. The project was funded by Santos Ltd and was completed in December 2007. The results of the tests were deemed inconclusive and suggested more targeted work was required to isolate the causes of any noticeable effects.

Incorporation into Management

Recent research findings have confirmed the validity of present management arrangements for this fishery. Collaboration with Queensland, Western Australia and Indonesia will continue to provide information on the management of shared tropical stocks.

Current Research

Current research is focussed on developing a monitoring program that will provide regular, spatially-referenced age data and an index of relative abundance for the offshore snapper species across northern Australia. The data will provide essential information for establishing annual harvest rates and, in turn, ensure greater reliability of stock assessments.

NT Fisheries is currently collaborating with Indonesia and Timor Leste in the Arafura and Timor Seas Ecosystem Action Program, which aims to characterise the biological and socioeconomic profile of the Arafura and Timor seas (ATS) region and identify cross boundary issues, including the exploitation of fisheries. It is expected that this project will strengthen links between each of the countries bordering the ATS and improve the flow of information necessary to accurately assess offshore snapper fisheries.

MANAGEMENT/GOVERNANCE

Management

Objective

Management objectives for the fishery are achieved by maintaining target, 'group' and non-retained species catch levels within acceptable ranges. Should landings of target species 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 the fishery.

More information on the operational decision rules in place for the fisher can be found at: http://www.nt.gov.au/d/Content/File/p/Fish_Rep/TRF_DECISION%20RULES.pdf

History

Separate management measures were implemented for the fishery in 1993 when it was annexed from the Demersal Fishery. Limits were implemented on the number of operators in response to concerns that fishers displaced by fishing restructuring programs interstate may lead to over exploitation of goldband snapper stocks.

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 NT Government.

The Timor Reef Fishery Assessment Group was established to provide advice to the Timor Reef Fishery Management Advisory Committee (TRFMAC) and NT Fisheries on the potential of introducing a catch quota management system into revised management arrangements for the fishery. An outcome from these groups was the development and subsequent implementation of Individual Transferable Quotas in the fishery.

Current Issues

The effect of illegal, unreported and unregulated (IUU) fishing in northern Australian waters is not clearly understood. It is important that adequate resources are allocated by the Australian Government to mitigate IUU impacts on the sustainability of offshore snapper stocks across northern Australia.

The industry and NT Fisheries continue to liaise with oil and gas exploration companies in an effort to increase cooperation and reduce potential economic impacts on fishing operators by exploration activities.

Future Plans

NT Fisheries will continue to work with TRFMAC and the industry on matters relating to catch quota management. The introduction of a vessel monitoring system is being explored to complement the move to quota management arrangements for the fishery.

Goldband snappers landed adjacent to the boundary of the fishery are likely to form part of the same stock. Management triggers recognise this and management arrangements are under constant review.

Compliance

The Water Police Section (WPS) of the NT Police, Fire and Emergency Services is responsible for fisheries compliance and enforcement under the NT *Fisheries Act 1988*. The WPS effectively monitors compliance in the fishery through the inspection of vessels arriving in and departing from the single Port of Darwin. This may include verification of fishery logbook returns against processor returns (i.e. a requirement for all operators to specify where they are selling their product). If necessary, the WPS has the power to investigate the records of wholesalers and licensees. In 2011, no domestic compliance issues were recorded in this fishery.

The Commissioner of Police is currently considering engaging the Australian Fisheries Management Authority (AFMA) to undertake specific compliance services on their behalf in relation to the fishery. It is WPS intention for the administration, operational and 'day to day' compliance aspects of the fishery to be undertaken by AFMA.

Consultation, Communication and Education

Regular consultation occurs between NT Fisheries, the Timor Reef Fishermen's Association and the NT Seafood Council. In addition, NT Fisheries staff regularly visit the wharf to speak informally with fishers.

TRFMAC, consisting of representatives from all fishery stakeholder groups, and NT Fisheries provide advice to the Minister and the Executive Director of Fisheries on matters related to the management of the fishery.

NT Fisheries liaises with conservation groups and non-government organisations on matters of relevance to the fishery. NT Fisheries also produces publications in the form of Fishery Reports, Fishnotes and newsletters to inform and educate stakeholders.

Senior Research Scientist – Dr Julie Martin
Aquatic Resource Manager – Mr David McKey

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TREPANG FISHERY STATUS REPORT 2011

INTRODUCTION

Trepang fisheries in northern Australia date back to at least the 1700s, when Macassans from Celebes (Sulawesi Island group, Indonesia) visited northern Australia to fish for these species. The term trepang refers to the dried body wall of holothurian sea cucumbers, whereas the term bêche-de-mer refers to the cooked body wall.

Trepang fishing activity in the Northern Territory (NT) declined around 1880. By 1907, the South Australian Government ceased issuing licences to Macassans, possibly due to the emergence of a local industry. Landing reports, although scant, suggest the catch was many times higher than current levels.

A lower level of commercial exploitation continued until around 1945. Little fishing activity was observed until the early 1980s, with virtually no reported exports. Commercial fishers were generally European Australians assisted by Aboriginal people who inhabited the remote Arnhem Land coast.

Increasing interest in the late 1980s led to the re-opening of the NT Trepang Fishery.

Currently, there are six trepang licences, all owned by one licensee.

The principal target species in this fishery is sandfish (*Holothuria scabra*). It prefers coastal areas with soft sediment substrate and is often found in beds of seagrass, which plays an important role in triggering larval settlement.

Management arrangements for the NT Trepang Fishery were reassessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) in 2011. The fishery was subsequently accredited as a Wildlife Trade Operation (WTO) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) for a period of three years. The assessment demonstrated that the fishery was managed in a manner that does not lead to overfishing, and that fishing operations have minimal impact on the structure, productivity, function and biological diversity of the ecosystem. The fishery is due for reassessment in 2014.

PROFILE OF THE FISHERY

Commercial

Area

The fishery operates in waters to 3 nautical miles (nm) seaward of baselines (i.e. the NT coastline and surrounding islands). Most of the activity occurs along the Arnhem Land coast, the major harvest areas being around Cobourg Peninsula and Groote Eylandt.

Fishing Method

Sandfish is the most important species for tropical sea cucumber fisheries. It 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 tide 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 in water visibility improves and cyclone activity is minimal.

Catch

The total harvest of trepang in 2011 was 45.1 tonnes, which is an increase from the 22.2 tonnes obtained in 2010, and a decrease from the 2009 harvest of 64.6 tonnes (Figure 1). Total harvest peaked in 2002, with 371 tonnes of trepang harvested. No byproduct species were harvested in 2011 due to the hand-collecting method of harvesting.

Effort

Between 1996 and 2011, fishing effort varied substantially with many peaks and troughs observed (Figure 1). The 2011 effort was recorded as 54 days, which is a decrease from the 2010 effort of 58 days and the 2009 effort of 72 days. A significant decrease in effort has occurred since 2007 (227 days).

Catch Rates

Since 2006, catch rates have followed an overall trend of decline (Figure 2). However, two increases were observed in 2009 with a catch rate of 139 kg/hour and in 2011 with a catch rate of 107.9 kg/hour.

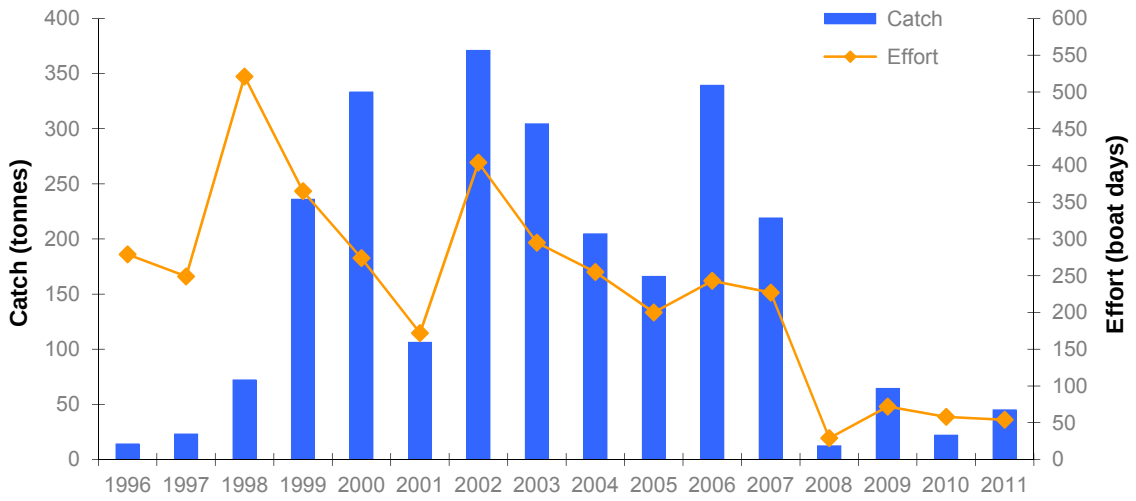

Figure 1. Annual total catch* and effort for the commercial Trepang Fishery, 1996 to 2011

*Catch weight indicates whole wet weight, which is double the reported gutted and blanched weight.

Figure 2. Catch per unit effort (CPUE) for the commercial Trepang Fishery, 1996 to 2011*

*Catch rates represented here are per hour of operation where a catch was declared in units of weight.

The low catch and effort values recorded in 2008 and 2010 have been attributed to a business decision by the Trepang Fishery licensee to concentrate effort in other jurisdictions and to focus resources on the aquaculture and ranching of trepang. The ongoing availability of skilled skippers and crew is also an operational issue for the NT Trepang Fishery. The skill of divers and in water visibility greatly impacts catch rates.

Marketing

With restricted land access to most of the NT coastline, all fishing operations are vessel based. Initial processing includes washing, grading and freezing the harvested product, with most operators removing the stomach, and then boiling and freezing the trepang. The processed catch is generally unloaded in Darwin (the only NT port with all season access) and transported to domestic facilities for further processing, which typically is mechanical drying.

Due to limited domestic demand, most of the catch is exported.

Recreational Sector

The recreational harvest of trepang is not known, but is 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 (Coleman 1998, Coleman 2004). The local Asian community may take limited amounts for personal consumption.

Fishing Tour Operator Sector

There were no reports of trepang in the catch of Fishing Tour Operator clients in 2011.

Indigenous Sector

No catch of trepang by Indigenous fishers was reported during the National Recreational and Indigenous Fishing Survey of northern Australia (Henry and Lyle 2003). Information collected during field trips suggested that trepang was never used as food by Aboriginal people.

Non-retained Species

Trepang harvesting usually occurs at low tide by hand collecting individuals. Due to this precise fishing method, there are no non-retained (bycatch) species.

Ecosystem Impact

Hand collecting of trepang is unlikely to have an impact on the sea floor. The effect of removing quantities of trepang from the ecosystem is unknown. However, with the current low participation rate and precautionary management, impacts are likely to be low.

Economic Impact

Confidentiality constraints prevent the publication of this information.

STOCK ASSESSMENT

Monitoring

Operators in the fishery are required to complete and submit catch (numbers and weight) and effort logbook information for each day of fishing. This information is used to assess the status of the fishery.

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 has no hard parts that might be a reliable indicator of weight. By reporting total weight and number in the catch, fishers nevertheless provide useful information on trends.

Fishers also continue to report fishing locality and harvest area in latitude and longitude so that future assessment and management may address the dynamic spatial attributes of the fishery.

Stock Assessment Methods and Reliability

Studies in Queensland indicate limited genetic variability between shallow and deepwater populations of sandfish. This 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.

Sexual reproduction of sandfish is via broadcast spawning, which generally occurs in the warmer months from December to February. The planktonic larvae of this species spend 10 to 14 days in the water column before settlement. Consequently, there is potential for larval dispersal between populations.

Although there is no current stock assessment for the fishery, Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) has adopted a precautionary management approach. This includes a limit on the number of licences (six) and the area of the fishery (i.e. within 3 nm of the NT baselines). This cautious management approach, together with natural inhibitors (visibility, accessibility, wet season and cyclonic events) limit the potential for overfishing.

Current Exploitation Status

In 2011, no performance measures for the fishery reached the trigger reference points.

If this was to occur in the future, an examination of the cause and implications of the trigger will be conducted and a report will be provided to the Executive Director of Fisheries. If necessary, NT Fisheries will consult with the industry and other stakeholders on the need for alternative management arrangements.

Licensed commercial operators are permitted to harvest all trepang species. Discussions with fishers indicate that the fishery continues to target sandfish in preference to other lower value species found in tropical waters. A review of trepang fisheries elsewhere indicates that in the event of a population decline in the higher value species, fishers seek to maintain profitability by targeting the lower-value holothurian species.

Such a situation was observed in the Queensland Bêche-de-mer Fishery, where commercial fishers targeted white teatfish (*Holothuria fuscogilvia*) and prickly redfish (*Thelenato ananas*), and in the Torres Strait fishery, where fishers targeted teatfish (*H. fuscogilvia, H. noblis*), prickly redfish and surf redfish (*Actinopyga mauritiana*). Such a trend has not been observed in the NT Trepang Fishery.

Future Assessment Needs

A program to develop a series of cooperative industry based projects is still being investigated. It is expected that a program of management strategy evaluation will be initiated to identify research directions and monitor information that would be appropriate for various management options. Research will seek to assess the status of stocks both within and outside the fishery.

Incorporation into Management

Future monitoring will depend on the information needs identified above and future fishery performance.

RESEARCH

Current research primarily involves analysis of trends in fishery statistics and assessment, and assimilation of research from other areas and jurisdictions.

The industry is working on trial hatchery techniques for sandfish concentrating on improving hatchery techniques and rearing of juvenile sandfish. This work is providing greater understanding of biological parameters relevant to the NT, including local growth rates.

In collaboration with Flinders University of South Australia, NT Fisheries and the South Australian Research and Development Institute, industry is conducting a genetic study of stocks along the NT coast. The results of this project will provide insight to the geographic extent of the mixing of

genetic information and assist in identifying any genetic evidence of geographically distinct trepang stocks in NT waters. It is anticipated that this research will be completed in 2012.

Work commenced in 2007 on an industry-funded pilot survey of NT coastal waters (inside 3 nm). The survey involved most of the NT coast with the exception of waters from Groote Eylandt to the NT/Queensland border. The survey utilised a 'stalled plate' trawl design; however, technical difficulties encountered during the survey may have limited the success of this approach. Further fine scale surveys will be conducted to aid in spatial management and projection of trepang distributions in the NT.

MANAGEMENT/GOVERNANCE

Management

Objective

The fishery management arrangements seek to conserve, enhance, protect, utilise and manage trepang stocks in the NT. Key management strategies include:

- Limiting the number of commercial licensees to a maximum of six.
- Having two separate management zones, with no more than three licences authorised to operate in each zone.
- Limiting fishing to an area extending from the high water mark to an imaginary line 3 nm from baselines.
- Limiting the number of crew and collectors/divers.
- 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 principal target species, indicate that the current arrangements are appropriate.

In addition, fishing in the tropical inshore waters of the NT with their large tidal range (exceeding 8 m in some areas) and distinct wet/dry monsoon seasons with highly turbid water, place operational limitations on the fishery in addition to the collection of trepang by hand. Highly turbid water impedes the effectiveness of hand gathering, with commercial operators reporting their inability to harvest trepang during spring tides and heavy flooding, often associated with the monsoons. As a result of these factors, actual fishing time is limited. These natural inhibitors are taken into account by management and are acknowledged as providing further protection to trepang stocks.

The fishery is managed in accordance with the management objectives, performance indicators, triggers and management actions agreed by the industry, NT Fisheries and the Australian Government assessment process as part of WTO accreditation (Table 1).

History

In the 1980s, six licences were issued for the harvesting of trepang by hand. 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 introduced at that time to regulate the number of crew and permitted divers/collectors.

Current Issues

Reported catch levels for the target sandfish in 2011 were within acceptable levels.

There is little information available on the magnitude and impact on northern Australian trepang stocks of illegal, unreported and

unregulated (IUU) fishing by foreign vessels operating in northern Australian waters. NT Fisheries continues to work with the Australian Government to ensure adequate resources are allocated to mitigate IUU impacts on the sustainability of trepang stocks.

Compliance

Fisheries compliance and enforcement in the NT is conducted by the Water Police Section (WPS) of the NT Police, Fire and Emergency Services, under the NT *Fisheries Act 1988*. The WPS monitors and enforces the fishery's management arrangements by inspecting vessels arriving in and departing from the single Port of Darwin. Compliance includes verification of fishery logbook returns against processor returns (i.e. requirement for all operators to specify where they are selling their product). If necessary, WPS has the power to investigate the records of wholesalers and licensees.

In 2011, no significant compliance issues were recorded for the fishery.

Consultation, Communication and Education

Periodic consultation occurs between NT Fisheries, the holder of the trepang licences and the NT Seafood Council on matters related to the continued long term ecologically sustainable management of the fishery.

NT Fisheries also liaises with conservation groups and non-government organisations on relevant matters.

Fishery Reports, Fishnotes and newsletters are published to inform and educate stakeholders.

Senior Research Scientist - Dr Thor Saunders
Aquatic Resource Management Officer - Mr Steven Matthews

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Coleman, A. P. M. (1998). Fishcount: A Survey of Recreational Fishing in the Northern Territory. Department of Primary Industry and Fisheries *Fishery Report* 43.

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Table 1. Management objectives and status against performance indicators for the NT Trepang Fishery for 2011

Species or group	Management objectives	Performance indicator	Trigger reference point (TRP)	Harvest status for 2011	Management action
Target species	Ensure intergenerational equity by maintaining ecologically sustainable annual catches in all sectors.	Sustainable yield estimates developed. Change in total catch.	Total catch increases over 300 tonnes per year.	Trepang catch in 2011 was 45.1 tonnes - TRP not reached.	The Executive Director of Fisheries (EDF) to be notified within 60 days if TRP reached.
		Change in CPUE.	CPUE for *Holothuria scabra* increases or decreases by 30 % compared with the mean of the previous three years.	The 2011 CPUE value was 10 % higher than the previous three-year average - TRP not reached.	An internal examination of cause and implication of TRP being triggered with report prepared within six months to the EDF. Consultation with industry and other stakeholders on need for alternate management strategy or action if necessary and agreement on line of action.
		Change in average weight.	Individual average weight decreases by more than 20%.	The average individual weight decreased by 18% in 2011 - TRP not reached.	
		Change in catch composition.	Catch of trepang species other than *H. scabra* increases to over 30% of total catch.	*H. scabra* were the only species harvested in 2011 - TRP was not reached.	If appropriate, any amended arrangements to be implemented within 12 months of trigger being reached.
		Change in licence ownership.	Any licences traded.	There were no licences traded in 2011 - TRP was not reached.	
Byproduct and bycatch species	Ensure sustainability of byproduct and bycatch species taken in the NT Trepang Fishery.	Monitoring logbook. Onboard monitoring.	NA - no byproduct or bycatch in the fishery.		NA

RECREATIONAL

FISHING TOUR OPERATOR STATUS REPORT 2011

INTRODUCTION

By the middle of the 1980s, a handful of barramundi guides and fishing lodges had begun operating in various locations throughout the Northern Territory (NT). By 1989 there were 24 guided fishing businesses and a well organised Fishing Tour Operators' Association.

This was the start of a boom period in guided fishing tourism that was triggered by the NT Government decision to allocate barramundi resources to the recreational fishing sector in several key areas. The remarkably rapid growth of this industry necessitated more formal management, leading to the introduction of Fishing Tour Operator (FTO) licences in 1993. Licence numbers peaked at 218 in 1997.

Most FTOs target barramundi in coastal and inland areas, while others operate offshore targeting other species. Vessels range in size from small dinghies up to luxury motherships.

FTOs and their clients observe the same fishing controls as recreational fishers and none of their catch may be sold or bartered.

FTOs operating in Kakadu National Park require an additional permit issued by the Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC).

PROFILE OF THE FISHERY

Area

The majority of FTOs operate in areas which are accessible to the general public. A large proportion of FTOs operate out of Darwin but the industry is well represented in the regional areas of Gove and Katherine. While several FTOs are based on big tidal rivers, some are based on Aboriginal land and others operate from bush camps, lodges and commercial accommodations.

While FTO licence conditions do not generally restrict access to specific areas other than those not accessible to recreational fishers, there are restrictions on the number of commercial operations allowed in specific areas managed by SEWPaC and the NT Parks and Wildlife Commission. 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 as those that may be used by other recreational fishers. Most FTO fishing activity is conducted using lines (rod) with bait, or trolling or casting with an artificial lure. FTOs submit logbook returns to Fisheries Division of the Department of Primary Industries and Fisheries (NT Fisheries) for each day spent fishing. The numbers of various species caught and released are recorded together with the number of line hours spent barramundi fishing, game fishing, reef fishing, crabbing or using other methods, such as cast netting or drag netting.

Catch and Effort

In 2011, the total FTO catch was 162 607 fish, representing a 22% decline from the peak catch of 207 858 in 2006 (Figure 1).

Barramundi continued as the species most frequently caught with a record catch of 63 859 in 2011, an 8% increase from the previous peak in 2006 (Figures 2 and 3). Most barramundi (87% average over an 18 year period) caught by FTOs are released. In 2011, 58 266 barramundi (91% of the catch) were released.

Other common species caught by FTOs in 2011 included golden snapper (13 101), stripey snapper (also known as Spanish flag, 12 157), grass emperor (also known as tricky snapper 7261) and trevally (6519) (Figure 2). While trevally has a high rate of release (93%), the release rate for the other species averages 63%.

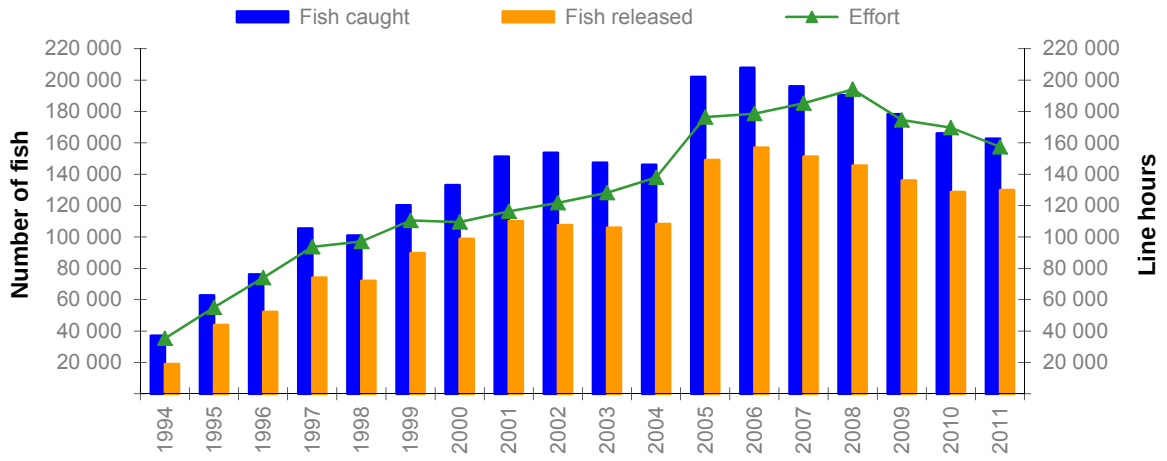

Figure 1. Catch, release and total line-hours fished by FTOs, 1994 to 2011

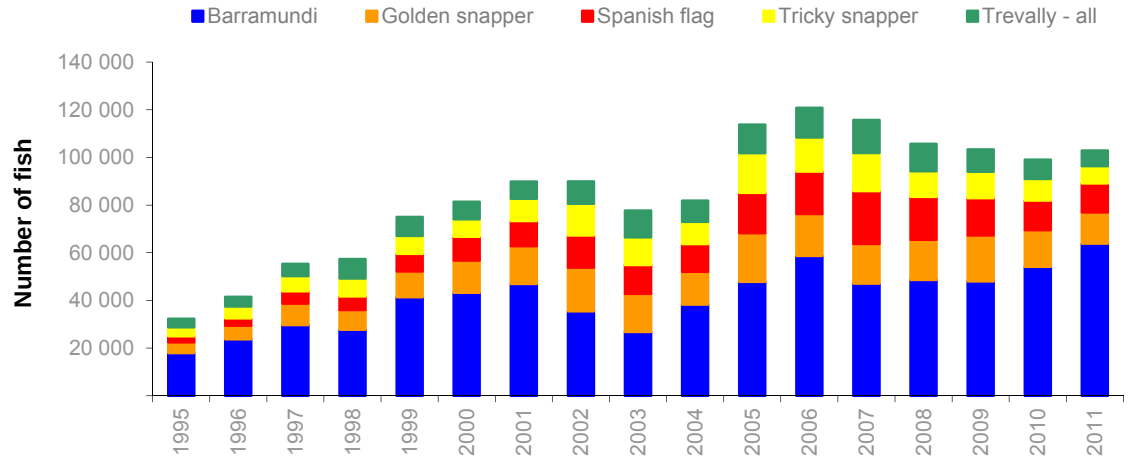

Figure 2. The five species most frequently caught by FTOs, 1994 to 2011

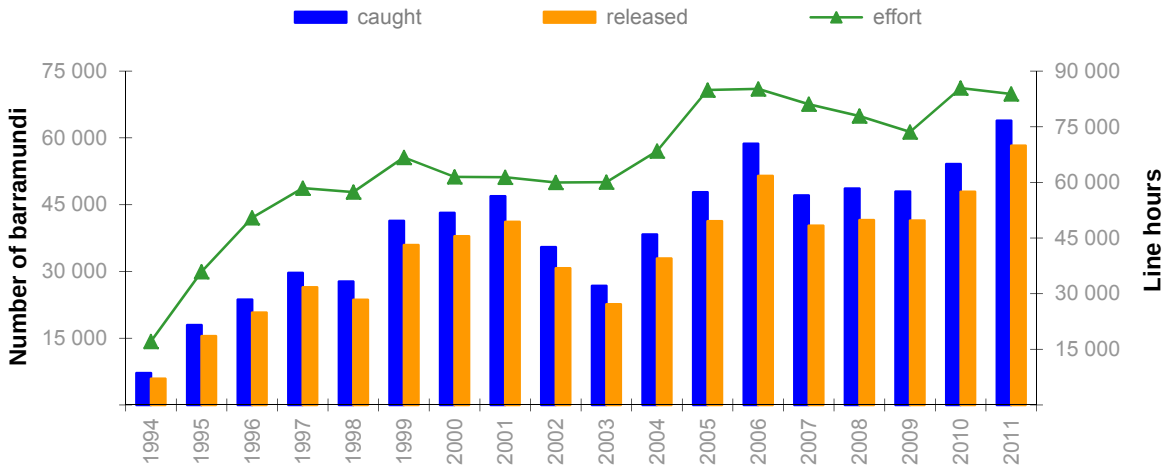

Figure 3. Total barramundi numbers caught and released, and line hours fished by FTOs, 1994 to 2011

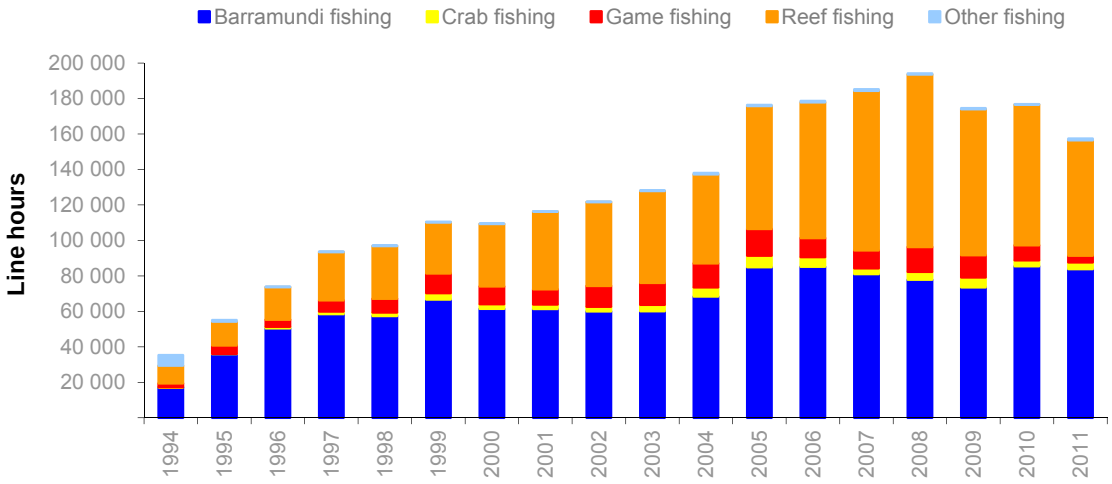

Figure 4. Line hours spent fishing by FTOs using various fishing methods, 1994 to 2011

In 2011, 157 431 line hours were spent fishing, representing a decline of 19% from the peak of 194 085 hours spent fishing in 2008 (Figure 1). Barramundi fishing has traditionally accounted for the majority of the fishing effort; however, in 2008 and 2009, reef fishing was the most predominant method of fishing (Figure 4). In 2011, barramundi fishing once again accounted for the majority of fishing effort with 83 846 line hours, representing 53% of the total FTO effort (Figure 4). In addition, 65 072 line hours were spent reef fishing in 2011, representing 41% of total FTO effort (Figure 4).

Reef fishing catch per unit effort (CPUE) Territory-wide has declined significantly over the past decade across all sectors. Figure 5 below specifically shows the decline in the FTO CPUE for golden snapper caught in the Darwin area from 0.32 fish per hour in 2000 to 0.12 fish per hour in 2011.

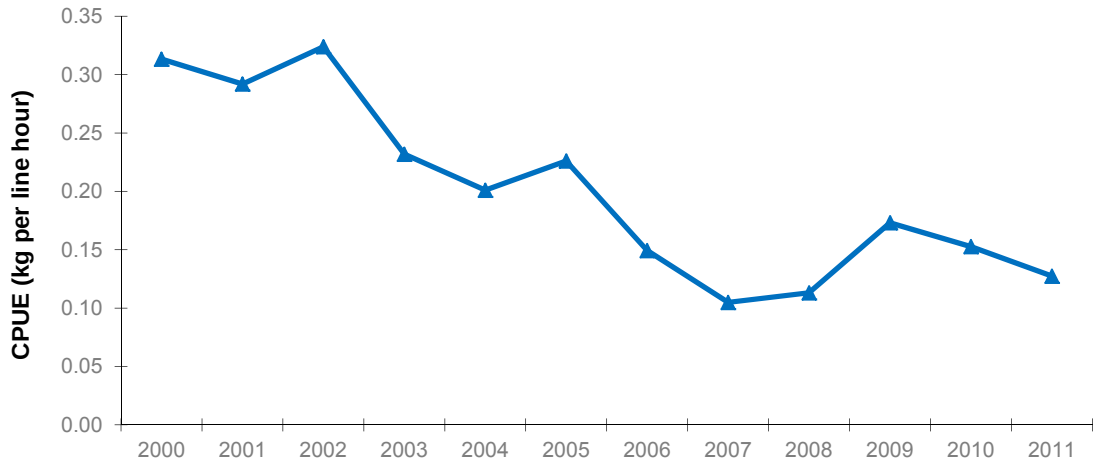

Figure 5. Golden snapper catch per unit effort (CPUE) for the FTO sector in the Darwin area (Area Grid 1230), 2000 to 2011

Non-retained Species

More than 75% of all fish caught by FTOs are released after capture. However, studies have shown that many reef fish species caught from water deeper than 10 m are susceptible to pressure induced injuries (barotrauma) that greatly increase levels of post-release mortality. Jewfish, golden snapper and other commonly caught reef fish species are highly susceptible to the effects of barotrauma and are unsuitable for catch and release in water deeper than 10 m.

Ecosystem Impact

No detrimental effects on ecosystems have been linked to the guided fishing industry.

Social Impact

There was a consistent increase in the number of 'client days' fished between 1994 (5583 client days) and the peak of 2008 (34 370 client days). In 2011 there were 26 848 client days fished, representing a 22% decline compared with the peak in 2008. Most client days fished in 2011 were by anglers from Victoria (6923), New South Wales (5696) and NT (5007). In addition, 650 clients (2.4%) were from other countries (Figure 6).

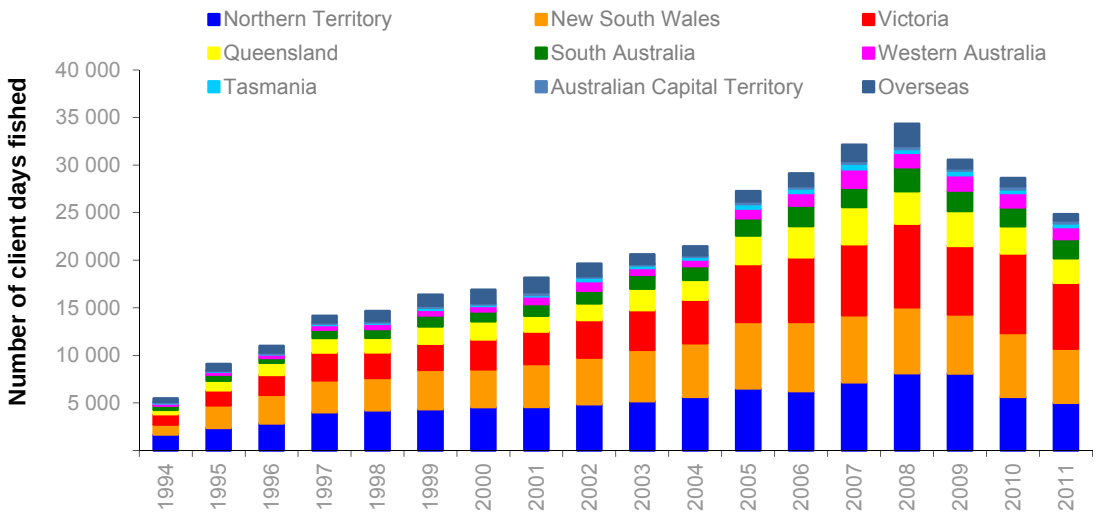

Figure 6. FTO client days fished and client origins, 1994 to 2011

Economic Impact

The FTO industry is an important contributor to the Territory's tourism sector; with approximately 70% of FTO clients being visitors from interstate or overseas, bringing new money into the economy. A recent valuation of the NT guided fishing industry for the three years 2008/09-2010/11 indicates the estimated average value of production is over $15 million per annum. The total economic impact of the sector for the same three year period is estimated at over $26 million per annum, with approximately 80% ($22 million) of this figure attributable to spending by interstate and overseas tourists. The estimated indirect employment impact is over 300 additional non-FTO jobs (in the wider NT economy) per 100 direct FTO jobs.

STOCK ASSESSMENT

Monitoring

The guided fishing tourism industry is monitored primarily through logbook returns information. Annual logbook data summaries are compiled to show the number of each species caught and released, fishing methods used, time and areas fished and client origins. In addition, NT Fisheries staff conduct onboard monitoring of this sector to obtain information on size structure and biology of key target species.

Stock Assessment Methods and Reliability

Data from FTO logbook returns and recreational fishing surveys are used for species-specific stock assessments. Details have been included in individual Fishery Status Reports elsewhere in this publication.

Current Exploitation Status

Although FTOs maintain a release rate of around 75% of their total catch, substantially increasing reef fishing effort is generating concern regarding the sustainability of several reef species with vulnerable life history characteristics (slow growth, late maturity) and a susceptibility to barotrauma. Releasing reef fish captured from water deeper than 10 m is no longer considered best practice and management strategies to most effectively conserve these fish stocks are being developed.

Future Assessment Needs

The FTO logbook returns provide essential data to fishery managers. These are combined with data from recreational fishing surveys to provide an overview of the NT recreational fishing sector. Results from the most recent recreational fishing survey are expected in 2012.

RESEARCH

Summary

All fisheries research on recreationally significant species is important to FTOs. The current relevant research programs focus on golden and other snappers, black jewfish, barramundi, sharks, Spanish mackerel and mud crabs. Detailed information is available in the relevant Fishery Status Report.

Incorporation into Management

Assessment of FTO and recreational fishing survey data, combined with outcomes from specific research programs, are considered when decisions are made regarding fishery area restrictions, regulation amendments, infrastructure developments, and land and native title claims.

Current Research

Although FTO clients release the majority of the fish they catch, they do have the potential to impact on the sustainability of key species, particularly the more sedentary species and those affected by barotrauma. NT Fisheries is currently working with the sector to study barotrauma and to better understand catch composition (e.g. size classes of different reef fish caught).

Current research is focused on the sustainability of key species, including a range of tropical snappers, black jewfish, barramundi, Spanish mackerel, mud crab and sharks. Details of these research programs can be found in the relevant Fishery Status Reports.

MANAGEMENT/GOVERNANCE

Management

Objective

The primary management objective for the guided fishing industry is to ensure its development is managed in a sustainable manner.

History

Guided fishing tourism began to increase in the mid-1980s. By 1989, there were 24 guided fishing businesses in the NT. FTO licences were introduced in 1993. They were issued free of charge until the 2007 licensing year. Licence numbers are not limited. Figure 7 illustrates the number of FTO licences issued each year since 1994 and those actively operated. Inactive licences account for around 35% of licences issued for any year.

Future Plans

In 2011, NT Fisheries continued working with the NT Guided Fishing Industry Association (NTGFIA) focusing primarily on the sustainability of key target reef fish species, refining the existing licensing framework and improving safety standards and the professionalism of the industry. A range of proposals regarding these and other matters will be made available for public comment in a discussion paper that will be released in 2012.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services is responsible for monitoring and enforcement of fishery regulations under the NT *Fisheries Act 1988*.

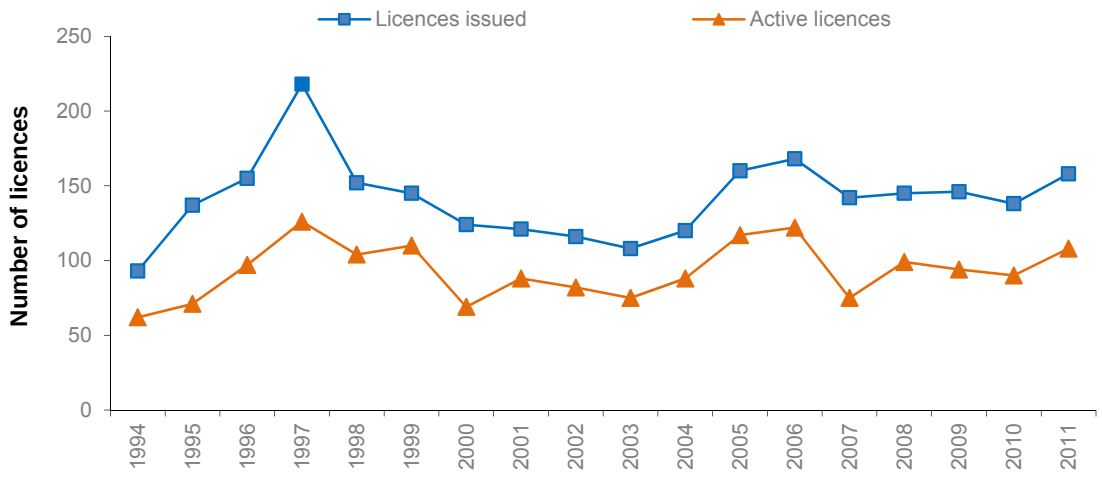

Figure 7. The annual number of FTO licences issued and those actively fished from 1994 to 2011

Consultation, Communication and Education

The establishment of NTGFIA enhanced consultation and communication between government agencies and the guided fishing industry.

The Guided Fishing Industry Steering Committee has been established consisting of representatives from both government and industry.

Aquatic Resource Management Officer, Recreational Fishing – Mr Kane Dysart

RECREATIONAL FISHING STATUS REPORT 2011

INTRODUCTION

Recreational fishing is an important part of the lifestyle of the people of the Northern Territory (NT), which has the highest level of recreational fishing participation per capita than any other part of Australia. Fishing tourism is important to the NT economy. Its success and popularity largely depend on the number and size of barramundi available in the NT. Approximately half of all barramundi caught recreationally in Australia come from NT waters (Henry and Lyle 2003).

There are many extensive inland tidal river systems that provide world class sport fishing for barramundi. The peak barramundi season occurs from March to June when wet season flood waters recede from the floodplains to the sea. However, barramundi are available throughout the year and can be caught in a range of fresh and saltwater habitats. The months preceding the Top End's wet season are also highly productive and barramundi are caught during that time in coastal saltwater environments and freshwater billabongs.

Although barramundi are a famous table fish, the majority (76%) of those caught by NT and visiting anglers are released. Fishing Tour Operators (FTOs) release nearly 90% of the barramundi they catch.

Part of the attraction to barramundi fishing in the NT is the diversity of fish species, habitats and fishing methods that anglers experience. Species caught during targeted barramundi fishing include saratoga, sooty grunter, king and blue threadfin, queenfish, golden snapper and mangrove jack. During the cooler dry season, many anglers target inshore migrations of mackerel and tuna. Sailfish and black marlin are often caught. Mud crabs are best targeted in the dry season when they are most abundant and easily caught.

Reef and bottom fishing is the most popular targeted fishing method after barramundi fishing. This is largely due to the high eating quality of many of the reef species. Black jewfish, red emperor, coral trout and a range of tropical snappers are targeted more often each year. Increasing bottom fishing effort and catch of these and other key reef species require close monitoring, especially in more populated areas. It is important that anglers become more aware of low survival rates of fish caught and released in water deeper than 10 metres.

Possession and size limits are the primary catch controls for recreational fishing in the NT. However, seasonal area closures also apply to the lower Mary and Daly Rivers during barramundi spawning periods.

One of the most important requirements for successful fishing in the NT is a boat. Although some landbased fishing opportunities exist, large tidal movements and the presence of saltwater crocodiles make boat fishing a safer and more productive option.

Some areas around the NT are closed to commercial barramundi netting to allocate the resource to recreational fishing and tourism. All waters within Kakadu National Park are closed to commercial fishing.

The NT Government continues to expand artificial reef sites close to Darwin and further offshore at Fenton Patches. These structures are for the specific benefit of recreational anglers and divers. Commercial fishing near these artificial reefs is not permitted.

There are several fishing clubs throughout the NT and various major annual fishing tournaments are conducted. Most tournaments are barramundi-specific with rules that promote 'catch and release' fishing. There are also a number of saltwater fishing competitions that focus on other sport, game and reef fish.

PROFILE OF THE FISHERY

A recreational fishing survey conducted in 1995 indicated that about 35% of the non-indigenous NT population fish in Territory waters (Coleman 1998). A survey in 2001 revealed a participation rate of 29% (Coleman 2004). Reports on each of these surveys are available from Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries). Participation rates and other key data from a survey completed in 2010 are expected in 2012. The information below relates primarily to the 2001 survey.

Area

The 2001 recreational fishing survey determined that over 25% of all recreational fishing in NT waters took place in Darwin Harbour, Shoal Bay and the offshore area adjacent to Darwin. About 40% of recreational fishing activity occurred in estuaries and 30% in rivers. A further 22% is focused within 5 km of the coast, 6% occurs further offshore and 2% took place in impounded waters. The Mary River accounted for 11% of all hours fished, while all other survey areas individually accounted for less than 10% of hours fished.

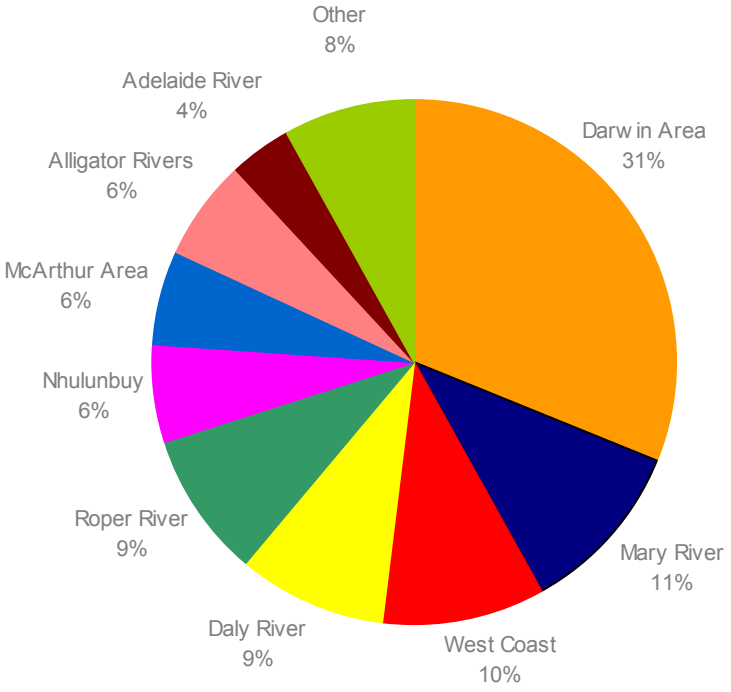

Figure 1. Recreational fishing line hours (time spent with lines in the water) by residents and visitors by areas fished from the 2001 recreational fishing survey of the NT (Coleman 2004)

Fishing Method

More than 75% of all recreational fishing in NT waters is conducted from boats, with 84% of fishers using lines. Artificial lures are used during half of all the time spent line fishing and bait is used during 41% of this time. A combination of lures and bait is used during 10% of all time spent line fishing. Fifteen per cent of fishing effort involves the use of pots and traps. The 2001 survey recorded very little use of cast nets, drag nets or other gear.

Catch

Of the 1.83 million aquatic organisms reported during the 2001 survey, 1.6 million (89%) were fish, while fewer than 0.2 million were crabs, molluscs and other types of aquatic life. Barramundi is the species most predominantly targeted by anglers in the NT. Most barramundi caught by recreational fishers are released. Saratoga, sooty grunters, king threadfin, golden snapper and mangrove jack are often caught on the same lures, baits and flies used to target barramundi. Many other popular saltwater species can be caught throughout the year, including red emperor, coral trout, black jewfish, blue tusk fish, saddletail snapper, blue lined emperor, queenfish and trevally.

Effort

The 2001 survey reported that people in the NT spent 314 272 days (or 1.9 million hours) fishing recreationally in that year. Residents fished an average of five days in that year, a decline from the average of eight days per year recorded during the Fishcount 95 survey. However, the number of hours spent fishing by visitors to the NT increased from 23% in 1995 to 37% in 2001.

Queensland visitors accounted for 33% of this increased effort, while New South Wales and Victorian visitors accounted for 26% and 16% respectively. Recreational fishing visitor numbers are highest in the dry season, when they account for 40% of all fishing effort. Visitor numbers are lowest in the wet season when they account for 15% of the overall effort.

Non-retained Species

Fifty-five per cent of all aquatic animals recorded during the 2001 survey were released. This was an increase over the 43% released in 2000-01. An increasing number of anglers release some or all of their catch. There is a particularly strong trend toward releasing larger barramundi in recognition of their increased spawning potential.

NT Fisheries supports the Released Fish Survival Program, which advocates methods that enhance the survival of released line caught fish. Recommended methods include the use of fish-friendly tackle such as environets and circle hooks.

Studies by NT Fisheries revealed that at least 90% of lure caught barramundi survive after release. However, studies on the effects of barotrauma on released black jewfish indicate that almost half of those caught from depths of more than 10-15 metres sustained life threatening injuries and were considered unlikely to survive after release. Similar studies on golden snapper indicate that they are also susceptible to barotrauma. Educational material has been produced to make recreational fishers aware of the effects of barotrauma on various fish species when fishing in deep water.

Ecosystem Impact

Although no significant studies have been conducted on the effects of recreational fishing on natural NT ecosystems, no major detriment has been identified. The National Policy for Recreational Fishing and The National Code of Practice for Recreational and Sport Fishing promote the importance of ecological awareness. The River Watch Program also promotes environmental awareness in the fishing community.

Social Impact

The 2001 survey found that about 44 000 (32%) of non-Indigenous NT residents fish for recreation. Most anglers surveyed reported that they fish to be outdoors and to relax and unwind, while others mainly fish to be with family and friends. Catching fish for sport and the table were also important motivators, while comparatively few anglers fish to participate in competitions.

Recreational fishing is a significant lifestyle activity in the NT, where participation rates and boat ownership are proportionately higher than elsewhere in Australia and fishing for consumption is not always the primary motivator.

Economic Impact

The 2001 survey indicated that $34.7 million is spent in the NT each year on recreational fishing. Most of this expenditure is for the purchase of boats, vehicles and associated running costs. The purchase of fishing gear is another significant expenditure. Visitors to the NT contribute 25% of this amount.

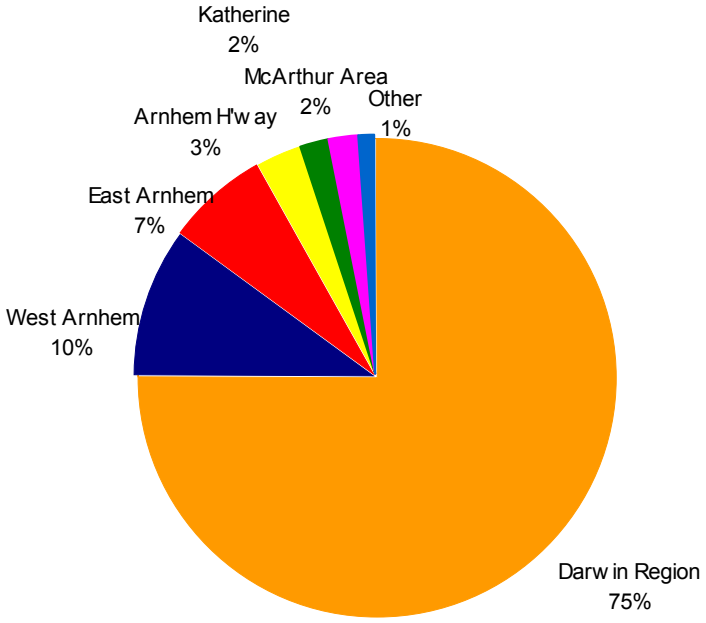

Figure 2. Annual expenditure by survey zones in the 2001 recreational fishing survey

STOCK ASSESSMENT

Monitoring

Broad scale recreational fishing surveys were conducted in 1995, 2001 and 2010. Results from the 2010 survey are expected to be available in 2012. Many research programs by NT Fisheries focus on the species that are important to recreational, commercial and Indigenous stakeholders. Current research on snappers, Spanish mackerel, sharks, barramundi and mud crabs is particularly important to recreational fishing. Outcomes of this research will influence future management decisions. More specific information on research programs relevant to recreational fishing is provided in individual Fishery Status Reports in this publication.

Some fishing tournaments have participants tagging fish as well as providing catch and effort information. For example, details of all fish caught, measured, tagged and released in the annual NT Barra Classic held on the Daly River are reported to NT Fisheries. The detail provided to NT Fisheries which has provided a substantial amount of information to assist with the sustainable management of the barramundi stock in this river.

Stock Assessment Methods and Reliability

Research, recreational fishing survey, FTO and commercial fishing data are used for fishery stock assessment purposes. Details are included in the relevant Fishery Status Reports.

Current Exploitation Status

Exploitation levels determined by tagging and stock assessments have generally indicated that the fish stocks targeted by recreational fishers are sustainable across the NT. However, in some heavily utilised areas, the total catch of many reef species now exceeds the maximum sustainable yield.

Future Assessment Needs

There is a need to obtain a better understanding of catch and effort in the recreational fishing sector. This issue will be partially addressed by the 2010 survey report due to be released in 2012.

RESEARCH

Summary

Fishcount 95 provided a valuable dataset which was updated by the Northern Territory component of the National Recreational Fishing Survey in 2001. In 2012, this dataset will be further updated using survey data collected in 2010.

Fisheries research is generally species or area-specific. Many species researched are important to recreational, commercial and traditional fishers. Current research programs of relevance focus on golden and other snappers, black jewfish, barramundi, sharks, Spanish mackerel and mud crabs. Specific details are provided in individual Fishery Status Reports in this publication.

Incorporation into Management

Recreational catch and effort information from surveys is utilised in conjunction with data from other sectors to assist with the management of key species.

Current Research

Currently, the most significant research for recreational fishers relates to tropical snappers, black jewfish, barramundi, sharks, Spanish mackerel and mud crabs.

Research on the susceptibility of golden snapper and black jewfish populations to overfishing and barotrauma continued throughout 2011.

Tagging of golden snapper is ongoing to gain a better understanding this species' movements throughout its lifecycle.

A trial to determine the success of vents built into the mesh of pots to enable the escape of juvenile mud crabs continued in 2011.

When completed, findings from the 2010 recreational fishing survey will be incorporated in future fishery assessments.

MANAGEMENT/GOVERNANCE

Management

Recreational fishing in the NT is managed by NT Fisheries through the NT *Fisheries Act 1988*, supporting Regulations and various fishery management plans. Management controls include species-specific personal possession limits and a general personal possession limit. Minimum size limits apply to barramundi (55 cm) and mud crabs (male 13 cm, female 14 cm) and a maximum size limit of 1.2 m 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 fishing restrictions apply at Stokes Hill Wharf. No fishing is allowed at the Doctors Gully Aquatic Life Reserve. In addition, a number of commercial fishing closures apply in popular areas to provide sole recreational access to the resource in these areas.

Permits are required by recreational fishers intending to fish waters within or abutting Aboriginal land. Information on permit requirements is available from the Northern Land Council and the Tiwi Land Council. The Amateur Fishermen's Association of the Northern Territory (AFANT) issues permits for access to the Tiwi Islands.

More information in relation to recreational fishing controls in the NT can be found in the Recreational Fishing Controls booklet from NT Fisheries or on its website.

History

Prior to 1991, recreational fishers in the NT were required to observe a daily barramundi bag limit of five per person and a limit of ten for individuals on extended trips. In 1991, the concept of daily 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 30 mud crabs per vessel when three or more people are on board.

Personal possession limits of five Spanish mackerel and five black jewfish were introduced in 1993 and 1997, respectively. These limits were reduced to two in 2010. In 1997, the general possession limit of 30 fish per person was introduced, but this did not include the specific possession limits for managed finfish until 2002.

A NT-wide requirement to release female freshwater crustaceans carrying eggs or live young was introduced in 2011. The Daly River Fish Management Zone (DRFMZ) was also declared in 2011, with reduced personal possession limits of three barramundi and 30 freshwater crustaceans, including a maximum of ten freshwater prawns. A vessel limit of 90 freshwater crustaceans was also introduced in the DRFMZ when three or more people are on board, and this includes a maximum of 30 freshwater prawns. Reduced freshwater pot limits in the DRFMZ are three per person and six per vessel when two or more people are on board.

The Mary River was closed to commercial barramundi gillnetting in 1988. Similar closures followed for the Daly River in 1989, 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 McArthur River in 2002, the Adelaide River in 2004 and the Finniss River and Bynoe Harbour in 2010. These closures have been implemented together with voluntary commercial fishing licence buybacks to allocate the barramundi resource solely to the recreational sector in these areas.

Barramundi Stocking

To provide alternative recreational fishing opportunities, NT Fisheries continued stocking Manton Dam in 2011 with the release of 5 000 barramundi fingerlings.

Current Issues

The sustainability of reef fish populations and the maintenance of access rights to historic fishing areas are the main issues for recreational fishers in the NT.

Future Plans

A draft recreational fishing development plan has been compiled, with a focus on future sustainable management and data collection, catch controls, access and infrastructure requirements, industry development, resource sharing and improving community stewardship of fishery resources. The draft development plan was compiled by a community-based working group and will be made available for public comment in 2012. One of its key objectives is to ensure that recreational fishers adopt greater responsibility for the management of aquatic resources and the development of recreational fishing.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services is primarily responsible for fisheries compliance and enforcement in the NT.

Recreational fishing controls are displayed on signage at boat ramps, launching sites, tourist

establishments and River Watch Centres throughout the Top End of the NT.

Consultation, Communication and Education

The Amateur Fishermen's Association of the NT (AFANT) is the peak representative association for recreational fishing in the NT, while the NT Guided Fishing Industry Association (NTGFIA) represents the guided fishing industry. NT Fisheries consults primarily with these associations on recreational fishing issues and future management and development. Public consultation is conducted when broader matters require community input. The NT Government provides annual funding to both associations to assist them in their roles.

Signage depicting fishery regulations and other advice is erected at boat ramps, launch sites and fishing tourism establishments throughout the NT. Information on recreational fishing in the NT is also available from NT Fisheries. Literature on recreational fishing is also provided on the NT Fisheries website and at various shows and exhibits throughout the NT.

Aquatic Resource Management Officer, Recreational Fishing – Mr Phil Hall

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AQUACULTURE

AQUACULTURE INDUSTRY SUPPORT AND DEVELOPMENT STATUS REPORT 2011

SUMMARY

The Northern Territory (NT) aquaculture industry's total value declined by 43% in 2011 to $15.4 million compared with $27.1 million in 2010. This decline was due mainly to lower production in the pearl farming industry.

A privately-run pilot sea cucumber hatchery continued to meet its research objectives and move towards the goal of establishing a sea cucumber farming industry. The company is conducting sea cucumber ranching trials in conjunction with an Aboriginal community on Groote Eylandt.

An additional sea cucumber ranching trial continued on Goulburn Island in 2011 in collaboration with Fisheries Division of e Department of Primary Industry and Fisheries (NT Fisheries), the Warruwi community and a private company.

PROFILE OF AQUACULTURE

National Issues

NT Fisheries is a member on two national committees of importance to aquaculture, namely the Sub-Committee on Aquatic Animal Health and the Aquaculture Committee. These committees provide advice to the National Biosecurity Committee and the National Marine and Coastal Committees, respectively on current and emerging national issues related to the management and development of the aquaculture industry.

Currently, the Aquaculture Committee is working to establish best practice models for environmental assessment, regulatory arrangements and benchmarking these administrative processes between jurisdictions.

Aboriginal Enterprise Facilitation

A policy was developed during 2011 to better assist Aboriginal communities to develop aquaculture-based enterprises. Subsequently, NT Fisheries formed a range of partnerships with external agencies to work collaboratively to support Indigenous people to achieve their enterprise aspirations.

Collaborative work began in 2011 with Charles Darwin University, the University of the Sunshine Coast and the Australian National University on social research to identify successful models for aquaculture enterprise development within Aboriginal communities. The Fisheries Research and Development Corporation and the National Climate Change Adaptation Research Facility funded the research.

Additional funding was obtained from the Australian Centre for International Agricultural Research in 2011 to continue to assess the viability of sea cucumber ranching by Indigenous communities. This work commenced in 2010 with two communities, one on Goulburn Island and the other on Groote Eylandt, in partnership with a private company that is developing a sea cucumber farming business.

Environmental Management

NT Fisheries continued to work with the NT Department of Land Resource Management to maintain a current register of operators working under an approved Environmental Management Plan. A water quality monitoring protocol for barramundi farms was implemented in 2005.

New Investment

A pilot sea cucumber hatchery continued to be operated by private industry at the Darwin Aquaculture Centre (DAC). Commercialisation trials for this species began in 2009. The operator of the hatchery has access to earthen ponds in

Darwin and sea areas around Groote Eylandt to conduct pilot grow-out trials to assess the viability of sea cucumber farming based on hatchery production.

A private pearl oyster research hatchery and nursery facility established at DAC continued to operate and a number of successful trials were conducted in 2011.

RESEARCH

Research on barramundi fingerling production to support the barramundi farming industry continued at DAC. This has resulted in further improvements in larval rearing and nursery production procedures.

In collaboration with NT Fisheries, the University of Sydney conducted a three-year, Australian Research Council-funded project to improve the detection and management of nodavirus, a serious fish pathogen. A new test for nodavirus was developed and validated in 2009. The test is now routinely used by the Australian barramundi industry and its associated veterinary laboratories.

Research on sea cucumber hatchery production continued during 2011. This work is conducted jointly between DoR and a private sea cucumber farming company and is funded by the Australian Seafood Cooperative Research Centre.

DAC continued to work in association with a Nhulunbuy-based business to produce several thousand juvenile giant clams (*Tridacna squamosa)*. They will be grown to market size and sold to the aquarium trade via the Nhulunbuy business. Further trials were carried out at DAC in 2011 to refine the juvenile rearing process. Export approval was sought from the Federal Government to allow DAC to conduct trials to assess the potential of clam exports. Seabased growout trials were commenced with two Aboriginal communities in 2011.

DAC is working with elders on the Tiwi Islands to trial the farming of the blacklip oyster (*Striostrea mytiloides*), which is part of the traditional diet of Tiwi Islanders. The elders hope to grow enough blacklip oysters to boost seafood supplies to the community. Broodstock was collected in 2009 and hatchery techniques were researched and trialled. A small oyster trial was set up in 2011 to assess oyster growout techniques.

Aquatic Animal Health

The Department of Primary Industry and Fisheries' Berrimah Veterinary Laboratories continued to provide a valuable health service in 2011, diagnosing aquatic animal health problems as well as maintaining monitoring programs and certifying stock suitable for translocation for the aquatic industries.

Industry Liaison

NT Fisheries continued to provide secretarial and logistical support to the Pearling Industry Advisory Committee, which is a statutory committee that provides advice to the Executive Director of Fisheries and the Minister on pearling matters.

DAC also maintains a farm-based extension program, which ensures regular visits to aquaculture farms to address technical issues.

Manager, Aquaculture – Dr Ann Fleming

AQUATIC ANIMAL HEALTH STATUS REPORT 2011

INTRODUCTION

Barramundi and pearl oysters are the major aquaculture species that receive animal health services from the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries). NT Fisheries also works in partnership with Aboriginal communities to explore farming methods for species such as sea cucumbers, giant clams and tropical rock oysters. The aquatic animal health program of NT Fisheries also supports all aquaculture industries and development programs through diagnosing diseases, investigating disease outbreaks, providing disease control advice, health certification and quarantine services, and by participating in collaborative research projects.

The success of aquaculture depends on the use of healthy stocks and the proper management of farming operations so that health problems and disease risks are minimised. There have been relatively few significant disease problems in the NT aquaculture industry. Those problems were addressed through a cooperative approach between the industry, NT Fisheries and university research providers.

The department's Berrimah Veterinary Laboratories work closely with NT Fisheries to provide aquatic animal disease diagnostic and management services.

SIGNIFICANT DISEASE EVENTS

The bacterium *Edwardsiella ictaluri*, which is a nationally reportable disease agent, was diagnosed in three species of native catfish held in a licensed ornamental aquarium facility. The species were the black catfish (*Neosilurus ater*), the toothless catfish (*Anodontiglanis dahli*) and Berney's catfish (*Neoarius berneryi*). The affected catfish had suffered prior stresses from capture and relocation, skin trauma and low water temperature, which may have increased their susceptibility to infection. Several bacterial isolates were referred to the Australian Animal Health Laboratory to confirm the diagnosis. The source of the infection was suspected to be cross-contamination within the aquarium operation. The immediate control measures used to contain the disease included antibiotic treatment, culling, disinfection and movement restrictions. Subsequent modifications to the aquarium and its management have improved biosecurity practices at the facility. Active surveillance, which was conducted twice afterwards, returned negative results. Limited opportunistic surveillance for *E. ictaluri* in wild native catfish species in NT waterways did not reveal the presence the bacterium.

Epizootic ulcerative syndrome, or red spot disease, which is an endemic disease in certain streams and rivers in the NT, was diagnosed in several species of recently-caught native fish. Skin lesion samples were referred to the Fish Disease Laboratory in Western Australia to confirm by molecular analysis the involvement of the fungal pathogen *Aphanomyces invadans*. The affected species were sleepy cod (*Oxyeleostris lineolatus*), mullets (*Mugilidae*), gudgeons (*Mogurnda* sp.), mouth almighty (*Glossamia aprion*) and archerfish (*Toxotes* sp.).

Viral encephalopathy and retinopathy, a viral disease in fish caused by a piscine betanodavirus, had a pathological effect on brain and eye tissues of susceptible fish. The disease

was diagnosed in 61-day-old nursery barramundi at a pond-based grow-out farm. The pathogen is considered endemic in the Darwin region. It can cause significant losses when stocks are held at high density. Older juveniles and adult barramundi were not clinically affected. Further epidemiological investigation suggested that the disease had spread through horizontal transmission during the nursery phase of production, after the age of 37 days. Stress factors that may have contributed to disease susceptibility included translocation, grading and low water temperature.

An opportunistic bacterial infection caused unusual mortality in five month old juvenile pearl oysters (*Pinctada maxima*) in hatchery tanks. Prolonged low salinity, due to recent heavy rains, was the likely main stress factor.

Health Certification, Monitoring and Testing

The guidelines in the NT Zoning Strategy continued to be implemented for quarantine, health certification and laboratory testing prior to movement of animals. Testing is designed to provide specific pathogen-free stock to support the aquaculture industry as well as to meet the import requirements of other jurisdictions.

Pre-translocation histopathological examination of pearl oysters (*Pinctada maxima)* continued to be a major aspect of maintaining the health of stocks in the NT and at interstate culture sites.

Juvenile barramundi (*Lates calcarifer*), the main broodstock held in the Darwin Aquaculture Centre, were examined routinely by histopathology and were tested specifically for betanodavirus and *Streptococcus iniae* at about 21 days of age, on a batch-by-batch basis.

Juvenile sea cucumbers (*Holothuria scabra*) derived from parent broodstock obtained from local waters were examined sub-grossly before translocation within the NT for ranching and growing-out purposes.

A routine histopathological examination of cohorts of first generation cultured juvenile giant clams (*Tridacna squamosa*) found one batch of 4 to five month old clams had incidental co-occurrence of a presumptive yeast organism, probably *Rhodotorular mucilaginosa*, within the zooxanthellae circulatory system in about 30% of the samples examined.

Fish Kill Investigation

Two fish kill incidents were reported and investigated in the Darwin region, one at Tipperary Waters Marina and the other at Buffalo Creek in April and December 2011, respectively. In the Tipperary Waters Marina case, several hundred fish of mixed species and sizes were affected, but no significant pathogens were detected in the samples taken. The water quality parameters appeared to be within normal limits; contributing causes may have included recent heavy rain, seasonal temperature and salinity stratification. The problem disappeared within a few days. In the Buffalo Creek case, about 100 fish, including catfish, scats and mullets, were affected. Similar fish kills have occurred at this location in the past during the early wet season, when sudden storms wash organic matter downstream. Following on-site investigations, a low dissolved oxygen content in the water was again presumed to be the cause of the fish kill.

Aquatic Animal Health Pathologist - Dr Kitman Dyrting

BARRAMUNDI FARMING STATUS REPORT 2011

SUMMARY

Farmed barramundi (*Lates calcarifer*) production (tonnes of whole fish) increased by 3% in 2011. The combined production in 2011 from three pond-based farms was 719 tonnes, compared with 698 tonnes in 2010. The total production value decreased slightly from $5.75 million in 2010 to $5.72 million in 2011.

PROFILE OF THE FARMING SECTOR

Hatchery/Nursery Production

Commercial annual fingerling production from the Northern Territory (NT) Government's Darwin Aquaculture Centre (DAC) decreased from 764 400 in 2010 to 683 500 in 2011. About 800 000 larvae were sold interstate. Only DAC sold fingerlings during the year. Approximately 79% of the fingerlings (540 000) were sold locally and 21% (143 500) were sold interstate. The size of the fingerlings supplied to local farmers ranged between 25 mm and 63 mm; for interstate farmers it was 45 mm.

Farm Production

Six aquaculture licences were endorsed to produce barramundi. Three companies marketed fish in 2011: Australian Barramundi Culture Pty Ltd (Humpty Doo), Arda-Tek (Berry Springs) and Wild River Farmed Seafood (Berry Springs). Arda-Tek also began operating as a tourism farm, offering a barramundi fishing experience and selling fresh caught fish.

Some farmers continued to maintain an interest in prawn farming to assess commercial and technical viability.

Impoundment Stocking

DAC supplied over 4000 fingerlings of approximately 146 mm in size to Manton Dam in 2011.

Translocation

A zoning strategy covers health and biosecurity issues related to the importation of barramundi larvae and fingerlings, and their movement within the NT. The strategy identifies disease control regions within the NT. Fish may be moved between, or within, zones of equivalent health status, but movement into zones of higher health status requires health certification and quarantine measures to ensure that diseases are not transmitted along with the stock.

Marketing

In 2011 most of the fish produced on farms was sold either directly or indirectly to interstate markets. A small volume was sold directly off the farm through a tourism fishing operation. The majority of fish were sold whole, weighing over 1.0 kg. About 7.5% of the fish sold weighed less than 1.0 kg. No fillets were sold in 2011.

Employment

Permanent labour employed in the grow-out and hatchery/nursery sectors of the industry averaged 10.5 in 2011 compared with 11 in 2010; casual employment remained steady at around 8.

Ecologically Sustainable Development/Environmental Management

The Department of Land Resource Management supervises environmental assessments and approvals. As part of aquaculture licence conditions, all farms must have an approved Environmental Management Plan, which stipulates the environmental parameters under which the farm must be constructed and operated. Pond based farms are required to have a discharge licence. All farms are subject to environmental and aquaculture licence compliance audits.

RESEARCH

In 2002, Marine Harvest P/L funded research to develop a bacterin against two pathogenic marine bacteria (*Vibrio harveyi* and *Photobacterium damselae*), which affect barramundi fingerlings. The bacteria caused significant mortality in fingerlings at the DAC hatchery/nursery and at the Marine Harvest sea cage farm. The bacterin was used in bath immersions of all fish prior to their transfer to Port Hurd. The use of the bacterin, together with improved on-farm management of the fish, was considered to have successfully reduced mortality due to the bacteria.

In 2006, an autogenous vaccine against one strain of *Streptococcus iniae* found in the NT, which causes streptococcosis, the most devastating bacterial disease affecting farmed barramundi in Australia, was developed and produced commercially by Intervet Norbio, in collaboration with Marine Harvest and Berrimah Veterinary Laboratories (BVL). The vaccine was approved by the Australian Pesticides and Veterinary Medicine Authority for use in fingerlings destined for Marine Harvest's barramundi sea cage farm.

From 2005 to 2007, DAC improved hatchery culture protocols to reduce the rate of fingerling deformity to less than 5%. Following further improvements, the deformity rate declined to around 1%.

In 2007, another autogenous vaccine was developed in collaboration with the barramundi pond-based farming industry. This time the vaccine included a second NT strain of *Streptococcus iniae* and was produced commercially by Allied Diagnostics.

Recent Research

Together with BVL, DAC maintains an aquatic animal health program to assist the industry. In 2008-09 DAC helped the industry to investigate and develop controls for a number of disease problems, such as the protozoan parasite *Amyloodinium*, and the potentially toxic microalga *Prymnesium* sp.

In 2005, the Australian Research Council funded a study of the causative agent of VER (viral encephalopathy and retinopathy), the most significant viral disease affecting barramundi hatchery and nursery production. In collaboration with DAC, BVL, the University of Sydney and Marine Harvest, two PhD students commenced research in May 2006. A new broodstock screening test (polymerase chain reaction) was developed and validated, which will help to improve the understanding of the epidemiology of the disease.

The Fisheries Research and Development Corporation funded a project to establish a method to improve the rapid diagnosis of *Streptococcus iniae* strains, which could assist in the further development of appropriate vaccines against *S. iniae* for use on barramundi farms. The project was completed in 2009.

DAC has improved the efficiency of barramundi production in the hatchery and nursery by continuously refining and reviewing culture techniques.

INDUSTRY DEVELOPMENT

Commercial barramundi farming commenced in the NT in the early 1990s 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 to late 1990s and changing back from prawns to barramundi in recent years. Barramundi production from pond and seacage farms peaked at just over 1000 tonnes in 2004. The NT Government has supported the industry's development through a range of programs, including research and extension advice, and the supply of larvae and juvenile fish from its commercial barramundi hatchery and nursery at DAC.

The NT Government also provides a disease investigation and certification service through

BVL, which has assisted the industry to develop further, ensuring that aquatic animal health and biosecurity issues are effectively managed.

Current Issues

The barramundi industry is going through a period of significant challenge. Competition from cheaper imports and rising production costs encouraged the industry to focus on improving efficiencies and innovation to stay competitive.

Future Plans

DAC will continue to work on improving hatchery and nursery production techniques, and disease management to enhance the efficiency of barramundi production in the NT. DAC is also joining an industry-wide program for the genetic improvement of farmed barramundi. Genetic improvement could lead to gains in the growth rate of the fish and an increased efficiency in feed utilisation, thereby enhancing economic sustainability of the industry.

The projected demand for fingerlings locally and interstate in 2012 is estimated to be approximately 550 000.

Industry Liaison

DAC regularly facilitates contact with all active aquaculture licence holders and encourages open channels of communication with the industry. In addition, it provides an extension officer to advise farmers and conduct regular visits to the farms.

Aquaculture licensees were represented by the NT Seafood Council through the Aquaculture Licensee Committee.

Manager, Aquaculture – Dr Ann Fleming

PEARLING INDUSTRY STATUS REPORT 2011

INTRODUCTION

The Northern Territory (NT) pearling industry produced 92.7 Kan* of pearls in 2011 from farmed pearl oysters (*Pinctada maxima),* which reflected a decline of 48% from the 177.3 Kan produced in 2010. There was also a significant decline of 56% in the production value of the pearling industry, from $20.93 million in 2010, to $9.28 million in 2011.

The recent global economic crisis continues to have a major impact on the pearling industry as it has reduced demand for pearls in international markets, leading to reduced prices. Production rationalisations within the industry are expected to result in further declines in pearl production and value next year.

*Kan and momme are old Japanese units of weight where 1000 momme equal 1 Kan. A 13 mm round pearl weighs about 1 momme, which equals 3.75 grams.

PROFILE OF THE FARMING SECTOR

Commercial Production

Active pearl oyster farms are distributed along the northern coast of the NT in three main areas: Bynoe Harbour, Cobourg Peninsula/Croker Island and the English Company Islands.

Hatchery/Nursery Production

Most pearl oysters used in the production of Australian South Sea pearls in the NT are hatchery-reared. Two hatcheries currently operate in the NT: a research and development hatchery and a commercial production hatchery. The latter produces pearl oysters for pearl culture on its farm and has the option to sell them to other licensees. Pearl oysters farmed by other licensees can also be sourced from Western Australian (WA) hatcheries or from WA wild-harvested stock.

Farm Production

Pearl oyster farms are usually located in a sheltered embayment that facilitates continual access. Pearl oysters are placed in panels that are suspended from floated long lines and are cleaned regularly to ensure that fouling does not impede the viability of the pearl oyster or the production of the pearl.

Pearl oysters are seeded by artificially placing a nucleus derived from the shell of the Mississippi mud mussel together with a piece of donor mantle tissue into the oyster. The resulting pearl sac that forms following this operation deposits nacre around the nucleus, creating the pearl. A series of turning actions occur after the nucleus is implanted to assist in the development of a well-shaped pearl sac to ensure even coating of the nacre. It takes two years to produce a pearl.

If an oyster produces a good quality round pearl, it may be re-seeded with another nucleus and maintained for another full growout cycle. However, only a proportion of oysters are seeded a second time and even less a third time. Re-seeded pearl oysters generate larger pearls because the pearl sac has increased in size due to the production of the first pearl, allowing a larger seed nucleus to be inserted.

Farmed pearls vary in size, shape and quality, and are priced accordingly. There are also several other products from pearl oyster culture, namely Keshi (natural pearls of various shapes and sizes), Mother of Pearl (MOP), which is the pearl oyster shell (used for buttons, jewellery and decorative inlays) and pearl meat (the adductor muscle of the pearl oyster). Approximately 50 tonnes of MOP and 2000 kg of pearl meat valued at $318 000 and $141 000, respectively were produced in 2011.

Translocation

A protocol is in place that addresses health and security issues related to the importation of adult and juvenile pearl oysters into the NT and their translocation within the NT.

Marketing

The marketing of Australian South Sea pearls is conducted individually by licensees. Most of the pearls produced each year are sold either via private treaty, at auctions in either Japan or Hong Kong, or through retail outlets operated by the companies in Australia and overseas. MOP is exported to many countries; however, Italy and South Korea are the major customers. Due to recent changes to the Commonwealth Export Orders, pearl meat can now be sold in both the Australian and international markets.

Employment

About 87 people were directly employed in pearl farming or farm-related activities in the NT during 2011, down from 90 in 2010. The effects of the global economic crisis have resulted in further rationalisation of employment.

Indigenous Development

Aboriginal people play an important role in the operation of pearl farms. The land-based infrastructure of most farms is located on Aboriginal-owned land and is controlled through access agreements with traditional owners and land councils. Employment opportunities exist for local Aboriginal people to assist in the operation of the farms.

Ecologically Sustainable Development/Environmental Management

Pearling farms operate under Environmental Management Plans (EMPs) to ensure that best practices are employed to minimise the impact of pearling operations on the environment. In cooperation with the NT Government, the industry has developed EMPs for each farm.

RESEARCH

Summary

The renewed interest in pearling in the mid-1980s highlighted a lack of knowledge regarding pearl stocks in the NT. This led to a survey of diving for pearl oysters by the Bureau of Rural Resources in 1989. This was followed by a Fisheries Research and Development Corporation (FRDC)-funded project which commenced in 1991 to describe the current status of the fishery, determine the size-frequency and morphometric characteristics of harvested NT 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.

An FRDC-funded report on a survey of pearl oyster health across northern Australia in 1998 provided valuable information to assist the industry and government to improve disease management protocols. A book titled 'The pearl oyster *Pinctada maxima*: An atlas of functional anatomy, pathology and histopathology' was published in 2005, based on samples collected during the pearl oyster health survey and pathology samples submitted to the Veterinary Pathology Laboratories in WA, Queensland and the NT.

Much of the research by the pearling industry is conducted in-house and its outcome is contributing to the competitive advantage of individual companies.

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 the pearl oyster culture industry. The distribution of this species extends across the central Indo-Pacific region from India to New Guinea and the Philippines; in Australia, it extends from Carnarvon on the west coast, to south of Cairns on the east coast.

Pearl oysters have been fished commercially in NT 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 its MOP value – the lustrous nacre of the shells was used for the production of buttons, ornaments and as an additive in paints and cosmetics. Between 1884 and 1887, oysters were collected from the harbour until they were fished out.

As pearlers spread around the coast from Darwin, new pearling grounds were discovered as the old were progressively fished out. This resulted in large yield fluctuations of MOP over the next 80 years. By 1899, 51 luggers were working the grounds harvesting about 200 tonnes of MOP a year. This slowly fell to 60 tonnes by 1910, ceased during World War I and did not start again until 1923. Again, production increased until 1930 when 32 luggers yielded about 700 tonnes of MOP per year. Production remained around this level until 1939 when World War II halted production until 1948. After the war, production slowly increased until 1953. In 1953, the Australian Government permitted 35 Japanese divers into Australia in an attempt to rebuild the industry. The industry flourished again and production peaked at 1100 tonnes of MOP a year and remained at that level for three years. As the new areas were fished out, production again declined slowly.

The arrival of plastics made shell harvesting uneconomic and MOP harvesting virtually ceased by 1964 when only two luggers remained in the industry, harvesting only 5 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 conducting diving for NT pearl oysters. Unlike the shallow and productive grounds in WA, the NT grounds are deeper, more isolated and patchier and have a higher proportion of oysters not suitable for round pearl culture. Consequently, in the early 1970s, Paspaley Pearls started to obtain culture stock from WA and as techniques improved in the transport of oysters to the NT, the reliance on sourcing local oysters declined.

The success of Paspaley Pearls' pearling activities in the NT and WA, along with an expanding WA industry, prompted the NT Government to promote the expansion of a local pearling industry. Five additional companies met the government's selection criteria and 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 NT waters, with average yields during this period reaching 40 tonnes per year. Since 1994, there has been very limited harvesting of pearl oysters due to a reliable supply of hatchery-reared oysters and poor yields of good culture stock from the local pearling grounds.

In 1998, to assist with the development of the industry, both the Pearl Oyster Culture Industry Management Plan and Fisheries Regulations were changed to allow trade in fishing and hatchery units. Further changes occurred in 2006 that included changing licensing from a financial to a calendar year, the provision of additional pearl oysters to assist in training technicians in the art of pearl oyster seeding and allowing additional shell to account for pearl oysters that fail to retain their seeded nuclei. This was achieved by increasing the unit value by 15%, from 1000 to 1150 oysters.

Current Management Arrangements

The NT 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 wild-harvest fishing units and 300 hatchery units. A licensee may substitute part or all of their annual pearl oyster fishing allocation for hatchery-reared pearl oysters. Although a limited allocation of MOP

fishing occurs in most years, no licensee currently fishes for pearl oysters suitable for pearl culture.

Each fishing or hatchery unit represents the right to seed 1150 oysters. Therefore, with the available 420 units, the total number of new pearl oysters that may be seeded each year under the NT allocation system is 483 000. Only 18% of the seeding entitlement was used in 2011.

After successful negotiations with the WA Department of Fisheries and the WA pearling industry, NT licensees now have the option of seeding their NT allocation in WA and afterwards moving it to the NT.

A Memorandum of Understanding (MoU) has been developed between the NT and WA Governments to ensure that the Australian South Sea pearl industry is managed in a consistent manner since the industry is highly susceptible to market pressures and any change in management arrangements in one jurisdiction could impact on the other. The MoU was signed by the respective Fisheries Ministers in June 2006 to ensure that complementary management measures are put in place and that both jurisdictions consult on any matter affecting the industry.

A compliance program developed in conjunction with the industry, based around farm audits, was implemented in 2007.

Current Issues

The ongoing depressed world market for pearls is continuing to affect the viability of pearl oyster farming.

The WA Government is reviewing its pearling legislation, which may result in changes in the way the seeding quota is administered. Discussions with the WA Government on this topic are continuing.

Industry Liaison

Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) provides a management officer for the pearling industry to assist with its issues and for the strategic development of the industry. The Pearl Industry Advisory Committee (PIAC) meets once a year to address issues of specific importance to the pearling industry and is composed of each pearling licensee and NT Fisheries staff. PIAC is chaired by the Executive Director of Fisheries.

The industry can also raise any issues of concern and contribute to aquaculture development in the NT through membership of the NT Seafood Council.

Pearling Industry Manager - Mr Murray Barton

INDIGENOUS

INDIGENOUS FISHING AND ECONOMIC DEVELOPMENT STATUS REPORT 2011

INTRODUCTION

Aboriginal and Torres Strait Islander people have lived in Australia for over 40 000 years. In the Northern Territory (NT), many Indigenous groups live on the coast, nearly half of them in remote or rural areas, making up approximately 32% of the NT's population (ABS 2006).

Subsistence fishing is an important part of Aboriginal culture in the NT as it is a traditional source of protein and economic benefit. In addition, many of the freshwater and marine species found in billabongs, rivers and coastal waters of northern Australia are totemic to Aboriginal people and are therefore of great cultural significance.

The NT *Fisheries Act 1988* makes provision for Aboriginal people to continue traditional use of fish and aquatic life.

Most Indigenous fishing activities, which occur close to communities and out-stations, are widespread across the northern part of the NT. Those activities occur in inshore waters (61%), estuarine waters (11%) and on rivers (17%) (Henry and Lyle 2003).

Most coastal Indigenous groups continue to practise customary management, education and law relating to the sea. These customary laws have been passed down over generations in the form of stories, dance, song, art and ceremony. Customary management styles vary across the NT, with each group respecting others' boundaries for hunting and fishing. This usually means that Indigenous people will prefer to fish and hunt within their own country and seek permission before fishing in someone else's. Aboriginal customary fishing and hunting are undertaken according to the season, which allows for species to be targeted when in abundance and in prime condition (Davis 1983).

Some areas of significance, such as sacred sites, may exclude Aboriginal as well as non-Aboriginal people, 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 also act as traditional management tools that help protect species and habitats. Many Indigenous groups continue to manage their resources through the leadership of community sea rangers. The challenge is to ensure that Indigenous people in the NT are engaged at all levels of fisheries management and to identify some of the traditional management practices that may be incorporated into customary management.

PLANNING AND CONSULTATION

The NT Government has identified a need for greater Indigenous participation in various economic development activities, including aquaculture, fishing tourism and wild harvest fishing ventures to create long-term employment and produce positive economic and social outcomes. Such outcomes can only be achieved by establishing new partnerships with Indigenous communities while maintaining old alliances and by fostering a constructive working environment with Land Councils, other Indigenous organisations and the fishing industry to identify, negotiate and implement Indigenous economic development opportunities in the fishing industry.

A number of initiatives to increase the involvement of Indigenous people in the seafood industry and aquatic resource management in the NT have been successfully implemented over time, including:

- Establishing and maintaining recreational fishing campsites on Aboriginal land.
- Establishing agreements between Indigenous landowners and commercial fishermen.

- Implementing a dugong code of practice for the commercial fishing sector.
- Donating vessels to coastal ranger groups to carry out coastal surveillance.
- Establishing an Indigenous apprenticeship program in Fisheries Divisions of the Department of Primary Industry and Fisheries (NT Fisheries).
- Establishing the Indigenous Community Marine Ranger Program (ICMRP).
- Developing and delivering Certificate II Fisheries Compliance (Seafood Industry) training to Indigenous rangers.
- Conducting a pilot survey to investigate the impact of Indigenous people on sharks and rays through funding from the Natural Heritage Trust.
- Researching new and innovative aquaculture farming models suitable for remote Indigenous communities.

Consultative Committees

Many Indigenous groups have been included in the management of fish and aquatic life in the NT through the establishment of Aboriginal Fisheries Consultative Committees (AFCCs) by NT Fisheries. One of the principal roles of AFCCs is to provide a mechanism that allows information flow between Aboriginal people engaged in customary fishery management practices and the NT Government. Information obtained from AFCCs has been incorporated into contemporary fisheries management decision-making processes. In addition, AFCCs provide Aboriginal communities with an avenue to voice their concerns to Government about matters relating to fisheries.

The information provided to Indigenous communities through AFCC meetings increases their understanding of potential opportunities for involvement in commercial fishing, aquaculture, tourism, resource management and research.

There are seven established AFCCs in the NT; however, only two committees met during 2011. The composition of Aboriginal members on each committee is determined by the relevant community. AFCCs also have representatives from the Water Police, DPIF, the Amateur Fishermen's Association of the NT, the NT Seafood Council and other NT Government agencies as required.

AFCCs are currently being reviewed to improve Indigenous engagement in the fishing industry. NT Fisheries is developing a fisheries management framework to include Indigenous input more effectively.

Government Liaison and Community Involvement

The maintenance of open communication with Aboriginal communities has enabled DPIF to build a capacity among Indigenous people to participate in the long-term sustainable management of aquatic resources in the NT.

Through the AFCC consultative process, DPIF conducts discussions, and plans and implements new fisheries initiatives relevant to coastal Aboriginal communities. This may include exploring commercial development opportunities for remote coastal communities, which may help resolve social and economic problems that many communities face. The AFCC process is currently under review to improve Indigenous engagement in fisheries management and businesses whilst maximising recreational and commercial fishing interest.

Indigenous people are also represented on individual Fishery Management Advisory Committees, which provide advice to the Executive Director of Fisheries and the Minister on sustainable fisheries management.

To further enhance the capability and knowledge-sharing between Government and Indigenous people, NT Fisheries has employed a manager, a marine ranger coordinator and a support officer to carry out community engagement activities, including on-going consultation, economic development and resource management. This also includes the employment of Indigenous apprentices. Since the employment of the first four Indigenous apprentices in 2003, 18 more have been employed to work in NT Fisheries.

The apprentices develop skills in a wide range of areas in fisheries management and have completed qualifications in Certificates II and III Business Administration, Certificate III Laboratory Skills and Certificate III Seafood Industry (Aquaculture).

During 2011, the Indigenous Fisheries Development Unit (IFDU) officers spent 197 days in the field in remote communities working with marine rangers, meeting with traditional owners to discuss fisheries management issues and assisting interested people with economic development activities.

MARINE RANGER PROGRAM

The NT Government commenced funding Indigenous marine and sea ranger groups through the ICMRP in 2002 and continues to allocate annual grants to eight marine ranger groups amounting to $480 000. These marine ranger groups are strategically based along the NT coastline at Borroloola, Port Keats, Maningrida, Ngukurr and on Groote Eylandt, the Tiwi, Goulburn and Elcho islands.

ICMRP facilitates and provides fisheries monitoring and surveillance support in local coastal waters and assists the Water Police in search and rescue responses. It also promotes a culture of environmental responsibility and continues to strengthen community leadership. Increasingly, the marine ranger groups are playing an important role in educating both Indigenous and non-Indigenous fishers, as well as providing a visual presence on water to help deter illegal fishing activities.

The marine ranger groups provide regular reports of their coastal activities to NT Fisheries. Information contained in these reports is forwarded to other relevant agencies, such as the Water Police and the Australian Customs and Border Protection Service. The funded marine ranger groups conducted 158 patrols in 2011.

A nationally accredited Certificate II Fisheries Compliance (Seafood Industry) course was delivered in conjunction with Charles Darwin University in June 2011. The 2011 course was developed specifically for female marine rangers and provided an opportunity for 12 rangers across the NT to meet and develop their skills in a culturally appropriate manner. The Water Police and NT Fisheries staff provided essential support in the delivery of the training course that covered topics such as:

- Intelligence, surveillance and evidence gathering.
- Presenting evidence in court.
- Communicating in cross cultural environments.
- Promoting the sustainable use of aquatic resources.
- Working effectively in the seafood industry.

ECONOMIC DEVELOPMENT

Aboriginal people make up about 32% of the NT population; 80% live in remote or rural areas. Aboriginal-identified land covers 84% of the NT coastline.

Many coastal community groups live in geographically remote locations where they own land, which makes them potentially eligible for joining existing activities in the fishing industry and also developing new fishing enterprises. The NT Government is committed to facilitate and enhance partnerships with Aboriginal groups to increase their economic development and employment opportunities.

A number of Aboriginal communities are actively involved in the commercial fishing industry with several groups or individuals owning licences in the Aboriginal Coastal, Coastal Net, Barramundi, Mud Crab and Aquarium fisheries.

IFDU officers visited 12 remote communities in 2011 to conduct a range of activities, including training and providing advice on economic development opportunities.

Some Aboriginal groups and individuals have joined Fishing Tour Operators to facilitate the use of land-based facilities established on Aboriginal land.

A new initiative was launched in 2011 to encourage participation by Aboriginal community members in the seafood industry in the East Arnhem region. The East Arnhem Indigenous Fisheries Network is a pilot program funded by the NT Government, with assistance from the Federal Department of Education, Employment and Workplace Relations. The network aims to provide a support base to Aboriginal people seeking to be actively involved in commercial fishing and aquaculture, by providing advice, training coordination, mentoring and business development assistance.

SOCIAL BENEFITS

Fishing is an important lifestyle activity for Aboriginal people in northern Australia. It not only contributes to a healthy diet, it also provides cultural stimulation. In part, fishing also allows communities and families to retain their independence and connection to their country.

Many studies have documented the importance of wildlife catch in the diet of Aboriginal people. Seafood has also been shown to contribute a large proportion of caloric intake for those living in coastal outstations.

The value of food collecting, hunting and fishing is important in maintaining the social cohesion of communities. Social networks are reinforced through the customary sharing of gathered food. Hunting is also used as an important educational tool for teaching younger people to adhere to Aboriginal law through the expression of knowledge and strengthening spiritual beliefs. This traditional management knowledge has been extrapolated over thousands of years of fishing and management of aquatic resources and now needs to be harnessed and utilised to strengthen contemporary management. Such a management structure can assist in making informed fisheries management decisions across the NT, as well as recognise and empower Aboriginal people as natural resource managers.

Traditional subsistence fishing does not value individual species in a similar way to the commercial and recreational fishing sectors, but rather considers all of them collectively as valuable sources of protein. The Indigenous fishing sector targets species when they are most abundant and in prime condition. Other fishing is done opportunistically with virtually no waste or bycatch. Most subsistence fishing takes place as a family event or for the purpose of education, cultural maintenance and ceremony. It is a cultural obligation to provide food for everyone and as such, there is very little discarded catch.

A range of issues relate to Indigenous engagement in resource management and economic development. The cost of entry into the commercial fishing industry is too high for most Aboriginal people. There is also a shortage of fishing industry-related skills in remote areas. Coastal Aboriginal people may know where the fish hide and how to catch them; however, this alone does not guarantee a sustainable business. There is a need for fishing industry training and capacity-building in remote communities. Moreover, there is also a need for employment opportunities to complement such training. The fishing industry training should also be applicable to other jobs, thereby providing Indigenous people with a range of career options.

RESEARCH

Through ICMRP, many Aboriginal groups are becoming active in monitoring community fishing and assisting fisheries in core research activities.

In 2011, research training and capability were significantly increased in Aboriginal communities in partnership with three marine ranger groups that assist NT Fisheries with snapper monitoring in strategic locations. The research involves the collection and dissection of snapper species in an effort to better understand growth rates and sustainability of snapper stocks around the NT.

Marine rangers commenced work in 2008 on collaborative research projects with the NT Seafood Council and NT Fisheries. The research projects aim to identify juvenile red snapper nursery grounds, and the location, distribution and abundance of juvenile mud crabs. The research projects continued through early 2009 with the assistance of IFDU. Further information on these projects can be found in the Timor Reef Fishery Status Report 2009 and the Mud Crab Fishery Status Report 2009. In 2011, Aboriginal marine ranger groups were engaged in the following three fisheries research projects: a sawfish survey, mud crab escape vent trials, and monitoring of snapper and barramundi stocks.

In collaboration with NT Fisheries, the Anindilyakwa Sea Rangers conducted research in 2008 to develop appropriate methodology to monitor Indigenous fishing impacts on sharks and stingrays. The final report was released in 2010 (see Saunders and Carne 2010).

Manager, Indigenous Development – Mr Bo Carne

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AQUATIC BIOSECURITY

AQUATIC BIOSECURITY STATUS REPORT 2011

INTRODUCTION

The Aquatic Biosecurity program performs an important role by helping to protect the valuable aquatic resources, habitats, and fishing and aquaculture industries of the Northern Territory (NT) from introduced aquatic pests.

The Aquatic Biosecurity Unit (ABU) was established following recognition of the vulnerability of NT waterways to invasion by exotic species, as highlighted by the incursion of the black-striped mussel (*Mytilopsis sallei*) in Darwin Harbour in April 1999.

The role of Aquatic Biosecurity is to:

- Maintain a surveillance program for the early detection of introduced aquatic pests.
- Contribute to emergency eradication responses and/or control procedures to detected exotic aquatic pests.
- Coordinate the inspection and treatment of high-risk vessels entering Darwin Marinas.
- Provide a contact point for reporting potential aquatic pest species seen in the local environment.
- Raise public awareness of the threat of aquatic pests through educational activities.
- Represent the NT on national forums that address the prevention of entry and the management of introduced aquatic species.
- Assist in coordinating the implementation of strategies that will provide Australia with a nationally coordinated approach to aquatic pest issues.

Ecosystem, Social and Economic Impact

The introduction and subsequent establishment of an aquatic pest species in fresh, estuarine or marine waters of the NT has the potential to seriously impact on the biological diversity and productivity of our 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 and negatively affect the aesthetics of our waterways.

The establishment of aquatic pests may reduce the productivity of fisheries resources, increase the maintenance of fouled infrastructure, such as nets, pipes and vessels, and incur excessive costs associated with eradication. Further costs may also be associated with 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 aquatic pests may restrict the entry of vessels from infested ports.

ENVIRONMENTAL ASSESSMENT

The monitoring of water quality and marine biofouling organisms by ABU at sites within each of Darwin's lock-accessed marinas and at open-water locations in Darwin Harbour commenced following the eradication of the black-striped mussel from the infested marinas in April 1999. This monitoring continued during 2011 with assistance from the local industry. Monitoring at locations along the NT coastline also continued in cooperation with the industry and with Aboriginal marine rangers at Gove Harbour (Rio Tinto Alcan Pty Ltd), Milner Bay (Groote Eylandt, GEMCO) and Garden Point (Tiwi Marine Rangers).

In 2007-08, ABU conducted a Natural Heritage Trust-funded project to engage remote Indigenous communities in coordinated marine pest monitoring activities. The processes established through this project now form part of the ongoing Aquatic Biosecurity Monitoring Program. Training in marine pest awareness and surveillance has been incorporated in the Certificate II in Fisheries Compliance, in cooperation with the Indigenous Fisheries Development Unit of the Fisheries Division in the Department of Primary Industry and Fisheries (NT Fisheries). Through this training, marine rangers are encouraged to be involved in regular monitoring activities.

As part of a Certificate II in Fisheries Compliance course held in Jabiru in May 2010, Aquatic Biosecurity staff trained Aboriginal marine rangers to identify and monitor marine pests in their communities. Some of these ranger groups have since set up their own marine pest monitoring sites.

Monitoring Results

No recognised marine pest species were detected during 2011 at any of the locations monitored.

Differences in the species colonising artificial settlement surfaces are most apparent when enclosed marina sites are compared with open water sites. Although the species present in biofouling assemblages vary from one location to another, open water sites, including those in Darwin Harbour and along the NT coastline, generally have a greater diversity of biofouling taxa and number of individual species present within the fouling community. It is very rare for a single taxon or species to dominate the fouling community to the exclusion of other taxa or species.

Marinas, however, are an artificial environment and are not exposed to tidal regimes and water exchanges that characterise open water environments. Furthermore, marinas are subject to heavy vessel movements, which expose them to a higher likelihood of marine pest incursions. The four Darwin marinas tended to be dominated by blooms of one or two species, with the dominant species (and often taxonomic group), varying between marinas and over time. The most common of such organisms were barnacles and polychaete tubeworms. Both have a calcareous structure and are able to form large quantities of hard fouling matter in short timeframes and colonise hard substrates, including boat hulls in the lock-accessed marinas. Changes in water quality between the dry and wet seasons generally correspond to changes observed in the fouling communities

The Darwin marinas also tend to act as a sink for freshwater run-off, resulting in the stratification of marina waters with a cool layer of less saline water forming over the top of warmer, more saline water. This phenomenon is most notable in Cullen Bay and Tipperary Waters marinas between November and May. A stratified environment potentially contributes to the booms and busts of the aforementioned species. Given that these seasonal fluctuations result in a lack of competition from established populations of native species, opportunities may exist for the establishment of invasive species in Darwin marinas. Seasonal stratification can be minimised by marina management through the implementation of practices that promote adequate flushing and mixing of marina waters so as to support the establishment of a more diverse and resilient fouling community.

Marine Pest Survey of Darwin Harbour

During 2010, Darwin Harbour was the focus of a large-scale survey targeting marine pests as part of the National System for the Prevention and Management of Marine Pest Incursions. The survey was conducted by Golder Associates. Sampling took place in April and August/September 2010 to cover any variation that may occur between the wet and dry seasons in Darwin.

Twenty eight species with the potential to establish in the NT were targeted. No targeted species were detected during sampling.

AQUATIC PEST CONTROL

History

Prior to 1999, no record of an invasive exotic marine species had been reported from the waters of Darwin Harbour; however, on 1 April 1999, all Darwin marinas were quarantined due to an extensive invasion by the exotic black-striped mussel (*Mytilopsis sallei*).

This bivalve had the potential to seriously damage the local marine biodiversity and threaten the social and economic benefits derived from the marine environment. Following its discovery, a rapid response by the NT 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.

ABU was established following the recognition of the vulnerability of Darwin Harbour to invasion by exotic marine organisms and its status as a primary port and popular tourist destination. Introduced freshwater pests were also included in ABU's responsibilities.

Since 1999, the black-striped mussel and two other bivalve marine pest species, the Asian green mussel (*Perna viridis*) and the Asian bag mussel (*Musculista senhousia*), have been detected on a number of occasions as fouling either on the hulls or in the onboard plumbing of vessels arriving in Darwin from international locations, usually South-East Asia. These vessels have included apprehended illegal foreign fishing vessels (IFFVs), suspected illegal entry vessels (SIEVs), recreational cruising yachts and commercial vessels, such as rig tenders and tug boats. In such instances, the vessels were treated in cooperation with other relevant Australian and local government departments to mitigate the risk of the pest establishing in Darwin Harbour.

On numerous occasions, ABU also controlled populations of non-native fish and invertebrates. Feral fish in NT waterways are usually common ornamental species, such as guppies, platies or swordtails, which generally appear to have either been deliberately released or have escaped from backyard ponds during wet season rainfall. Invertebrate snail species are often inadvertently spread through trade in aquarium plants.

Current

Six reports were received of suspected marine pests during 2011. Following investigations, five were found to be native or cosmopolitan species. In the one instance that identified known marine pest species, both the Asian green mussel and the Asian bag mussel were detected.

The identity of the species was confirmed by the Curator of Molluscs at the Museum and Art Gallery of the NT. The detections were made during a routine vessel inspection on a recreational sailing vessel that had travelled to international ports. The vessel was slipped and treated to remove pest populations from both the hull and the internal seawater systems.

Eight freshwater pest reports were received and investigated during 2011. The investigations highlighted the ease with which common ornamental fish, such as guppies (*Poecilia reticulata*), can be released (intentionally or unintentionally) from tanks and ponds and establish populations in drainage creeks and streams. Guppies and other exotic fish can compete with native species and impact negatively on the ecosystem. Known populations of exotic aquarium fish in NT waterways are currently being monitored to ensure that they are not adversely affecting native species where they have established.

Aboriginal marine rangers submitted one sample of marine fouling organisms during 2011. In this case, the samples were found to be native species. Collected samples are lodged with the Museum and Art Gallery of the NT, thus contributing to the knowledge of species distribution in these remote areas of the NT coastline.

Future Assessment Needs

With the expansion of port industries and the associated increase in shipping movements, combined with the transient nature of the NT population, the opportunities for exotic species to be introduced to the NT will increase.

The continuing spread of the noxious fish tilapia throughout Queensland waterways is of serious concern. Tilapia is an extremely aggressive and successful competitor; its potential spread into the NT will impact on native fish, including iconic species, such as barramundi.

In light of the increasing risk of introducing aquatic pests to the NT, it is critically important to continue to collect environmental information on NT aquatic habitats and find ways to expand aquatic pest monitoring and surveillance activities, particularly in freshwater environments.

VECTOR MANAGEMENT

History

Two high-risk categories have been identified through a risk assessment based on voyage history, stopovers in international ports and vessel maintenance regimes for vessels that frequent NT waters: vessels that had been in international waters and which subsequently entered Darwin marinas, or vessels that were apprehended.

- Vessels that transit international waters can transport exotic species as fouling, either on the hull or in the internal pipe works. Marinas are recognised to be at a greater risk of marine pest establishment because they are disturbed artificial habitats frequented by high-risk vessels and which experience extremes in environmental conditions. Although the vast majority of vessels entering marinas are recreational cruising yachts, they also include commercial vessels, such as fishing and tug boats.
- Vessels that have been apprehended for illegal activities and which have originated from, or transited through, areas known to be inhabited by potential aquatic pest species can pose a potential threat. Some vessels from this class (iceboats from the Province of Probolinggo in East Java and all SIEVs) are considered to pose an extreme risk as a high proportion of them have had hulls infested with either black-striped or Asian green mussels.

Current Issues

The vessel categories mentioned above continue to be of concern. The inspection and treatment of high-risk vessels entering Darwin marinas continued in cooperation with marina management. Similarly, high-risk IFFVs and SIEVs are managed by the Federal Department of Agriculture, Fisheries and Forestry Biosecurity Division (DAFF Biosecurity) and the Australian Fisheries Management Authority (AFMA) with the assistance of ABU when required.

COMPLIANCE

Vessels intending to enter Darwin marinas are required to undergo an inspection and/or treatment of their internal seawater systems prior to being permitted entry. With the assistance of lockmasters, compliance has been excellent.

In 2011, 92 vessels were inspected and/or treated compared with 143, 133 and 173 in 2010, 2009 and 2008, respectively (Figure 1). The number of recreational vessels inspected each month clearly highlights Darwin's dry season tourism peak.

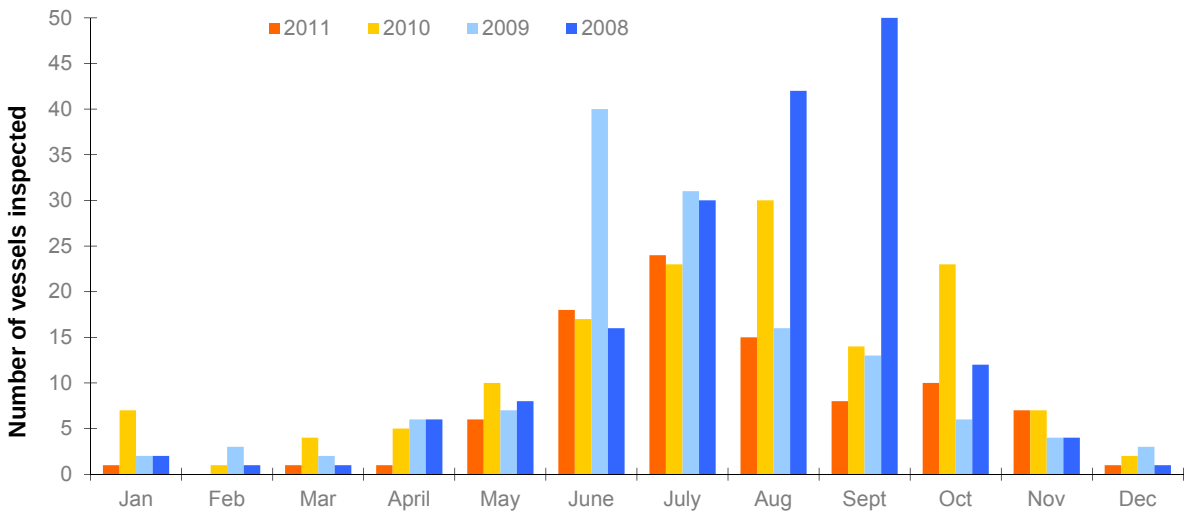

Figure 1. The number of vessels inspected prior to marina entry each month, 2008 to 2011

In addition to recreational vessel inspections, vessels apprehended off the northern Australian coastline destined for the ports of Darwin and Gove are examined for the presence of aquatic pest species.

Future Plans

To help protect the marine environment and associated industries, the Australian and state/territory governments and marine industries are implementing the National System for the Prevention and Management of Marine Pest Incursions (National System). The National System aims to prevent new pests arriving, respond to new arrivals and minimise the spread and impact of existing established pests.

As a result of increased mining, oil and gas and industrial development around Darwin, an increase is predicted in international shipping, which will increase the risk of the introduction of marine pest species via such vectors as hull fouling and ballast water. The National System will address such pathways by implementing both regulatory and non-regulatory marine pest management protocols. The national marine pest website http://www.marinepests.gov.au provides details of the National System and contains resources for various industry sectors.

Consultation, Communication and Education

Vessel inspection and treatment protocols were developed in consultation with members of the fishing industry, marina owner/operators, ship repair and maintenance facilities, the Australian Customs and Border Protection Service, the Australian Defence Force, DAFF Biosecurity and AFMA. Information from on-going environmental monitoring is regularly reported to stakeholders and is available on the NT Fisheries website and on request. Brochures outlining general marine pest information and vessel inspection protocols are distributed to stakeholders. Publications are available from the Aquatic Biosecurity pages of the NT Fisheries website.

The general issue of aquatic pests has been presented in seminars and through articles in the popular media. Such presentations have targeted the general public and stakeholder groups, such as commercial and recreational fishers, yachtsmen, port operators, ship repair and maintenance facilities, and Indigenous groups. Presentations and field trips have also been conducted at high schools and at tertiary environmental science classes.

To facilitate the reporting of aquatic pest sightings, contact phone numbers have been widely publicised through brochures, posters and the website.

There is a need to conduct further public education initiatives in relation to aquatic pests in freshwater systems. The use of native species in aquaria and ponds, as opposed to non-native species, will continue to be promoted and encouraged. Programs are also required to educate the public about the threats posed by the spread of tilapia from Queensland. Early detection of new populations and prompt action will be the key to prevent the establishment of this invasive fish in the NT. Early detection will largely depend on a well-informed and alert local community.

A/Manager, Aquatic Biosecurity – Mr Murray Barton
Technical Officer, Aquatic Biosecurity – Mr Alex Beatty

FISHERIES LICENSING AND COMPLIANCE

FISHERIES COMPLIANCE STATUS REPORT 2011

INTRODUCTION

The Water Police Section (WPS) of the Northern Territory Police, Fire and Emergency Services (NTPFES), in close collaboration with Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries), is responsible for fisheries compliance in the Northern Territory (NT). WPS and NT Fisheries work together to optimise voluntary compliance with fisheries regulations by residents and visitors, as well as deterring and disrupting unlawful fishing activities. WPS and NT Fisheries are signatories to the Australian Fisheries National Compliance Strategy 2010-15.

WPS assists NT Fisheries in developing and delivering training to Aboriginal marine ranger groups across the NT, and is also represented on all Fishery Management Advisory Committees.

WPS delivers the following services in the aquatic environment:

- Search and rescue.
- Marine safety education, compliance and enforcement.
- Investigation of marine incidents and accidents.
- Marine support for the Tactical Response Section.
- Counter-terrorism protection of visiting foreign warships.
- Counter-disaster (e.g. flooding, cyclones) operational response.
- Management of the NTPFES vessel fleet.

WPS has to balance policing priorities with fisheries compliance priorities. As a result, the number of fisheries patrols and contacts with fishers will vary from year to year.

Current Status

During 2011, short (generally one to two days), medium (up to seven days) and long-range (up to 12 days) fisheries compliance patrols were conducted across the NT. The patrols were conducted in the following regions:

- Darwin Harbour and Shoal Bay.
- Bynoe Harbour, Fog Bay, Finniss River and Dundee Beach.
- The Tiwi Islands.
- The Daly River region.
- The Adelaide River.
- The Mary River, including the Management Zone/Shady Camp 1 and 2 Mile Holes.
- Kakadu, including the East Alligator, South Alligator and Wildman rivers, including Pocock's Beach.
- The Victoria and Keep rivers near Timber Creek.
- Nhulunbuy.
- Blue Mud Bay and Bennett Bay.
- The Gulf of Carpentaria, from Port Roper to Calvert River, including the Roper and McArthur river systems.

In addition, four major dedicated intelligence-led operations were undertaken by WPS in 2011 targeting the unlawful sale of fish, unlawful commercial fishing operations in popular recreational fishing areas, possession of fish in excess of prescribed possession limits and the use of excess fishing gear by licensed fishermen in a managed fishery. These operations detected fisheries offences leading to summons being issued to alleged perpetrators to appear in court.

In 2011, approximately 4620 contacts were made by WPS (compared with 3393 in 2010) with commercial and recreational fishers, and fishing tour operators (FTOs). Random checks were conducted on catch, fishing gear and licences (where applicable), as well as on general compliance with other relevant fisheries and marine safety legislation. Twenty fisheries matters were referred for prosecution (compared with 24 in 2010). Nine Fisheries Infringement Notices (similar to 2010) were issued. In 2011, 32 cautions were issued, compared with 39 in 2010.

This suggests a high voluntary compliance rate with fisheries regulations.

WPS assisted NT Fisheries to deliver the Certificate II in Fisheries Compliance course to 12 female Aboriginal marine rangers. All rangers completed the course and attained their qualifications. Support, advice and targeted in-the-field training were provided to a number of Aboriginal marine ranger groups for the surveillance and detection of alleged illegal fishing practices.

Future Plans

WPS will continue to focus on increasing the level of compliance by commercial, recreational and FTO fishers using relevant fisheries legislation. Enhanced training, support, advice and opportunities for joint operations will be provided to Aboriginal marine ranger groups.

Senior Policy Officer - Ms Leonie Cooper
Water Police Section - Sergeant John Pini

FISHERIES LICENSING STATUS REPORT 2011

LICENSING

The Fisheries Licensing Section of the Department of Primary Industry and Fisheries grants and renews licences and permits under Sections 11 and 15 of the Northern Territory *Fisheries Act 1988*. In 2011, 1024 licences and 86 permits were issued. 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 Table 1.

It should be noted that the holders of a specific licence type may have exercised an option (e.g. 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.

With the upgrade of the licensing database, the Licensing Section is progressing towards electronic processing of application forms, which will enable the applicant to apply or renew a licence online.

Fisheries Licensing forms are now available for download from our website http://www.nt.gov.au/d/Fisheries/.

DATA

The logbook return information submitted by permit holders and licensees is processed by the Logbook Returns Section. The information is vital in assisting the sustainable management of fisheries, in stock assessments and to enable the compilation of accurate gross value of product figures. In order to have reliable data, it is essential for all licence holders to submit accurate and timely logbook returns.

Fisheries Logbook forms are now available for download from our website http://www.nt.gov.au/d/Fisheries/.

Table 1. The number of licences and permits issued in 2011

Licence type	Number
A1 – Coastal Line Fishery licence	54
A2 – Coastal Net Fishery licence	5
A3 – Bait Net Fishery licence	2
A4 – Spanish Mackerel licence	16
A5 – Shark Fishery licence	17
A6 – Demersal Fishery licence	60
A7 – Barramundi Fishery licence	20
A8 – Mud Crab Fishery licence	49
A9 – Mollusc Fishery licence	1
A10 – Pearl Oyster Fishery licence	7
A12 – Aquarium Fish/Display licence	11
A13 – Trepang Fishery licence	6
A14 – Development Fishery licence	2
A15 – Restricted Bait Entitlement	125
A16 – Finfish Trawl Fishery licence	1
A17 – Jigging Fishery licence	1
A18 – Timor Reef Fishery licence	15
A50 – Development Fishery – Coast Net	1
B1 – Fish Trader/Processor licence	35
B2 – Fish Retailer licence	388
C1 – Aquaculture licence	11
C2 – Pearl Oyster Culture licence	8
D1 – Aboriginal Coastal licence	5
D2 – Fishing Tour Operator licence	158
D3 – Aquarium Trader licence	10
D4 – Net licence	12
D5 – Public Aquarium licence	3
D14 – Development permit	1
S16 – Permit	59
S17 – Special permit	27
Total number of licences and permits issued	1110

APPENDIX 1: GLOSSARY OF ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
ACS	Australian Customs Service
AFANT	Amateur Fishermen's Association of the NT
AFCC	Aboriginal Fisheries Consultative Committees
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AIMS	Australian Institute of Marine Science
AQIS	Australian Quarantine and Inspection Service
BFMAC	Barramundi Fishery Management Advisory Committee
BVL	Berrimah Veterinary Laboratories
CITES	Convention on International Trade in Endangered Species
CLFMAC	Coastal Line Fishery Management Advisory Committee
CPUE	Catch per unit effort
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific Industrial and Research Organisation
CWLTH	Commonwealth
DAC	Darwin Aquaculture Centre
DFMAC	Demersal Fishery Management Advisory Committee
DPIF	Department of Primary Industry and Fisheries
EMP	Environmental Management Plan
EPA	Environment Protection Agency
EDF	Executive Director of Fisheries
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Australian)
ESD	Ecologically sustainable development
FRDC	Fisheries Research and Development Corporation
FTF	Finfish Trawl Fishery
FTO	Fishing Tour Operator
FFV	Foreign Fishing Vessel
FRDC	Fisheries Research and Development Corporation
GIS	Geographic Information System
ITQ	Individual Transferable Quota
IUU	Illegal, Unreported and Unregulated (fishing)
MCFMAC	Mud Crab Fishery Management Advisory Committee
MCFMP	Mud Crab Fishery Management Plan
MLS	Minimum Legal Size
MOP	Mother of Pearl
NDF	Non-Detriment Finding
NPOA	National Plan of Action (for Sharks)
NRFSNT	National Recreational Fishing Survey: Northern Territory
NRIFS	National Recreational and Indigenous Fishing Survey
NSPMMPI	National System for the Prevention and Management of Marine Pest Incursions
NT	Northern Territory
NTAC	NT Aquarium Committee
NTFDOC	NT Fisheries Development Opportunities Committee
NTFJA	NT Fisheries Joint Authority
NTGFIA	NT Guided Fishing Industry Association
NTPFES	Northern Territory Police, Fire and Emergency Services
NTSC	NT Seafood Council
OCS	Offshore Constitutional Settlement
OFMIG	Ornamental Fish Management Implementation Group
ONLF	Offshore Net and Line Fishery

OSAG	Offshore Snapper Advisory Group
PIAC	Pearling Industry Advisory Committee
POCIMP	Pearl Oyster Culture Industry Management Plan
SEWPaC	Department of Sustainability, Environment, Water, Population and Communities (Australian Government)
SIRC	Shark Implementation and Review Committee
SMFMAC	Spanish Mackerel Fishery Management Advisory Committee
TAE	Total allowable effort
TL	Total length
TEP	Threatened, endangered and protected (species)
TRF	Timor Reef Fishery
TRP	Trigger Reference Point
TRFAG	Timor Reef Fishery Advisory Group
TRFMAC	Timor Reef Fishery Management Advisory Committee
WTO	Wildlife Trade Operation

APPENDIX 2: GENERIC FISHERIES DIVISION DETAILS

General Enquiries

Fisheries Division
Department of Primary Industry and Fisheries
GPO Box 3000, Darwin NT, 0801
AUSTRALIA

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Fax: +61 8 8999 2065
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Please visit the website to obtain contacts for fisheries specific and aquaculture information.

Structure of Fisheries Division

Executive Director Fisheries

Aquatic Resources Branch

Director, Aquatic Resources

Fisheries Research

Aquatic Resource Management

Recreational Fishing and Fishing Tour Operators

Fisheries Development Branch

Director, Economic Development

Licensing and Data Services

Logbook Returns

Aquatic Biosecurity

Darwin Aquaculture Centre

Pearling

Fisheries Indigenous Development