**Fishery Report No. 113**

Title page image

July 2014

Northern Territory Government

Department of Primary Industry and Fisheries

GPO Box 3000

Darwin NT 0801

AUSTRALIA

**© Copyright**

Northern Territory Government 2014

This work is copyright. Except as permitted under the *Copyright Act 1968* (Commonwealth) no part of this publication may be reproduced by any process, electronic or otherwise, without the specific written permission of the copyright owners. Nor may information be stored electronically in any form whatsoever without such permission.

**Disclaimer**

While all care has been taken to ensure that information contained in the Fishery Status Reports is true and correct at the time of publication, changes in circumstances after the time of publication may impact on the accuracy of its information.

The Northern Territory of Australia gives no warranty or assurance, and makes no representation as to the accuracy of any information or advice contained in this Fishery Report, or that it is suitable for your intended use.

You should not rely upon information in this publication for the purpose of making any serious, business or investment decisions without obtaining independent and/or professional advice in relation to your particular situation. The Northern Territory of Australia disclaims any liability or responsibility or duty of care towards any person for loss or damage caused by any use of or reliance on the information contained in this publication.

Warning: Aboriginal and Torres Strait Island readers should be aware that this publication may contain images or names of deceased persons.

**July 2014**

**Bibliography**

Northern Territory Government (2014). Fishery Status Reports 2012. Northern Territory Government Department of Primary Industry and Fisheries. Fishery Report No. 113.

**Fishery Report No. 113**

**ISSN 1832-7818**

Contents

[Introduction 1](#_Toc389051367)

[Highlights and Priorities in 2012 2](#_Toc389051368)

[COMMERICAL WILD HARVEST 6](#_Toc389051369)

[Aquarium Fishery 7](#_Toc389051370)

[Barramundi Fishery 14](#_Toc389051371)

[Coastal Line Fishery 26](#_Toc389051372)

[Coastal Net Fishery 34](#_Toc389051373)

[Demersal Fishery 39](#_Toc389051374)

[Development Fishery 49](#_Toc389051375)

[Mud Crab Fishery 51](#_Toc389051376)

[Offshore Net and Line Fishery 61](#_Toc389051377)

[Spanish Mackerel Fishery 76](#_Toc389051378)

[Timor Reef Fishery 88](#_Toc389051379)

[Trepang Fishery 96](#_Toc389051380)

[RECREATIONAL 102](#_Toc389051381)

[Fishing Tour Operator 103](#_Toc389051382)

[Recreational Fishing 110](#_Toc389051383)

[AQUACULTURE 117](#_Toc389051384)

[Aquaculture Industry Support and Development 118](#_Toc389051385)

[Aquatic Animal Health 121](#_Toc389051386)

[Barramundi Farming 123](#_Toc389051387)

[INDIGENOUS 126](#_Toc389051388)

[Indigenous Fishing and Economic Development 127](#_Toc389051389)

[AQUATIC BIOSECURITY 132](#_Toc389051390)

[Aquatic Biosecurity 133](#_Toc389051391)

[Fisheries Licensing and compliance 139](#_Toc389051392)

[Fisheries Compliance 140](#_Toc389051393)

[Fisheries Licensing 142](#_Toc389051394)

[APPENDIX 1: GLOSSARY OF ABBREVIATIONS 144](#_Toc389051395)

[APPENDIX 2: GENERIC FISHERIES DIVISION DETAILS 146](#_Toc389051396)

Introduction

The Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) is responsible for the ecologically sustainable development of our fisheries and aquatic resources.

I am pleased to present this report summarising 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.

Territorians value 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 and aquaculture industry are valued at around $60 million and provide valuable supplies of high quality seafood such as mud crab, tropical snappers, Barramundi, shark and mackerel to restaurants and retail markets. 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. 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.

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 monitoring and management are still required if we are to ensure we achieve a sustainable and optimal use of our fish and aquatic resources, particularly in high-use areas around the main population centres. As a case in point, concerns of overfishing of Black Jewfish and Golden Snapper stocks around the Darwin area have made this fishery a priority for management changes to address this emerging problem. Ongoing vigilance is also required to prevent the introduction of aquatic pests and diseases into Territory waters.

NT Fisheries works in partnership with our Aboriginal, commercial, recreational, fishing tour operator and aquaculture stakeholders to promote fisheries and aquaculture development and facilitate access and sharing of fish resources. We also work closely with the Water Police Section (WPS) of the NT Police, Fire and Emergency Services and the Australian Fisheries Management Authority (AFMA) in the delivery of fisheries compliance programs. Community marine ranger groups also play a valuable and increasing 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.

I would like to thank all NT Fisheries, WPS and AFMA staff, Aboriginal marine rangers, commercial, recreational and fishing tour stakeholders who have worked collaboratively with the Department across our monitoring, research and management programs, to ensure the ongoing ecologically sustainable development of our fisheries.

Ian Curnow

Executive Director, Fisheries

Highlights and Priorities in 2012

Achievements for 2012

Developing fisheries while maintaining ecological values

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

A non-detriment finding was issued under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) for the harvest and export of giant clams and hard corals in the NT.

The management arrangements for the Timor Reef, Spanish Mackerel and Aquarium fisheries were re-accredited under the EPBC Act enabling the continued export of product.

An assessment of the status of key Northern Territory (NT) fish species was completed for Barramundi, mud crab, Golden Snapper, Black Jewfish, Grey Mackerel, blacktip sharks and Goldband Snapper.

Actively promoted legislative amendments to the *Fisheries Act* in consultation with key fishery stakeholder groups.

Established a formal research partnership with Charles Darwin University (CDU).

Established a tripartite partnership with fisheries and aquaculture research agencies from Queensland and Western Australia.

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

Commenced pilot trials on monitoring small inshore fishing vessels

Sharing fish resources between Indigenous, recreational and commercial uses

Developed a draft resource-sharing framework to facilitate the equitable use of Barramundi stocks by all fishers by a stakeholder group appointed by the Minister.

Released a discussion paper to the industry for the future development of the fishing tour operator industry.

Released a discussion paper for public comment on future management directions for the Coastal Line Fishery to control catches of targeted species while maintaining supplies of fresh fish for the market.

Finalised the Indigenous Fisheries Development Strategy 2012–14.

Commenced consultations 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.

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

Implemented Indigenous Community Marine Ranger Guidelines whilst undertaking research and monitoring activities.

Delivered the Certificate II in Fisheries Compliance course to 12 Aboriginal women rangers in partnership with the NT Water Police and CDU.

Facilitating the provision of fishing facilities and access opportunities

Finalised upgrades to recreational fishing infrastructure across the NT.

Facilitate Indigenous economic development

Assisted the formation of an Aboriginal corporation specifically designed to encourage Aboriginal people to be involved in the seafood industry.

Continued the development of an Indigenous Fisheries Network in the East Arnhem region to encourage Indigenous fisheries and aquaculture related businesses and activities.

Continued to determine the suitability and abundance of small pelagic fish stocks in regional areas which would directly benefit Indigenous communities.

Provided funding and support to the Indigenous Community Marine Ranger Program.

Continued to identify and address the constraints of involving more Indigenous people in fishing and aquaculture.

Assist aquaculture industry development

In partnership with Indigenous communities and private sector aquaculture businesses conducted sea-farming pilot trials of sea cucumbers, giant clams and tropical rock oysters at a number of remote locations on Goulburn Island, Groote Eylandt and East Arnhemland.

Ensured all aquaculture programs and services were aligned with industry priorities and the industry research and development plan.

Maintained strong research partnerships with existing and emerging aquaculture industries and other research providers.

Ensured that the NT aquaculture industry continued to operate in accordance with relevant environmental management plans by conducting annual reviews of all current licensed operations.

Protecting aquatic ecosystems from pests and diseases

Maintained a responsive and effective aquatic animal health diagnostic service.

Continued to monitor for aquatic pests and diseases of national importance to protect NT businesses and the environment.

Contributed to national management programs associated with the National System for the Prevention and Management of Marine Pest Incursions.

Maintained two marine pest monitoring programs, including the inspection of 126 vessels, through inspection protocols and monthly monitoring of almost 300 settlement plates at 12 locations across the NT.

Priorities for 2013

Developing fisheries while maintaining ecological values

Develop a resource harvest framework for the Offshore Net and Line Fishery to facilitate its ecologically sustainable development.

Develop a management framework for the ecologically sustainable harvest of small pelagic fish and squid.

Finalise re-accreditation for the Demersal, Offshore Net and Line, Aquarium and Mud Crab fisheries under the EPBC Act*.*

Implement improved Environmental Risk Assessment processes for NT Fisheries.

Collect key biological information on coastal reef fish species.

Continue monitoring and assessment of NT fisheries.

Publish the 2010 recreational fishing survey results.

Review the appropriateness of existing recreational fishing controls.

Implement agreed priorities from the Recreational Fishing Development Plan.

Implement legislative amendments to the *Fisheries Act*.

Survey the potential for inshore Aboriginal fisheries in key locations, such as Groote Eylandt and the East Arnhem region.

Sharing fish resources between Indigenous, recreational and commercial uses

Develop and implement a resource-sharing allocation framework for the NT.

Implement new resource allocation arrangements for the Barramundi Fishery.

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

Develop a resource harvest framework for the Mud Crab Fishery to minimise conflict between resource users and encourage its ecologically sustainable development.

Continue to provide assistance 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.

Continue to deliver the Indigenous Scientific Mentoring Program to facilitate the engagement of Aboriginal rangers in fisheries research projects.

Facilitating the provision of fishing facilities and access opportunities

Provide fisheries-specific advice to develop a self-launch boat ramp at Dundee Beach and to scope additional ramps in the Darwin Harbour region and in the coastal reaches of Mary River.

Provide fisheries-specific advice to government on the potential for new access to waterways and water bodies for recreational fishing in the NT.

Facilitate Indigenous development

Continue to support the development of a cooperative fishing network in East Arnhem Land.

Provide logistic and financial support to the Indigenous Marine Ranger Program.

Improve the consultative framework to assist remote communities to become more involved in fisheries management.

Support a mentoring program to assist Aboriginal fishers become involved in the seafood industry.

Continue to support a Science Mentoring Program to facilitate the engagement of Indigenous people in fisheries research projects.

Continue to partner with Indigenous communities and private sector aquaculture businesses to conduct sea-farming programs in remote locations.

Continue to work with CDU to identify successful development pathways for Indigenous fisheries enterprises.

Assisting in aquaculture industry development

Maintain strong research partnerships with existing and emerging aquaculture industries.

Produce fingerlings for the Barramundi sector to meet their production needs.

Ensure that the NT aquaculture industry continues to operate in accordance with relevant environmental management plans.

Case-manage aquaculture industry development proposals to help proponents negotiate government processes.

Protecting aquatic ecosystems from pests and diseases

Maintain a responsive and effective aquatic animal health diagnostic service.

Continue to monitor for aquatic pests and diseases of national importance to protect NT businesses and the environment.

COMMERICAL WILD HARVEST

Aquarium Fishery Status Report 2012

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. Some specimens are also sold to overseas buyers.

The current harvest and value of the fishery is comparatively small, 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 Industry and Fisheries (NT Fisheries) to determine future development opportunities and management arrangements for the industry within the principles of ecologically sustainable development (ESD).

Management arrangements for the Aquarium Fishery were re-assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Government Department of the Environment (DotE) in December 2012. The fishery was subsequently accredited as a Wildlife Trade Operation (WTO) under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act) for a period of 18 months. This accreditation is only granted where DotE considers that the fishery is managed in such a way that stocks are not subject to overfishing and where fishing operations have minimal impact on bycatch and the broader marine environment. The next re-assessment of the fishery is due in May 2014.

Profile of the Fishery

Commercial Sector

There are three licence categories in the 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).

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.

Area

Aquarium Fishery licence holders can harvest from most inland, estuarine and marine waters to the outer boundary of the AFZ. Permission to access some areas of land and sea country within the Fishery is also required. 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 most marine species takes place within 100 km of Nhulunbuy and Darwin.

Fishing Method

Aquarium Fishing/Display Fishery licence holders 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 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.

Almost 38 000 individual invertebrates were collected by the Aquarium Fishery in 2012. Most (89%) of these were hermit crabs, followed by various snails and whelks (10% as a group). The catch of 199 giant fluted clams (*Tridacna squamosa*) in 2012 was well below the harvest trigger point of 2000 individuals for this species. Licence conditions prevent the harvest of clams over 250 mm in size.

In 2012, 4 tonnes (t) of ‘live rock’ and 2.2 t of corals were harvested. The combined total for these groups (6.6 t) was well below the regional and overall trigger points of 20 t and 60 t, respectively.

Approximately 7300 individual fishes belonging to 109 taxa were harvested in 2012. In most cases (63%), fewer than 10 individuals from a particular taxon were collected. One quarter of the piscine catch consisted of rainbowfishes and 20% of catfishes. The combination of red scat and silver scat contributed a further 15%.

No seahorses (*Hippocampus* spp.) or narrow sawfish (*Anoxypristis cuspidata*) were harvested by the Aquarium Fishery in 2012.

Effort

It is difficult to compare and contrast 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. In most years, weather-induced limits on fishing activity, in conjunction with strict catch controls and low participant numbers, result in minimal fishing effort. Total effort in 2012 was 190 days, 3% up on the 2011 figure (184 days). Note that both of these totals are well below the 10-year average of 245 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 Aquarium Fishing/Display Fishery licence holders are sold to interstate or international buyers.

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, cast net, scoop net, hand pump or 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 the 2009-10 recreational fishing survey (West et al. 2012).

Non-retained Species

There is little bycatch in the 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 DotE 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. 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 2012 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 harvest 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 $370 000 in 2012.

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 information on the areas fished and the capture methods used. Common aquarium species targeted by licence holders at a particular point in time are also identified.

No monitoring trips were undertaken during 2012. However, monitoring trips are planned to periodically validate logbook data.

Current Harvest Status

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

Current catches relative to trigger reference points are not presented in this report as trigger parameters changed when new WTO conditions were implemented in December 2012.

Trigger reference points relating to the percentage difference between the current catch and the mean of the previous three years’ harvest are of limited biological meaning because they do not take into account variations in the time spent targeting the particular species/group (i.e. fishing effort) or environmental factors. Similarly, 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 be reviewed.

Future Assessment Needs

Highly conservative coral harvest controls imposed by DotE in December 2012 have severely limited the allowable catch of all coral species in the NT. These limits can only be relaxed if new research demonstrates that the harvest of each coral species will not be detrimental to its ongoing viability. NT Fisheries is investigating ways in which it can work with Industry to address these knowledge gaps. Future assessment needs of the Aquarium Fishery will be driven by the requirements for ESD reporting.

Research

Summary

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

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, with field support from 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 these 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.

To demonstrate the dynamic nature of such water courses, NT Fisheries conducted a number of electrofishing surveys at Scotts Creek (approximately 50 km east of Darwin) in 2009 and 2010. Rainbowfishes and gudgeons dominated samples taken at the end of each run-off period and the pools also dried completely by the end of each dry season.

Current Research

NT Fisheries and Charles Darwin University conducted surveys of freshwater fishes in the Mary and Daly rivers in 2012 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 (as 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, which specify limits on the size, number and type of fishes that can be retained as well as gear and area restrictions.

History

*Management framework*

Regulation of the 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 licence holders 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 (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 licence holders 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 with 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 Aquarium Fishery were first assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by DotE 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.

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 the risk of localised depletion.

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 t 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 for a further 18 months. The fourth, and current accreditation (again 18 months), expires on 30 May 2014.

*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 fishes were 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) to support a non-detriment finding (NDF) for its harvest. Recent international scrutiny on the level of information required to establish an NDF meant that the Australian CITES Scientific Authority for Marine Species has reviewed and, where appropriate, modified 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 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 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 2012.

Consultation, Communication and Education

NT Fisheries regularly consults and communicates with individual aquarium licence holders, 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

References

Gomelyuk, V. E. (2003). Coral Bleaching at Cobourg Marine Park in 2002-03. Parks and Wildlife Service of the Northern Territory, Darwin.

Pusey, B. J. (Ed.). (2011). Aquatic biodiversity of the Wet-Dry Topics of Northern Australia: patterns, impacts and future. Charles Darwin University Press. Darwin, 231 pp.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E. and Steffe, A. S. (2012). A survey of recreational fishing in the Northern Territory, 2009-10. Department of Primary Industry and Fisheries. *Fishery Report* 109.

Barramundi Fishery Status Report 2012

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

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 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 annual commercial fishing season is 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 onboard 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 2012 consisted of 728 tonnes of Barramundi and 394 tonnes of King Threadfin. This represents an increase over the 2011 harvest of 701 tonnes (t) of Barramundi and 325 t 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 2012 were Black Jewfish (*Protonibea diacanthus*), blacktip shark (*Carcharinus* spp.), Blue Threadfin (*Eleutheronema tetradactylum*) and Queenfish *(Scomberoides commersonnianus)* (Figure 2). Shark harvest is restricted to 500 kg of converted whole weight on board each vessel at any time.

The total amount of byproduct retained in 2012 was 30 t, constituting 3% of the total harvest, which was a decrease of 28 t from the 58 t retained in 2011. Byproduct species harvest generally declined in 2012 with the largest reduction occurring for Blue Threadfin (Figure 2).

Effort

There were 20 fully transferable licences in the commercial fishery in 2012, 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 2012

**Figure 2.** Byproduct composition in the commercial Barramundi Fishery from 2010 to 2012

In 2012, 23 552 hmnd were expended in the commercial Barramundi Fishery, representing an increase from the 21 093 hmnd of effort in 2011 (Figure 1). Although higher than the 2011 figure, the 2012 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 and 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 subsequently increased to 30.9 kg/hmnd in 2012, which is among the highest values 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 2012, CPUE for King Threadfin was 16.8 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.** Commercial catch per unit effort (CPUE) for Barramundi and King Threadfin in the Barramundi Fishery from 1973 to 2012

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 Northern Territory (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 the 2009-10 recreational fishing survey, 147 393 Barramundi were caught by non-indigenous, NT residents with 40 951 of these being harvested (West et al. 2012). Barramundi were the most popular fish species targeted representing 21% of the total catch.

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 2009-10, targeted Barramundi fishing accounted for 20% of the total NT resident, line fishing effort.

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 along 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 accounts for roughly 95% of targeted Barramundi fishing effort (line hours); livebait use accounting for the remaining 5% of effort. The relative proportions of lure and bait fishing have remained reasonably stable since 1995.

Catch

In 2012, FTO clients caught 57 571 Barramundi, representing a decrease of 10% on the 2011 FTO catch. According to FTO logbook information, 89% (51 456) of Barramundi caught in 2012 were released and 11% (6115) were retained. Assuming a post-release mortality rate of 10% (de Lestang et al. 2004), the FTO sector would have removed around 11 261 Barramundi in 2012.

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 2012 were the Mary and Daly river systems and Arnhem Land.

In 2012, FTO clients caught 2176 King Threadfin, representing an increase of 25% on the 2011 FTO catch. According to FTO logbook information, 63% (1379) of King Threadfin caught in 2011 were released and 37% (797) were retained. The most productive areas for King Threadfin include the Mary River and Darwin/Bynoe Harbour areas.

Effort

In 2012, 87 189 line hours were spent targeting Barramundi which is the highest amount of effort recorded for this sector on this species. The 2012 effort represents an increase of 4% from the 83 846 line hours expended in 2011.

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 2012, the catch rate improved to 0.7 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 2010, recreational fishers targeting Barramundi also caught threadfins, snappers, grunters and catfish. Overall, 58% of all fish caught by recreational fishers were released or discarded with the actual release rates varying between species.

FTO logbook returns indicate that Blue Threadfin, tarpon, saratoga, sooty grunter and catfish were all caught while targeting Barramundi. Overall, 10% of these were retained, with Blue Threadfin 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 2012; 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 services 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). The 2010 survey did not provide total visitor numbers across the NT although it is expected to be close to 40% for most areas and is as high as 98% of the total effort in areas such as King Ash Bay.

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 2012, the overall catch value of the commercial Barramundi Fishery was $5.82 million. In 2012, the Barramundi component was $4.58 million and the King Threadfin component was $1.15 million. The value of byproduct sold in 2012 was $0.09 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 return information provided by licence holders. The information provided by recreational fishers is also used.

An NT Fisheries researcher was present on commercial Barramundi boats for five days in 2012. 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.

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.

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, Mary, Roper and Victoria rivers were all estimated to be less than 10% from tag recaptures. This is an extremely low figure for such a productive species and is one of the reasons the NT Barramundi stocks are so healthy.

None of the management trigger reference points were reached during 2012 (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 aftereffects 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 higher 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 2008, 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 after 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). The use of knotless landing nets is recommended to minimise injuries and increase the chance of post-release survival.

Since 2008, research has focussed on expanding the abundance surveys to include both the Mary and Daly rivers with several sites being assessed annually in each river system. There has also been a concerted effort to increase the number of river systems in which tag/recapture experiments are conducted.

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 the 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.
* Tag-recapture programs on the Daly, Mary, Roper, Macarthur and Victoria rivers.

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 per person. This reduction in the possession limit was to further protect the important Daly River fishery in light of increasing recreational use and is 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 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 need to resolve questions specifically concerning:

* The impact of recreational catches on Barramundi stocks in heavily utilised areas.
* Increased targeting of mature female Barramundi.
* Resource sharing 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.
* 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*. 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 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

References

Chenoweth, S. F., Hughes J. M., Keenan, C. P., and Lavery, S. (1998). Concordance between dispersal and mitochondrial gene flow: isolation by distance in a tropical teleost, *Lates calcarifer* (Australian Barramundi). *Heredity* **80:** 187-197.

Coleman, A. P. M. (1998). FISHCOUNT. A Survey of Recreational Fishing in the Northern Territory. Summary. Department of Primary Industry and Fisheries *Fishery Report* 41.

Coleman, A. P. M. (2004). The National Recreational Fishing Survey: Department of Business, Industry and Resource Development *Fishery Report* 72.

de Lestang, P. and Griffin, R. K. (2000). Impacts of Saline Intrusion on Barramundi in the Mary River Region. Department of Primary Industry and Fisheries *Fishery Report* 50.

de Lestang, P., Allsop, Q. A., and Griffin, R. K. (2001). Assessment of Fish Passageways on Fish Migration. Department of Primary Industry and Fisheries *Fishery Report* 60.

de Lestang, P., Griffin, R. K., and Allsop, Q. A. (2004). Assessment of the Post-release Survival and Stress Physiology of Barramundi (*Lates calcarifer*). Department of Primary Industry and Fisheries *Fishery Report* 73.

de Lestang, P., Griffin, R. K., Allsop, Q. and Grace, B. S. (2008). Effects of two different landing nets on injuries to Barramundi, an Australian sport fish. *North American Journal of Fisheries Management*. 2008; **28:** 1911-1915.

Grace, B., Handley, A., and Bajhau, H. (2008). Managing, Monitoring, Maintaining and Modelling Barramundi. Department of Primary Industry and Fisheries *Fishery Report* 90.

Griffin, R.K. (2006). Half a Century on: Barramundi Research in Australia – The Linkage between Research and Management. Department of Primary Industry, Fisheries and Mines *Fishery Report* 84.

Griffin, R. K. and Kelly, M. E. (2001). Fishery Assessment Report: Northern Territory Barramundi Fishery 1999. Department of Primary Industry and Fisheries *Fishery Report* 56.

Keenan, C. P. (1994). Recent evolution of population structure in Australian Barramundi, *Lates calcarifer* (Bloch): an example of isolation by distance in one dimension. *Australian Journal of Marine and Freshwater Research* **45:** 1123-1148.

Pender, P. J. and Griffin, R. K. (1996). Habitat history of Barramundi (*Lates calcarifer*) in a North Australian river system based on barium and strontium levels in scales. *Transactions of the American Fisheries Society* **125:** 679-689.

Shaklee, J. B. and Salini, J. P. (1985). Genetic variation and population subdivision in Australian Barramundi, *Lates calcarifer* (Bloch). *Australian Journal of Marine and Freshwater Research* **36*:*** 203-218.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E. and Steffe, A. S. (2012). Survey of Recreational Fishing in the Northern Territory, 2009-10. Northern Territory Government, Australia. *Fishery Report* 109.

Coastal Line Fishery Status Report 2012

Introduction

The Coastal Line Fishery (CLF) 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 have led to a proposal for new management arrangements by the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries), in consultation with the CLF 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

CLF 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 97% of the fishing effort in the fishery in 2012.

Catch

The total reported catch for the fishery in 2012 was 167 tonnes (t) (146 t in 2011), but a decline from the peak catch of 311 t in 2004 (Figure 1). Historical data indicates that the catch fluctuated between 60 and 138 t 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 16% to around 3% in 2012.

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 commercial Coastal Line Fishery, 1999-2012

**Figure 2.** Catch, effort and catch per unit effort (CPUE) for the line only component of the commercial Coastal Line Fishery, 1999-2012

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 increased to 3.8 kg/hook hour in 2011 and then decreased to 2.5 kg/hook hour in 2012. Once again, this is attributed mainly to new operators entering the fishery in 2012. 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

In 2009-10 a comprehensive survey of recreational fishing occurred throughout the NT. This survey followed NT recreational fishing surveys conducted in 1995 and 2000.

Area

Recreational coastal line fishing takes place over most of the nearshore waters of the NT. Over 80% of recreational fishing activity occurred in marine waters – primarily estuaries, followed by inshore and offshore waters, with 55% occurring in the Darwin area in total.

Fishing Method

A variety of fishing gear is used by the recreational sector of the fishery. Boat-based fishing dominated with line-fishing by far the most common fishing method (95% of fisher days).

Catch

Resident recreational fishers captured a diverse range of scalefish, elasmobranchs (sharks and rays), crustaceans, molluscs and other taxa, with over 770 000 organisms caught during the 12-month survey period. Scalefish and elasmobranchs dominated the catch (almost 90% of the total or 691 000 organisms).

The most common scalefish harvested were snappers (23% of the total harvest). Within the snapper group, Golden Snapper (*Lutjanus johnii*) and Red Snapper (*L.* *malabaricus* and *L. erythropterus*) accounted for the largest portion of the harvest, estimated at 80 000 and 37 000, respectively. Cod (~27 000), Grass Emperor (~23 000), Stripey Snapper (~21 000) and Black Jewfish (~11 000) were also significant components of the harvest.

Effort

Regionally, Darwin Harbour attracted over a quarter (27%) of the NT-wide fishing effort, with zones immediately adjacent to Darwin (Darwin Surrounds and Bynoe/Finniss Area) attracting a further 28%. The Mary/Alligator rivers accounted for a further 17% of the effort, while the more remote zones accounted for less than 10% of resident effort in each case.

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 2012 reveals that the FTO sector catches large numbers of coastal fish, most notably, Golden Snapper (13 780), Stripey Snapper (13 245) and Grass Emperor (7487).

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 2012, reef fishing effort accounted for 71 226 hours fished by FTO clients, which is an increase on the 65 072 hours fished in 2011. There has been a decline in activity since 2009, which is consistent with a decline in client numbers since then. However, client numbers once again picked up slightly in 2012, resulting in an increase in hours fished compared with the previous year.

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

The National Recreational and Indigenous Fishing Survey (NRIFS) conducted in 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 CLF licensees from taking Barramundi, King Threadfin, Spanish Mackerel or mud crab. CLF 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 such species 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 2012. 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 2012, there were 18 active CLF licences, an increase on 13 active in 2011. This 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 2012, the catch value of the commercial sector of the fishery was $0.5 million. The Black Jewfish component was $0.45 million and for Golden Snapper, it was $24 800. 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 were completed for Black Jewfish and Golden Snapper in 1996 and 2011 using Stock Reduction Analysis, 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 has 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 38% 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 of 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 concluded in 2010. The results 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 Snapper 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 Emperor (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, the 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 on 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 exophthalmos (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 by-product 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.

General possession limits, Golden Snapper and Black Jewfish limits are currently under review.

Current Research

Current research projects include the collection of snapper frames from recreational anglers and FTOs around the NT. The project has been extremely successful, with over 1900 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 Indigenous marine ranger groups across the NT.

A Golden Snapper tagging program has continued in Darwin and Bynoe harbours and around the Tiwi Islands, with the support of the Amateur Fishermen’s Association of the NT (AFANT). NT Fisheries, selected recreational anglers and FTO operators have tagged over 2300 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, movement and growth rates. So far, 196 Golden Snapper have been recaptured representing a recapture rate of 8.2%.

A range of reflex tests followed by autopsies were carried out on 64 Golden Snapper in depths ranging from 10 - 30 m to determine the effects of barotrauma on survival when released. Results from the autopsies and reflex tests indicated the following mortality rates in different depths:

10-15 m 82% had injuries that rendered them unlikely to survive

15-20 m 100% had injuries that rendered them unlikely to survive

>20 m 100% had injuries that rendered them unlikely to survive.

Gill and gut samples are being collected from Black Jewfish, Golden Snapper and Grass Emperor from several locations across the NT with the help of Indigenous marine ranger groups to determine the types of parasites present. In addition, genetic samples are being collected to determine the stock structure of these important species.

Otoliths will also be collected to determine their chemical composition. Otolith microchemistry provides a permanent record reflecting the environmental conditions experienced by a fish throughout its life. 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 five CLF 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 m 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 2013.

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*.

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 – Mr Blake Taylor

References

Coleman, A. P. M. (1998). Fishcount: A Survey of Recreational Fishing in the Northern Territory. Department of Primary Industry and Fisheries *Fishery Report* 43.

Coleman, A. P. M. (2004). The National Recreational Fishing Survey: The Northern Territory. Department of Business, Industry and Resource Development *Fishery Report* 72.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project 99/158. NSW Fisheries Final Report Series No 48.

Walters, C. J., Korman, J., and Martell, S. J. (2006). A stochastic approach to stock reduction analysis. *Canadian Journal of Fisheries and Aquatic Sciences* **63:**212-223*.*

Coastal Net Fishery Status Report 2012

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 14 to five.

Recreational and Indigenous fishers often target the same species as commercial Coastal Net licence holders 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 licence holders only able to fish in the single region nominated on their licence. The three regions are:

* Darwin (from Cape Hotham to Native Point and Cape Ford to Cape Dooley).
* Gove (between Cape Arnhem and Cape Wilberforce).
* Borroloola (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 licence holders 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. Licence holders 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 licence holder is permitted to use a gillnet with a mesh size up to 100 mm.

Catch

The total reported catch in 2012 was 6 tonnes (t), an increase on the 4.4 t caught in 2011 (Figure 1). Mullet accounted for 84% of the total catch in 2012. The fishery averaged around 36 t per year between 2001 and 2007. Much of the inter-annual variation in catch, effort and catch rate is probably due to business decisions. Many operators 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 2012

Effort

Two of the five licences in the fishery were active in 2012.

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 2012 was 182 hmnd, an increase of 159 hmnd on the 2011 figure but well below the average of 588 hmnd since 2001.

Catch Rates

The CPUE for the fishery has averaged 44.1 kg/hmnd since 2001. The CPUE in 2012 was 32.9 kg/hmnd, which is an increase from the CPUE of 27.7 kg/hmnd in 2011.

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 Survey of Recreational Fishing in the Northern Territory (SRFNT) conducted in 2009–10 provided no estimation of drag net use. However, the annual recreational fishing effort using cast nets was estimated at 3007 ± 623 hours (West et al. 2012).

Catch

Some of the key species harvested by commercial coastal net operators also form a component of the recreational fishery of the NT.

Results from SRFNT indicated that mullet and small baitfish dominated the cast net catches followed by squid and tarpon (West et al. 2012). 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 2012, 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 the National Recreational and Indigenous Fishing Survey 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 trevallies (8000) (Henry and Lyle 2003).

Non-retained Species

Commercial licence holders are prohibited from retaining Barramundi, King Threadfin, Spanish Mackerel or mud crab. Operators are required to clear their nets in water not less than 30 cm deep to facilitate the release of any bycatch 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*. 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 operators to use only haul or surrounding nets and therefore be in continuous attendance of their gear when it is in use.

In 2012, 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 2012 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 2012, the commercial sector of the fishery was estimated at $30 000.

### 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*.

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 the 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 was conducted in 2009–10 (West et al. 2012). This survey quantified NT resident catch, harvest, effort and expenditure. Only limited information was obtained on visitor fishing activity through on-site surveys (e.g. at boat ramps and accommodation establishments) for key catchments. Results from this survey have provided an improved understanding of the recreational harvest of coastal species.

A Fisheries Research and Development Corporation 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 in 1992. 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 sharing 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 under the *Fisheries Act*. 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

The Fisheries Division of the Department of Primary Industry and 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 – Mr Blake Taylor

References

Coleman, A. P. M. (2004). The National Recreational Fishing Survey. Department of Business, Industry and Resource Development *Fishery Report* 72.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project 99/158. NSW Fisheries Final Report Series No 48.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E. and Steffe, A. S. (2012). Survey of Recreational Fishing in the Northern Territory, 2009-10. Northern Territory Government, Australia. *Fishery Report* 109.

Demersal Fishery Status Report 2012

Introduction

In February 2012, the Demersal Fishery and the Finfish Trawl Fishery were amalgamated, resulting in a single Demersal Fishery in which traps and lines are permitted across the whole fishery and finfish trawl gear is permitted in two defined zones. At the same time individual transferable quotas (ITQs) were implemented into the management arrangements of the fishery. The new arrangements set total allowable catches (TAC) for Goldband Snappers, Red Snappers, and all other retained fish (‘group’ species) taken in the fishery. The changes provided for equitable distribution of TAC to existing operators and the capacity for transferability of quota units.

The 2012 catch was comprised mainly of Red Snappers (*Lutjanus malabaricus* and *L. erythropterus*) and Goldband Snappers (*Pristipomoides* spp.). Painted Sweetlips, Red Emperor (*L. sebae*) and cods (Family Serranidae) were key byproduct species. Most of the fish taken by the Demersal Fishery licence holders 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*, manages all finfish taken in the fishery while the day-to-day management of the fishery is conducted by the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries).

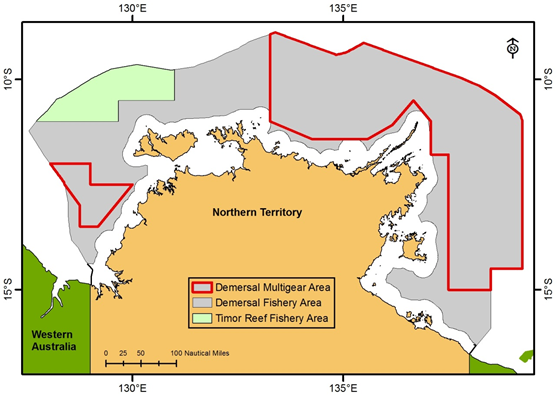
The fishery was assessed in 2009 against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Government Department of the Environment and received full Export Exempt accreditation under the Commonwealth *Environment Protection and Biodiversity Conservation Act*. 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 nautical miles (nm) from the coastal baseline to the outer limit of the Australian Fishing Zone, excluding the area of the Timor Reef Fishery (Figure 1).



**Figure 1.** Location of the Demersal Fishery

Fishing Method

Commercial operators are authorised to use baited traps and vertical lines, including hand lines and drop lines, throughout the Demersal Fishery. Semi-demersal trawl nets are also permitted in the two multi-gear areas (Figure 1). There was no line fishing in 2012. Trawl operators are required to use a bycatch reduction device and square mesh funnel or cod end, which reduces the amount of bycatch and increases the value of the landed product.

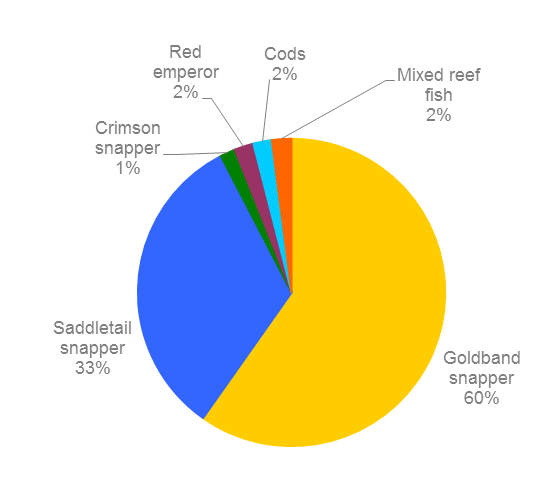
Catch

In 2012, the catch composition reflected the two different fishing methods. Goldband Snappers and Red Snappers are the two principal species groups targeted by traps (Figure 2). There are three Goldband Snapper species: *Pristipomoides multidens, P. typus* and *P. filamentosus*, with *P. multidens* making up around 90% of the total Goldband Snapper group. Key ‘group’ species harvested by trap vessels were Red Emperor (*L. sebae*) and cods (Family Serranidae).

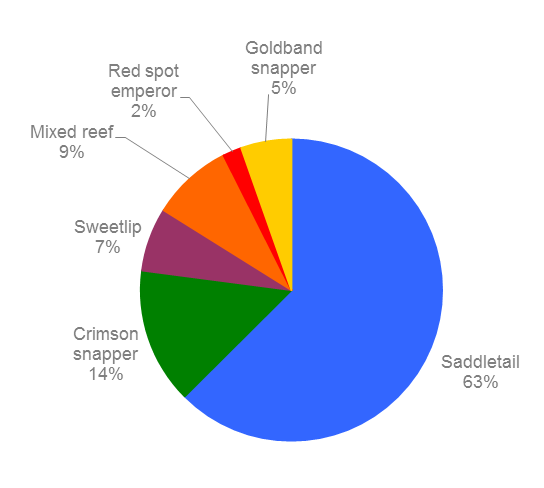
Trawl vessels targeted Saddletail Snapper (*Lutjanus malabaricus*) and Crimson Snapper (*L. erythropterus*) (Figure 3). ‘Group’ species targeted by the trawl gear include Painted Sweetlips (*Diagramma labiosum*), Redspot Emperor (*Lethrinus lentjan*) and Goldband Snappers.

The current total allowable commercial catch (TACC) for all species combined is 3815 tonnes (t). This is made up of 2500 t for combined Red Snapper species, 400 t for combined Goldband Snapper species and 915 t for all other retained species (‘group’ species).

In 2012, the total commercial catch was 2228 t, comprising 178 t from trap vessels and 2050 t from trawl vessels (Figures 4 and 5). Red Snappers (1641 t) comprised 74% of the total catch and Goldband Snappers (217 t) made up 10% of the catch. The total catch of group species was 370 t. The increase in trawl catch from 2011 was a result of increased effort in the fishery following the introduction of ITQ.



**Figure 2.** Catch composition when using traps in the Demersal Fishery in 2012



**Figure 3.** Catch composition when using trawl in the Demersal Fishery in 2012

Effort

Eight active licences (using eight vessels) fished for 980 boat days in the fishery in 2012 (Figures 4 and 5). In comparison, there were 11 trap licences active in 2011, which fished for 562 boat days with a single trawl vessel fishing for 325 boat days. The substantial variability in trap effort since 2009 generally reflects movement between the Demersal Fishery and the nearby Timor Reef Fishery. The increase in trawl effort is a result of the entry of new vessels into the fishery with the implementation of the new ITQ management arrangements.

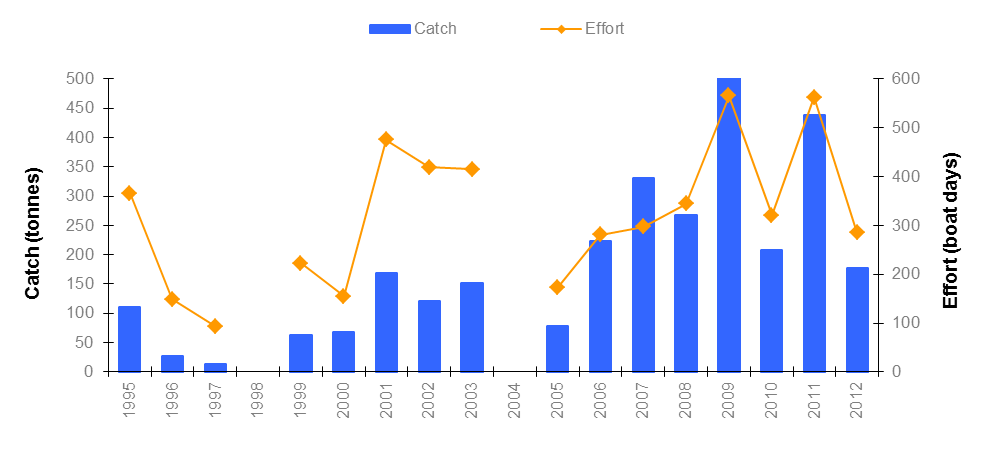
Catch Rates

Trap and line catch per unit effort (CPUE) has fluctuated considerably over the history of this fishery (Figure 6). Stock Reduction Analysis evidence suggests that this is not due to changes in fish abundance or sustainability concerns. The fluctuating CPUE reflects the small number of operators and their developing knowledge of the fishery.

Trawl CPUE has shown little change since 1997, ranging from 3.0 to 3.9 t per boat day (Figure 7). CPUE for 2012 was 2.9 t per boat day. This decrease is most likely due to the entry of new operators who have yet to develop a sound knowledge of the fishery.

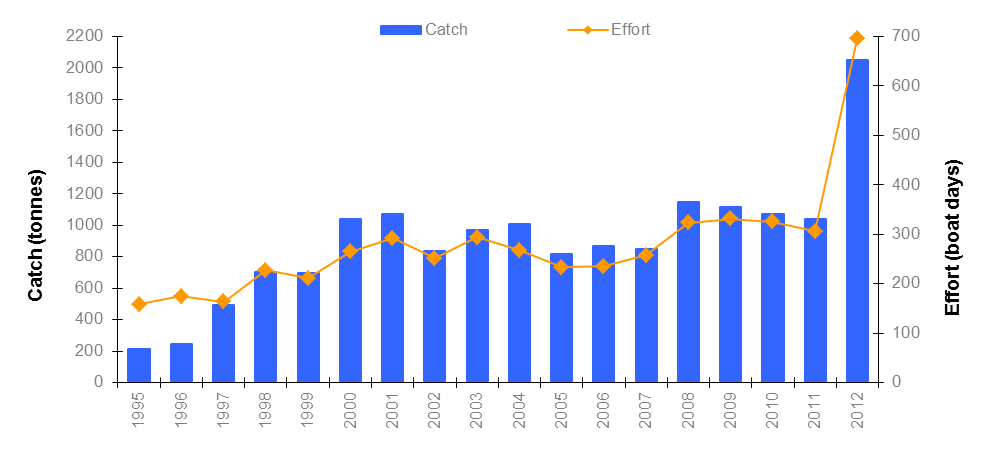
Marketing

Currently, the majority of 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.

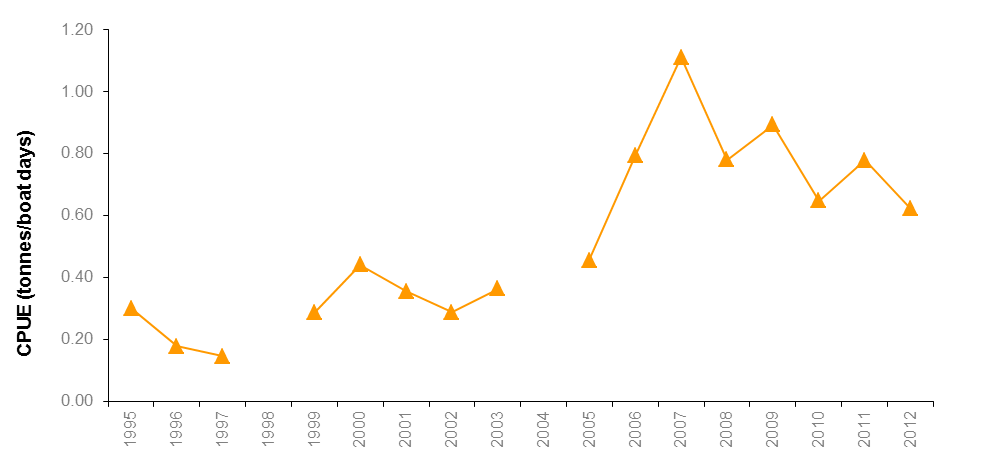


**Figure 4.** Commercial catch and effort for the trap and line component of the Demersal Fishery, 1995 to 2012\*

\* 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.

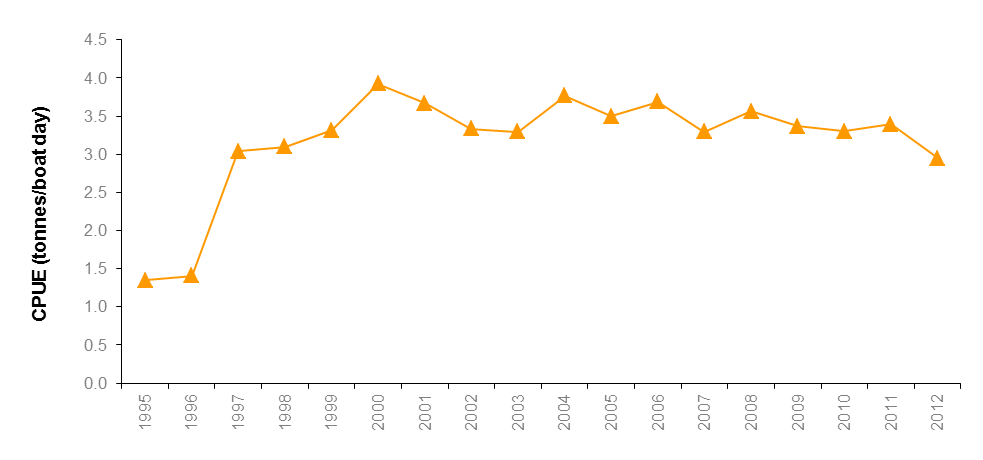


**Figure 5.** Commercial catch and effort for the trawl component of the Demersal Fishery, 1995 to 2012



**Figure 6.** Total catch per unit effort (CPUE) for the trap and line component of the Demersal Fishery, 1995 to 2012\*

\* 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 7.** Total catch per unit effort (CPUE) for the trawl component of the Demersal Fishery, 1995 to 2012

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 10% of those of the commercial sector. FTOs are considered in all reviews of the fisheries management arrangements to ensure 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

Trap and trawl gears catch different proportions of bycatch and recognising this, the management objectives specify that bycatch must remain below 10% for trap and line gears and below 35% for trawl gear. In 2012, non-retained species consisted mainly of trevally and scads (Carangidae) and small sharks (Carcharinidae). Bycatch was reported to be less than 3% of the total trap catch and around 20% of the total trawl catch.

The presence of larger species, including sharks and rays, has declined coincidental with the use of Bycatch Reduction Devices (BRD).

Threatened Species Interaction

Early in 2012, there were a small number of interactions with threatened, endangered or protected species recorded by onboard observers. The number of interactions was reduced with the improvement of the BRD technology as the fishery developed through the year.

Ecosystem Impact

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

Vertical lines and traps are passive fishing gear types and 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 unimpeded entry and exit of fish from traps of the same design as used in the fishery.

The semi-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 further reduces some of the broader ecosystem impacts.

Social Impact

The commercial sector of the fishery directly employs about 60 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 $12.02 million in 2012. The Goldband Snapper component was valued at $1.84 million and the Red Snapper component at $8.26 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.

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 to whom it was sold. This information enables effective tracking of quota and monitoring of catch for comparison against performance indicators and trigger points.

In accordance with the Demersal Management Framework, four monitoring trips were conducted onboard vessels using trawl gear in 2012. NT Fisheries staff documented vessel and gear information, location, depth, fishing practices and catch composition, including bycatch. Information gathered during the monitoring trips is used to help improve fishing practices, cross check logbook records and monitor bycatch and interactions with threatened, endangered and protected species.

Stock Assessment Methods and Reliability

The most recent assessment of Goldband Snappers, using age structured stock reduction analysis (SRA), was completed in 2011. The assessment used data from the Timor Reef Fishery (TRF) only, but a further assessment using data from both the Timor Reef and Demersal Fisheries is expected to be completed in 2013.

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 2014.

An assessment of Red Snappers, including both *Lutjanus malabaricus* and *L erythropterus*, was last conducted in 1996 (Ramm 1997). Data from an independent trawl survey was used to provide a Red Snapper biomass estimate of 24 000 t and a conservative annual sustainable harvest of 1500 to 2500 t from the Arafura Sea area of the fishery. A stock assessment for Red Snapper, using the SRA model, will be completed in 2013 and, to assist in future assessments, biomass and age data for Red Snappers will be collected in the swept area survey planned for 2014.

Current Status

Catches in Australian waters of the Arafura Sea are below current TACCs. The introduction of the new management arrangements and the consequent entry of new operators to the fishery has seen a 50% increase in the total catch. It is expected that catches will reach the TACCs within the next couple of years. Operational decision rules agreed to by stakeholders are in place to ensure the harvest rate is appropriate at all levels of harvest up to the TACC.

Future Assessment Needs

Goldband and Red Snapper stock assessments will be completed in 2013. Some key parameters still required for both goldband and Red Snappers include:

* A more accurate estimate of the current Australian harvest rate.
* More comprehensive age information.
* Information on the movement of Red Snappers prior to recruitment to the fishery.
* Catch and effort information from the Indonesian fisheries.

Research

Summary

The monitoring and management of Red Snapper species (including Goldband Snapper) across northern Australia was addressed in a project completed in 2011 (O’Neill et al. 2011). The project assessed current monitoring and logbook datasets across three jurisdictions (Queensland, Western Australia and NT) 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 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 Snapper (*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).

NT Fisheries collaborated with Indonesia and Timor Leste in the Arafura and Timor Seas Ecosystem Action Program (ATSEA, 2012). The project characterised the biological and socioeconomic profile of the Arafura and Timor Seas (ATS) region and identified 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.

Incorporation into Management

Research findings to date suggest that the current TACCs 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 the development of 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 information essential to determining annual harvest rates and, in turn, ensure greater reliability of stock assessments.

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 (e.g. demersal snappers and associated finfish) 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 for the fishery.

More information on the operational decision rules in place for the fishery can be found at: <http://www.nt.gov.au/d/Content/File/p/Fish_Rep/DF_Decision_Rule.docx>.

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*.

An Offshore Snapper Advisory Group (OSAG) was established in 2010, comprising members from the industry, recreational fisher and FTO representatives, compliance and departmental officers to provide advice to the industry and NT Fisheries on the development of a new management framework. In February 2012 a catch quota management system was introduced to the management arrangements for the fishery. OSAG considered the introduction of ITQs to the fishery, focussing primarily on Red Snappers to support the greatest potential for growth of the fishery. At the request of the industry, the fishery underwent a significant restructure, which saw the management arrangements move to an ITQ system.

At the same time, the Finfish Trawl Fishery (which shared both fishing area and fish stocks with the Demersal Fishery), was revoked; the Finfish Trawl licence holders and fishing gear were merged with the Demersal Fishery.

Current Issues

The management focus for the Demersal Fishery is the further development of the fishery (particularly the Red Snapper component) coincident with encouragement of operators to fish the entire fishery area in an ecologically sustainable manner.

Operators have committed more expertise and resources to the development of the fishery as a result of the restructure and catches have increased as a corollary.

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.

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 (WPS) of the NT Police, Fire and Emergency Services is responsible for fisheries compliance and enforcement in the NT under the NT *Fisheries Act*.

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 their product is sold. Returns submitted by traders/processors are also analysed and used to validate fishery logbook returns as required.

The Commissioner of Police engaged 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.

A vessel monitoring system has been mandated for all vessels in the fleet to complement the move to quota management arrangements for the fishery.

There were no recorded compliance issues in 2012.

Consultation, Communication and Education

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

The Offshore Snapper Advisory Group (OSAG), which comprises members from the industry, recreational fisher and FTO representatives, compliance and departmental officers, was established in 2010 to provide advice to NT Fisheries.

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

Senior Aquatic Resource Manager – Mr David McKey

References

ATSEA (2012). Transboundary Diagnostic Analysis for the Arafura and Timor Seas Region. Jakarta, Indonesia, http://www.atsea-program.org/.

Blaber, S. J. M., Dichmont, C. M., Buckworth, R. C., Badrudin Sumiono, B., Nurhakim, S., Iskandar, B., Fegan, B., Ramm, D. C. and Salini, J. P. (2005). Shared stocks of snappers (Lutjanidae) in Australia and Indonesia: Integrating biology, population dynamics and socio-economics to examine management scenarios. *Reviews in Fish Biology and Fisherie*s **15:** 111-127.

Lloyd, J. and Puig, P. (2010). The Utilisation of GIS Spatial Statistical Methods to assist in the Development of Ecosystem Based Fishery Management Strategies using the Northern Territory Demersal and Timor Reef Fisheries as Case Studies. Final Report FRDC project 2005/047. Darwin, NT Department of Regional Development, Primary Industry, Fisheries and Resources. *Fishery Report* 99.

Newman, S. J., Steckis, R. A., Edmonds, J. S. and Lloyd, J. (2000). Stock structure of the gold-band snapper, *Pristipomoides multidens* (Pisces: Lutjanidae) from the waters of northern and western Australia by stable isotope ratio analysis of sagital otolith carbonate. *Marine Ecology Progress Series* **198:** 239-247.

Ovenden, J. R., Lloyd, J., Newman, S. J., Keenan, C. P. and Slatter, L. S. (2002). Spatial genetic subdivision between northern Australia and south-eastern Asian populations of *Pristipomoides multidens*: a tropical marine reef fish species. *Fisheries Research* **59:** 57-69.

Ramm, D. C. (1994). Australia's Northern Trawl Fishery. Final Report to FRDC for project 86/049. *Fishery Report* 32.

Ramm, D. C. (1997). Towards the Sustainable Use of Northern Territory Fishery Resources: Review workshops led by Carl J. Walters. Final report to FRDC on project 96/158. Department of Primary Industry and Fisheries *Fishery Report* 39.

Salini, J. P., Ovenden, J. R., Street, R., Pendrey, R., Haryantis and Ngurah (2006). Genetic population structure of Red Snappers (*Lutjanus malabaricus* Bloch & Schneider, 1801 and *Lutjanus erythropterus* Bloch, 1790) in central and eastern Indonesia and northern Australia. *Journal of Fish Biology* **68:** (Sup B) 217-234.

Development Fishery Status Report 2012

Introduction

The commercial fishing industry is characterised by evolving technologies and changing market opportunities. In order to be able to conduct trials of new fishing gear, access new species or to fish in new areas, commercial operators are required to apply for a development permit or licence.

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

Applicants approved by the Director of Fisheries are issued a development permit under Section 17 of the *Northern Territory* *Fisheries Act*. Performance criteria are assigned to each permit so that the feasibility of the trials can be assessed. Permit holders who have satisfied all aspects of the performance criteria and can demonstrate that the fishery and/or gear is both ecologically and economically sustainable, may re-apply for a development permit or, if appropriate, a Development Fishery 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

One development permit was issued to trial the harvest of tropical rock lobster and sea urchins in the 2011-12 licensing period.

***Fishing Method***

Harvest can only be undertaken using hand held implements (e.g. nooses and spears). SCUBA and Hookah gear may be used.

***Catch***

Confidentiality constraints prevent the publication of specific catch and effort data for the development permit; however, available operational data indicates the possible harvest of a number of species of tropical rock lobsters (*Panulirus ornatus* and *P*. *versicolor*) along with sea urchins of the family Echinometridae.

Non-retained Species

Harvest methods are highly selective. As such, interactions with non-target species are understood to be negligible.

Development Fishery Licences

Two Development Fishery licences were issued to trial the use of various fishing gears to harvest squid and small pelagic fish in the 2011-12 licensing period. One licence was issued for lift net and drop net gear, while the other was issued for a small purse seine net and drop net gear.

Fishing Method

A lift net is a small net positioned in the water alongside the vessel. Lights are used to draw fish into the area above the net, at which time the net is raised, capturing the fish.

A drop net operates similarly to a cast net. Fish are encouraged under the net with the use of lights. The net is then dropped over aggregated fish.

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 Fishery licences. However, key species taken in 2012 included Goldstripe Sardinella (*Sardinella gibbosa*), Slender Sardine (*Dussumieria elopsoides*) and Spotted Sardine (previously known as northern pilchard, *Amblygaster sirm*).

Non-retained Species

A small number of Spanish Mackerel were reported in logbook returns in 2012.

Ecosystem Impact

The potential impact of a proposed developmental fishing operation on the ecosystem is considered when assessing an application for a permit or licence. The precautionary principle is applied when evaluating applications to prevent adverse environmental impacts.

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 by conditions on their permit or licence to complete and return logbook returns detailing their operations. Annual activity reports are also required as a condition of the permit or licence.

NT Fisheries scientists conducted two onboard monitoring trips in the Development Fishery in 2012. 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 Development 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 – Mr James Woodhams

Mud Crab Fishery Status Report 2012

Introduction

The Mud Crab Fishery is one of the key Northern Territory (NT) wild harvest fisheries. In 2012, the commercial wild harvest sector caught 389 tonnes (t) of mud crabs valued at $7.8 million.

The mud crab resource is also important to both Indigenous and non-Indigenous Territorians, who together harvest approximately 10% of the concurrent commercial catch (Hay and Kelly 2002; 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.

Management arrangements for the NT Mud Crab Fishery were re-assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries in September 2012 by the Australian Department of the Environment (DotE, previously the Department of Sustainability, Environment, Water, Population and Communities). The fishery was subsequently accredited as a Wildlife Trade Operation (WTO) under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) for a period of five years. This accreditation demonstrates that the fishery is managed in such a way that stocks are not subject to overfishing and fishing operations have minimal impact on bycatch and the broader marine environment. The next re-assessment of the fishery is due in 2017.

Profile of the Fishery

Commercial Sector

Area

The fishery operates in the tidal waters of the NT, with most activity concentrated in the Gulf of Carpentaria. Some fishers also operate along the north Arnhem Land 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 and in most creeks adjoining Shoal Bay, Leaders Creek, Kakadu National Park or parts of the Cobourg Marine 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 motherships 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 estuaries or on coastal mud flats. 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 here as ‘double pot-lift days’.

Pots are manually hauled into dinghies and each crab is checked to ensure that it is above the minimum legal size (MLS) measured across the widest part of the carapace, 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 2012, 389 t of mud crabs were harvested by the commercial fishery (Figure 1). In 2000 and 2001, the annual commercial mud crab catches exceeded 1000 t (data prior to 2003 not shown). It is believed that those exceptional catches were due to high recruitment during favourable environmental conditions. The introduction of the commercially unsuitable crab (or ‘soft crab’) rule 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 MLS 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 2012 catch was similar to that in 2011 (397 t), the difference being a drop of just over 2%.

Byproduct caught in commercial mud crab pots during 2012 consisted of 98 kg of cod, 78 kg of catfish, 6 kg of sharks, 5 kg of snapper and 2 kg of bream, the bulk of which was used to bait pots. No bycatch was reported in the 2012 logbook returns. Refer to the Non-retained Species Section for further information on bycatch.

Chart of catch, effort and catch per unit effort for the NT commercial Mud Crab Fishery, 2003 to 2012

**Figure 1.** Catch (tonnes), effort (pot-lifts ÷ 1000) and catch per unit effort (CPUE; kg/pot-lift) for the NT commercial Mud Crab Fishery, 2003 to 2012

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. No additional effort was introduced into the fishery. All licences were fully utilised in 2012.

Total reported effort in 2012 was 690 836 pot-lifts (Figure 1), which represents a 1% increase on the 2011 figure. The proportion of double pot-lift 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 2012.

Catch Rates

CPUE in 2012 equated to 0.57 kg per pot-lift (Figure 1), which represents a 2% decrease on the 2011 figure. During the first decade of the fishery, catch rates remained relatively stable with an average of 0.35 kg per pot-lift. CPUE increased to 0.65 kg per pot-lift in 1996, eventually reaching 1.12 kg per pot-lift in 2001. That peak was followed by a decline and then a plateau (at around 0.40 kg per pot-lift) from 2003 to 2006. CPUE has remained at, or above, 0.50 kg per pot-lift 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 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 and parts of the Cobourg Marine Park. Crabbing is often undertaken in conjunction with other fishing activities in coastal and estuarine regions.

Surveys of recreational fishing in 1995-96,   
2000-01 and 2009-10 show that the majority (i.e. around 80%) of crabbing activity takes place close to Darwin, with comparatively little activity in Arnhem Land and the Gulf of Carpentaria (Coleman 1998; Coleman 2004, West et al. 2012).

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 the substrate, may also be used, but must not be constructed from material that entangles mud crabs or other aquatic life.

A gear limit of five pots (or dillies) per person applies, with a maximum of 10 pots per vessel. Mud crabs may also be harvested by spear, crab hook, hook and line, hand net, cast net or drag net.

Catch

The MLS for mud crabs harvested by recreational fishers is 13 cm for males and 14 cm for females. There are no restrictions on the take of ‘soft’ (or empty) mud crabs by the recreational sector; however, the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) produces extension material (*Fishnote* 28; Grubert and Phelan 2007) that encourages the testing and release of soft crabs.

The 2009-10 Survey of Recreational Fishing in the NT (West et al. 2012) indicated that non-Indigenous resident anglers caught over 44 000 mud crabs between April 2009 and March 2010. Of these, just over 30 000 individuals (68% of the catch) were retained, equating to around 24 t of mud crab.

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 2009-10, recreational fishing using pots and traps totalled 130 945 hours and accounted for 15% of the total NT resident recreational fishing effort (West et al. 2012). However, the pot/trap category included both marine and freshwater pots/traps (the latter used to catch cherabin and redclaw etc.), and so the estimates above do not refer specifically to mud crab fishing.

Catch Rates

The estimated catch rate for mud crabs using pots and traps was 0.34 individuals per hour in 2009-10 (West et al. 2012). Again, this is an under-estimate as the effort component includes soak times for freshwater pots/traps.

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.

Fishing Method

FTO clients employ the same harvest methods and are subject to the same catch and gear controls as recreational fishers.

Catch

In 2012, the FTO sector landed 2970 mud crabs, of which 1956 (66%) 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 2012, FTO clients spent 5425 hours of fishing effort targeting mud crabs. This represents a 41% increase on the 2011 figure of 3846 hours but is similar to the 2009 estimate of 5539 hours. Such inter-annual 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 3% of the total time spent fishing by this group.

Catch Rates

CPUE and harvest per unit effort of mud crabs by FTO clients in 2012 was 0.55 and 0.36 crabs per hour, respectively. Both estimates are the highest reported in the last ten years.

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

Indigenous Sector

Area

Most fishing effort is localised and centred close to Indigenous 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 Indigenous 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 t (Henry and Lyle 2003). Indigenous 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 when used in the NT. 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 and Lee, in press). This equates to a low bycatch rate of 1.3 fishes per 100 pot-lifts.

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 and Lee, in press). This equates to a bycatch rate of 14 fishes per 100 pot-lifts; 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 and Lee, in press). Of these, only blue swimmer crabs are harvested for consumption.

The primary methods used by Indigenous 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 2012.

Ecosystem Impact

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

DotE 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 to crab fishers supplying gear and consumables, and providing maintenance and 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. 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 2012, the NT commercial mud crab catch was 389 t, valued at $7.8 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 over the past 15 years.

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 (Grubert et al. in press) produced estimates of fishing mortality 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 2013. 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 of 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 (Grubert et al. 2012), describing links between mud crab catches and environmental drivers, such as rainfall and temperature (Meynecke et al. 2012a, b), and reducing bycatch of under-sized mud crabs and non-target species through the use of escape vents (Grubert and Lee, in press).

Incorporation into Management

NT Fisheries reviews the results of all research programs annually. Any pertinent issues 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 FRDC funded project ‘Improving gear selectivity in Australian mud crab fisheries’ undertaken by NT Fisheries found 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 and Lee, in press). The use of these devices can also increase the catch of legal-sized crabs by up to 15%. Allowing smaller crabs to exit the pot through escape vents removes any deterrent effect they may have (by way of aggressive encounters) on other crabs entering the pot and may explain the observed increase in catch rate of legal-sized crabs in vented pots.

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, that aims to contain fishing effort and protect breeding stocks, has been adopted in the fishery. MCFMP was introduced in 1991 and has been amended every couple of years since that time. Notable changes include a ban on the take of berried female crabs (1993), a 10 mm increase in the MLS of female crabs (1995), prohibition on the take of commercially unsuitable crabs (2001), a 10 mm increase in the MLS of both sexes of commercially harvested crabs (2006) and the unitisation of Mud Crab Fishery licences (2010).

The primary trigger reference points for the fishery relate to pronounced changes in catch, effort or mean size of crabs (Table 1). If these or other triggers limits are exceeded, then MCFMAC will assess the situation and provide advice to the Executive Director of Fisheries.

Current Issues

The fishery has stabilised over the last five years with catches “plateauing' at around 400 t and CPUE remaining above 0.50 kg per pot-lift. As such, the main issues at present relate to the efficiency of the fishery, as opposed to the status of the stock.

The four SEWPaC recommendations to be addressed during the current period of WTO accreditation generally relate to routine reporting requirements, although one reiterates the need for contemporary estimates of the recreational and Indigenous take of mud crabs.

Future Plans

A comprehensive review of the NT Mud Crab Fishery will begin in the second half of 2013 with a view to implementing a revised management plan during the 2014-15 financial year

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 under-sized 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.

All new commercial crab fishers must attend an introductory interview (with an interpreter if necessary) prior to fishing. The purpose of these interviews is to provide the fisher with an understanding of the regulations and status of the fishery, as well as research, management and compliance issues.

NT Fisheries also produces a number of ‘Fishnotes’ for recreational fishers, which describe the life history of mud crabs, crabbing regulations, crab diseases, how to tie crabs and how to assess ‘soft’ crabs. These are available as hard copies or as electronic documents on the Department’s website.

Senior Research Scientist - Dr Mark Grubert

References

Coleman, A. P. M. (1998). Fishcount: A Survey of Recreational Fishing in the Northern Territory. Department of Primary Industry and Fisheries *Fishery Report* 43.

Coleman, A. P. M. (2004). The National Recreational Fishing Survey: The Northern Territory. Department of Business, Industry and Resource Development *Fishery Report* 72.

Grubert, M. A. and Phelan M. J. (2007). Mud Crab - running on empty? How to Ensure Your Mud Crab is Full! Department of Primary Industry, Fisheries and Mines *Fishnote* 28.

Grubert, M. A., Phelan M. J. and Bird, M. H. (2012). Use of a durometer to differentiate between soft- and hard-shelled mud crabs (*Scylla serrata*) *Journal of Aquatic Food Product Technology*, **21:**3-13.

Grubert, M. A. and Lee, H. S. (in press). Improving gear selectivity in Australian mud crab fisheries. Department of Primary Industry and Fisheries *Fishery Report* 112.

Grubert, M. A., Saunders, T. M., Martin, J. M., Lee, H. S. and Walters, C. J. (in press). Stock Assessments of Selected Northern Territory Fishes. Department of Primary Industry and Fisheries *Fishery Report* 110.

Haddon, M., Frusher, S., Hay, T., Hearnden, M., Gribble, N. and Brown, I. (2004). Mud Crab Assessment Workshop. Department of Business, Industry and Resource Development *Fishery Report* 79.

Hay, T. and Kelly, M. (2002). Mud Crab Status Report 2001. *In*: Fishery Status Reports 2001. Department of Business, Industry and Resource Development *Fishery Report* 65.

Hay, T., Gribble, N., de Vries, C., Danaher, K., Dunning, M., Hearnden, M., Caley, P., Wright, C., Brown, I., Bailey, S. and Phelan, M. (2005). Methods for Monitoring the Abundance and Habitat of the Northern Australian Mud Crab (*Scylla serrata)*. Department of Business, Industry and Resource Development *Fishery Report* 80.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project 99/158. NSW Fisheries Final Report Series 48.

Knuckey, I. A. (1999). Mud crab (*Scylla serrata*) population dynamics in the Northern Territory, Australia and their relationship to the commercial fishery: PhD Thesis, Northern Territory University, Darwin, 248 pp.

Meynecke, J. -O., Grubert, M. A. and Gillson, J. (2012a). Giant mud crab (*Scylla serrata*) catches and climate drivers in Australia - A large scale comparison. *Marine and Freshwater Research* **63:**84-94.

Meynecke, J. -O., Grubert, M. A., Arthur, J. A., Boston, R. and Lee, S. Y. (2012b). The influence of the La Niña-El Niño cycle on giant mud crab (*Scylla serrata*) catches in Northern Australia. *Estuarine, Coastal and Shelf Science* **100:**93-101.

Walters, C., Buckworth, R., Calogeras, C., Hay, T., Knuckey, I. and Ramm, D. (1997). Status and Future Development Potential of the Mud Crab Fishery. Towards the Sustainable Use of the Northern Territory Fishery Resources: Review Workshops led by Carl J. Walters. Final report to FRDC on project 96/158. (D. C. Ramm, ed.), Department of Primary Industry and Fisheries.

Ward, T. M. Schmarr, D. W. and McGarvey, R. (2007). Northern Territory Mud Crab Fishery: 2007 Stock Assessment. Report to the Northern Territory Department of Primary Industry, Fisheries and Mines. SARDI Research Report Series 244.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E. and Steffe, A. S. (2012). A survey of recreational fishing in the Northern Territory, 2009-10. Department of Primary Industry and Fisheries. *Fishery Report* 109.

**Table 1.** Management objectives and harvest status against performance indicators for the Mud Crab Fishery in 2012

| **Ecosystem component** | **Management objective** | **Performance indicator** | **Trigger reference point/s (TRP)** | **Current status of ecosystem components** | **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 ↓ by 2% between 2011 and 2012 - 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 ↑ 1% between 2011 and 2012 - 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 2012 - 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 2012 (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 2012 - 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 2012 - TRP not reached. | As per 2) above. |

Offshore Net and Line Fishery Status Report 2012

Introduction

The 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 the Environment (DotE, previously the Department of Sustainability, Environment, Water, Population and Communities) in late 2007. An approved Wildlife Trade Operation (WTO) was subsequently issued under the Commonwealth *Environment Protection and Biodiversity Conservation Act* *1999* (EPBC Act). A reassessment was conducted in 2012 and the fishery was subsequently reaccredited as WTO until October 2015. 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 Northern Territory (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 is conducted with Western Australia and Queensland. Information and samples collected from this fishery also support a number of university and government-sponsored research projects.

Profile of the Fishery

Commercial Sector

Area

Licence holders 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 km2, 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 nautical miles (nm) seaward of the coast to the boundary of the AFZ. Pelagic nets may be used from 2 nm seaward of the low water mark out 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 outer offshore area of the fishery during 2012.

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 using 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 1113 tonnes (t) in 2012, a 7% decline over the 2011 catch of 1195 t.

In 2012, the *C. tilstoni* and *C. limbatus* catch of 356 t represent 32% of total landings, a 64% increase over the 217 t taken in 2011 (Figure 1). The *C. sorrah* catch of 75 t (7% of the total catch) represents a 9% decrease over the 83 t taken in 2011 (Figure 1). While blacktip sharkswere the principal target species in 2007 and 2008, Grey Mackerel has been caught in substantially higher numbers since 2009. The 2012 Grey Mackerel catch of 347 t represents 31% of the total landings, an 18% decrease over the 423 t taken in 2011 (Figure 1).

Operators reported that market forces and other operational considerations, such as weather conditions and dedicated targeting of shark, in 2012 were the main causes of variation in blacktip shark catches. Consequently, variations observed in catch cannot be attributed to changes in abundance.

A prohibition exists on the possession of sharks and shark products for the Timor Reef, Demersal, 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 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 decreased by 31% to 294 t in 2012 from 426 t in 2011. Byproduct species principally comprised 98 t of Hammerhead Sharks (*Sphyrna* spp., 9% of total catch), 95 t of Bull Shark (*C. leucas,* 9% of the total catch), 27 t of Tiger Shark (*Galeocerdo cuvier,* 2% of the total catch), 23 t of Pigeye Shark (*C. amboinensis*, 2% of total catch), 17 t of Lemon Shark (*Negaprion acutidens,* 2% of the total catch), 12 t of Winghead Shark (*Eusphyra blochii*, 1% of the total catch), and 10 t of Dusky Whaler (*C. obscurus*, 1% of total catch).

A requirement to explicitly record catches of Bull Shark 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 Shark and a corresponding decline in the catch of the similar looking Pigeye Shark. In 2010, 2011, and 2012 there were only small catches of Pigeye Shark recorded. Based on habitat distribution and fishery monitoring data, it appears that Pigeye Shark are being misidentified and recorded as Bull Shark. A targeted education campaign was undertaken, which appears to have resulted in more correct reporting. Other byproduct shark species included Milk Shark (*Rhizoprionodon acutus*) and a variety of other carcharhinids (Figure 2).

Non-shark byproduct species landed in 2012 consisted of 23 t of Spanish Mackerel (*Scomberomorus commerson*) which exceeded the 13.5 t allocated to the fishery, 7 t of Longtail Tuna (*Thunnus tonggol*); 2 t of Black Pomfret (*Parastromateus niger*), and a combined weight of 10 t of other fish species (Figure 2).

Effort

A total of 861 boat days were spent fishing during 2012. This reflects a 7% increase compared with 2011; 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.

Catch Rates

The catch per unit effort (CPUE) for *C. tilstoni* and *C. limbatus* was 412 kg/boat day in 2012, an increase on the 269 kg/boat day reported in 2011. CPUE for *C.* *sorrah* was 87 kg/boat day, a decrease from 102 kg/boat day in 2011(Figure 3).

Grey Mackerel catch rates have generally followed a pattern of steady increase from the early 1990s. CPUE for Grey Mackerel increased during 2009 to 485 kg/boat day and remained relatively stable in 2010 at 479 kg/boat day, increasing again in 2011 to 521 kg/boat day. CPUE for Grey Mackerel decreased to 403 kg/boat day in 2012 (Figure 3).

**Figure 1.** Catches and effort for the target species in the commercial Offshore Net and Line Fishery, 1983 to 2012\*

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

**Figure 2.** Composition of the Offshore Net and Line Fishery’s commercial catch in 2012

\*Note: The targeted blacktip shark species (*C. tilstoni, C. limbatus* and *C. sorrah*) and Grey Mackerel represent 70% of the total catch in the fishery.

*C. tilstoni*

*C. sorrah*

**Figure 3.** Commercial catch per unit effort (CPUE) for the Offshore Net and Line Fishery target species between 1983 and 2012\*

\*Note: Blacktip 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 2009-10, a survey of non-indigenous, NT resident recreational fishers found that over 27 738 sharks were caught, with 1506 harvested and the remainder released (West et al 2012). During the same period a total of 3390 Grey Mackerel were reported captured with 1282 being released (West et al. 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 2012, 5571 sharks were caught by FTOs, representing a 9% decrease from the 2011 catch. All of these sharks were released. The species specific information is not available.

The 2012 FTO Grey Mackerel catch of 639 represents a 26% decrease from the 864 caught in 2011.

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 by Aboriginal people using traditional methods.

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

In 2012, interactions with three sawfish species were reported for this fishery: three with Largetooth Sawfish (*Pristis pristis*), 10 with Green Sawfish (*P. zijsron*) and 67 with Narrow Sawfish (*Anoxypristis cuspidata*). Interactions with 30 turtles (species unidentified) were also reported during 2012. Logbooks report that many of these animals are returned to the water 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 2012, there were 12 licences active in the fishery. Most vessels employ a skipper and have two or three crew members.

Economic Impact

At the point of first sale in 2012, the overall catch value of the fishery was $4.07 million. The blacktip shark component was valued at $0.17 million, $1.38 million for other sharks and $2.28 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 submitting monthly summary returns to reporting information for each gear set has been implemented since the late 1990s. The target species has also been recorded since July 2005. These changes reflect 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. During 2012, two monitoring trips totalling 24 days and covering 33 individual shots were conducted onboard commercial boats. 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 2012, one trip was undertaken on a vessel operating pelagic gill net gear. Mackerel was the dominant species in the catch, comprising 39% of the catch in terms of the number of fish caught, and *Carcharhinus tilstoni* and *C. limbatus* comprised 14% of the catch. The second monitoring trip took place on a vessel operating demersal longline gear and on this trip *Carcharhinus tilstoni* and *C. limbatus* were the predominate speciescomprising36% of the catch with *C. sorrah* accounting for 27% of the catch.

Research has continued since 2006 to develop a tagging protocol to monitor harvest rates of the target shark and indicator species. The project ‘Estimating fishing-related mortality and designing sustainable management protocols for shark fisheries in northern Australia’ is jointly funded by the Australian Research Council Linkage Program and the NT Fishing Industry Research and Development Fund and 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, more than 4000 sharks of all species were tagged, mostly during scientific monitoring trips onboard commercial fishing vessels operating in the fishery. Most of the sharks tagged were commercially important species. The results are expected to be published in 2013; however, preliminary analysis suggests that *C. tilstoni* and *C. limbatus* are being harvested at below sustainable levels and population change is stable. 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, the less certainty there is about the sustainability of the current blacktip shark 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 t annually: 1900 t in the Arafura and Gulf of Carpentaria zones, and 1500 t 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 t per year. The optimum annual harvest rate is 6% to 7% of the component of the stock vulnerable to gillnet fishing. The age structure modelling (Walters and Buckworth 1997) indicated that the overall stock should have been increasing at a rate of between 5% and 10% per year since the mid-1980s, when Taiwanese catches were greatly reduced.

However, CPUE data from the 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 t 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 notably 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 2012, trigger reference points (TRPs) for annual catch were exceeded for *C. sorrah*. In 2011 *C. sorrah* declined by 35% and then declined by another 9% in 2012. 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*.* 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 NT including Grey Mackerel and blacktip sharks. The stock assessments found all three species were 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 2013.

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-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 2012, 178 sharks were tagged and recaptures continue to be reported. 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. leuca*s 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. Results of this project are expected in 2013.

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 licence holder has been issued an allocation of TAE, which can be fished each year or transferred in full, or in part, to another licensee. A licence holder 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, with 12 active during 2012.

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 do 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 DotE 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. DotE had 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. In 2009, NPOA Sharks Plan 1 was reviewed and the revised NPOA Sharks Plan 2 released in 2012.

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 t 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 t, 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 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 DotE 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 in October 2012 and received a WTO which is valid until September 2015. 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. 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 DotE.

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.

Compliance

WPS is responsible for all fisheries compliance and enforcement in the NT under the *Fisheries Act*. 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, WPS has the power to investigate the records of wholesalers and licensees.

In 2012, 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.

Principal Research Scientist - Dr Thor Saunders

Research Scientist – Mr Grant Johnson

Aquatic Resource Management Officer – Mr David McKey

References

Beatty, A., and Crofts N. J. (2004). Hammerhead Sharks. Weird or Wonderful? - Some interesting facts about a strange looking shark. Department of Business Industry and Resource Development *Fishnote* 34.

Blaber, S. J. M. (2006). Artisanal Shark and Ray Fisheries in Eastern Indonesia: Their Socioeconomic and Fisheries Characteristics and Relationship with Australian Resources: ACIAR Project FIS/2003/037 supplementary stock assessment meeting, CSIRO Cleveland, Australia.

Bradshaw, C. J. A., Field, I. C., McMahon, C. R., Johnson, G. J., Meekan, M. G. & Buckworth, R. (In Press). More analytical bite for estimating the sustainability of shark harvests. *Marine Ecology Progress Series*.

Crofts, N. J., and de Lestang, P. (2004). Grey Mackerel. Department of Business, Industry and Resource Development *Fishnote* 35.

Coleman, A. P. M. (2004). The National Recreational Fishing Survey: The Northern Territory. Department of Business, Industry and Resource Development *Fishery Report* 72.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project 99/158. NSW Fisheries Final Report Series No 48.

McAuley R. B., Simpfendorfer C. A. and Hall, N. G. (2007). A method for evaluating the impacts of fishing mortality and stochastic influences on the demography of two long-lived shark stocks. *ICES Journal of Marine Science* **64:** 1710–1722.

Rose, C., Gribble, N. A. and Stapley, J. (2003). Northern Australian Sharks and Rays: the Sustainability of Target and Bycatch Species, Phase 1. Final Report to the Fisheries Research and Development Corporation, Project 2001/077. QDPI&F, Brisbane, Australia.

Salini, J., McAuley, R., Blaber, S., Buckworth, R., Chidlow, J., Gribble, N., Ovenden, J., Peverell, S., Pillans, R. Stevens, J., Stobutzki, I., Tarca and C., Walker, T. (2007). Northern Australian Sharks and Rays: the Sustainability of Target and Bycatch Species. Phase II. Final Report to FRDC, Project 2002/064. CSIRO Marine and Atmospheric Research, Cleveland, Australia.

Simpfendorfer, C., McAuley R., Chidlow, J. and Unsworth, P. (2002). Validated age and growth of the dusky shark (*Carcharhinus obscurus)* from Western Australian waters. *Marine and Freshwater Research* **53:** 567-573.

Stevens, J. D., West, G. J., and McLoughlin, K. J. (2000). Movements, recapture patterns, and factors affecting the return rate of carcharhinid and other sharks tagged off northern Australia. *Marine and Freshwater Research*. **51:** 127-141.

Stobutzki, I., Stevens, J., Miller, M., Salini, J., Deng, R., Fry, G., Taranto, T., McAuley, R., Buckworth, R., Gribble, N., McPherson, G. and McLoughlin, K. (2003). The Sustainability of Northern Sharks and Rays. Final Report to Environment Australia.

Walters, C. and Buckworth, R. (1997). Shark and Spanish Mackerel stocks assessed. *Northern Territory Fishing Industry Council Newsletter*. July 1997. 8: 14-15.

Welch, D. J., Buckworth, R. C., Ovenden, J. R., Newman, S. J., Broderick, D., Lester, R. J. G., Ballagh, A. C., Stapley, J., Charters, R. A., and Gribble, N. A. (2009). Determination of management units for Grey Mackerel fisheries in northern Australia. Final Report, Fisheries Research and Development Corporation, Project 2005/010, Fishing and Fisheries Technical Report No. 4, Fishing and Fisheries Research Centre, James Cook University, Townsville, Australia, 158p.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E., and Steffe, A. S., (2012). Survey of Recreational Fishing in the Northern Territory, 2008-10, Department of Primary Industry and Fisheries *Fishery Report* 109.

**Table 1.** Management objectives and status against performance indicators for the Offshore Net and Line Fishery for 2012

| **Species or group** | **Management objective** | **Performance indicator** | **Performance measure** | | **Harvest status for 2012** | **Management action** |
| --- | --- | --- | --- | --- | --- | --- |
| Target species:  blacktip sharks  Grey Mackerel | 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.  Catch levels decrease by (↓) 30% over the previous two calendar years*.*  Catch levels decrease by (↓) 30% over the previous two calendar years*.* | *C. tilstoni*/*C. limbatus* 356 tonnes; *C. sorrah* 75 tonnes in 2012  – TRP not reached.  *C. tilstoni*/*C. limbatus*  ↑ 67% from 2011 following a ↓ 37% in 2011 from 2010 catch  – TRP not reached.  *C. sorrah* ↓ 9% from 2011 catch following ↓ 36% from 2010  – TRP reached.  Grey Mackerel catch ↓ 18% from 2011 following ↑ 6% from 2010 catch  – TRP not reached. | | MACs to review fisheries annually and make recommendations to the Executive Director of Fisheries (EDF).  Any amended arrangements will be implemented within 12 months of trigger being reached. |
| Byproduct species:  Bull Shark  Dusky Whaler  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.  Onboard monitoring of ONLF. | The byproduct proportion of the total catch increases by (↑) >35% in the calendar year.  Catch of any byproduct species increases to  (↑) >10%of the total catch in the calendar year. | The proportion of byproduct species in the total catch decreased to 30% of the total catch in 2012  – TRP not reached.  All byproduct species were within acceptable limits. | | As for target species above. |
| 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) species including:  Sawfish:  *Pristis clavata*  *P. pristis*  *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 64 interactions with TEP species in 2012.36 Interactions with turtles, 28 interactions with *P. zijsron* and 3 interactions *with P. pristis*.  – TRP not reached. | MACs to review fisheries annually and make recommendations to the EDF. |
| 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 2012

Introduction

Spanish Mackerel (*Scomberomorus commerson*) 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 targets this species, 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 from trawl gear in the Demersal Fishery. 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 (t) reported in the late 1970s. Annual catches by foreign fishing vessels were around 400 to 500 t through the late 1970s and early 1980s. Since the mid-1990s, the fishery has stabilised as a small, tightly controlled NT based troll fishery, which has since grown steadily.

The fishery has been assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Department of the Environment (previously 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*. 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.

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 mother ship 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 on 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*).

The commercial Spanish Mackerel catch in 2012 was 276 t, increasing from the 274 t caught in 2011 and the 254 t caught in 2010 (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 2012, the factors that affected 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.

Only 100 kg of Wahoo (*Acanthocybium solandri*) was recorded as byproduct for this fishery in 2012. 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 decreased to 23 t in 2012 from the 2011 catch of 26 t. The catch of Spanish Mackerel in the Demersal Fishery was less than 1 t in 2012, which matched the 2011 catch.

Effort

In 2012, there were 16 Spanish Mackerel Fishery licences, 12 of which were actively operating.

Fishing effort in the fishery was 719 boat days in 2012, a considerable decrease from the 813 boat days in 2011 and an increase from the 672 boat days in 2010 (Figure 1). Historically, a maximum effort of 1817 boat days was recorded in 1990 (Figure 1).

**Figure 1.** Annual catch (tonnes) and effort (boat days) in the NT Spanish Mackerel Fishery, 1983 to 2012

**Figure 2.** Catch per unit effort (CPUE) in the commercial Spanish Mackerel Fishery, 1983 to 2012

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 383.9 kg/boat day was achieved during 2012, which is the highest value recorded in the history of the fishery. 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

In 2009-10 a comprehensive survey of recreational fishing was conducted throughout the NT. This followed the NT recreational fishing surveys conducted in 1995 and 2000.

Area

Most Spanish Mackerel taken by recreational fishers are from waters within easy reach of the major coastal population centres of Darwin, Nhulunbuy and Borroloola. The 2009-10 survey found that most of the Spanish Mackerel catch occurred in the Darwin (30%) and Bynoe/Finnis (30%) areas (West et al. 2012).

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

The recreational survey conducted in 2009-10 estimated the total recreational catch of Spanish Mackerel by non-indigenous, NT residents to be around 8287 individuals with 4424 (53%) being released (West et al. 2012).

Effort

Regionally, Darwin Harbour attracted over a quarter (27%) of NT-wide fishing effort, with zones immediately adjacent to Darwin (Darwin Surrounds and Bynoe/Finniss Area) attracting a further 28%. The Mary/Alligator rivers accounted for a further 17% of the effort, while the more remote zones accounted for less than 10% of resident effort in each case (West et al. 2012).

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 2012, 2612 Spanish Mackerel were caught and 1486 of these were released (57%). These figures represent a small increase from the 2567 Spanish Mackerel caught in 2011 of which 1155 were released (45%).

Effort

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

Spanish Mackerel are mainly targeted by FTOs during game fishing. In 2012, 6291 hours were expended game fishing, a substantial increase from the 4029 hours in 2011.

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 2012.

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 Mackerel are highly regarded by the recreational and FTO sectors.

Economic Impact

At the point of first sale in 2012, the value of the catch from the commercial sector of the fishery was $2.26 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 on-board 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 from alternative assessments, the management of the fishery has used the approximate equilibrium catch of the Taiwanese fleet (450 t 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. The Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries), the Queensland Fisheries of 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.

Research funded by FRDC titled “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.

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 Mackerel to determine exploitation rates of this species.

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 t 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.

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 t (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.

**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 Demersal licensees | 1 | 4.5 |
| FTO licensees | 3 | 13.5 |
| Recreational fishers | 16 | 72 |
| Aboriginals | 1 | 4.5 |
| Total | 100 | 450 |

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 t per year (processed weight), with shark, tuna and mackerel being the main species. The foreign fishing fleet was permitted to fish within 12 nautical miles (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 Finfish Trawl Fishery (subsumed within the Demersal Fishery as of 31 January 2012,) 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 licence holder is restricted to only 30 whole trunks of Spanish Mackerel during a voyage. In addition to the 30 fish, for each tonne of Grey Mackerel harvested in ONLF, the licence holder may take an additional 10 trunks or whole Spanish Mackerel. In the Demersal Fishery, a licence holder must not possess more than 50 Spanish Mackerel on-board.

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.

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 Mackerel once again exceeded the commercial allocation.

Due to these high catch levels, the Spanish Mackerel Fishery Management Advisory Committee (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.

Current Issues

In June 2011, an Ecological Risk Assessment (ERA) workshop was held in Darwin involving a broad range of fisheries stakeholders. The ERA was based on the National Ecologically Sustainable Development 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 the industry, SMFMAC will continue to work through issues associated with the need to ensure the regulatory framework can control harvest levels in the fishery. SMFMAC is expected to meet in relation to this matter in 2013-14.

NT Fisheries will continue to work with Spanish Mackerel licensees and SMFMAC to ensure the conditions of export exemption accreditation are met. An application seeking continued export approval was submitted by NT Fisheries as 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 high enough 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*.

In 2012, 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.

Principal Research Scientist - Dr Thor Saunders

Aquatic Resource Management Officer – Mr Blake Taylor

References

Buckworth, R. C. (2004). Effects of Spatial Stock Structure and Effort Dynamics on the Performance of Alternative Assessment Procedures for the Fisheries of Northern Australia. PhD Thesis, University of British Columbia, 226 pp.

Buckworth, R. C., Newman, S. J., Ovenden, J. R., Lester, R. J. G., and McPherson, G. R. (2007). The Stock Structure of Northern and Western Australian Spanish Mackerel. Final Report, FRDC Project 1998/159. Department of Primary Industry, Fisheries and Mines *Fishery Report* 88.

Buckworth, R. C., Ovenden, J. R., Broderick, D., Macbeth, G. M., McPherson, G. R. and Phelan, M. J. (2011). GENETAG: Genetic mark-recapture for real-time harvest rate monitoring. Pilot studies in northern Australia Spanish Mackerel fisheries. Northern Territory Government, Australia. *Fishery Report* 107.

Stevens, J. D., and Davenport, S. R. (1991). Analysis of Catch Data from the Taiwanese Gillnet Fishery off Northern Australia, 1979-1986. CSIRO Marine Laboratories Report213.

Walters, C. J., and Buckworth, R C (1997). Shark and Spanish Mackerel Stocks assessed. *Northern Territory Fishing Industry Council Newsletter*, July 1997. 8(2), 14-15.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E. and Steffe, A. S. (2012). Survey of Recreational Fishing in the Northern Territory, 2009-10. Northern Territory Government, Australia. *Fishery Report* 109.

**Table 2.** Management objectives and status against performance indicators for the Spanish Mackerel Fishery for 2012

| **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).  Sustainable yield estimates are reviewed annually. | 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.  Annual review. | 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.  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. |
| 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). | Byproduct catch was less than 10% of the total catch – 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 2012 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. | There was no TEP species interaction in 2012 – TRP not reached. | As per 1) above. |

Timor Reef Fishery Status Report 2012

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 emperor (*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*, 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 2011, Individual Transferable Quotas (ITQs) were implemented into the management arrangements of the fishery. The new arrangements better address sustainability risks to Goldband Snappers, Red Snappers, and all other retained fish (‘group’ species) taken in the fishery by setting total allowable catches (TACs) for these species and removing unnecessary operating restrictions. The changes provided for equitable distribution of TACs to existing operators and also the capacity to transfer the units.

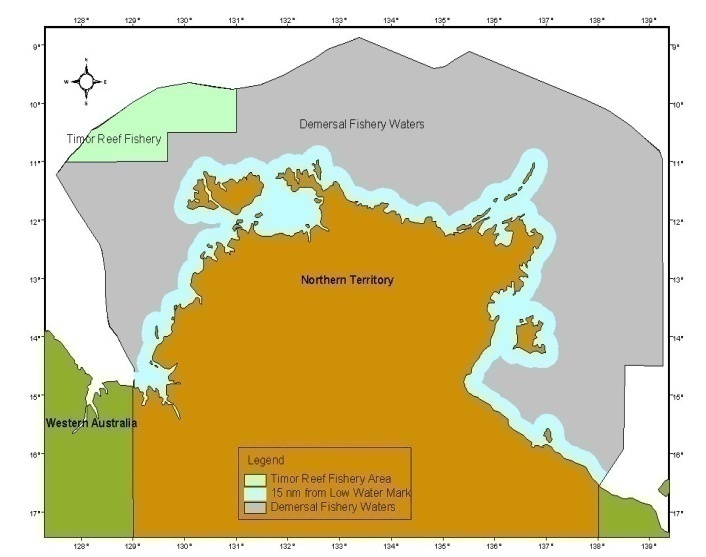
The fishery has been assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Government Department of the Environment (DotE, previously the Department of Sustainability, Environment, Water, Population and Communities). The fishery received full Export Exempt accreditation under the Commonwealth *Environment Protection and Biodiversity Conservation 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, 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 2012, one vessel used drop lines and traps, and six vessels used traps.

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 51% of the total catch in 2012, 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). The ‘group’ species, comprising cods, Red Emperor and mixed reef fish, increased to 19% of the catch in 2012 from 14% in 2011. At the same time, Red Snappers decreased from 38% in 2011 to 30% in 2012.

**Figure 2.** Catch composition of the commercial Timor Reef Fishery, 2012

The species composition of the catch has historically been gear-dependent. Drop liners generally catch a higher proportion of Goldband Snappers, compared with trap gear. This year was no exception, with the drop line gear catching a higher proportion (65%) of Goldband Snapper than the traps (50%).

The total allowable commercial catch (TACC) for all species combined is 2615 tonnes (t). This is made up of 900 t for combined Goldband Snapper species, 1300 t for combined Red Snapper species and 415 t for all other retained species (‘group’ species).

In 2012, the total fishery catch was 716 t (the same as in 2011) of which 365 t were Goldband Snappers (Figure 3). This represented an increase of 5% in the Goldband Snapper catch over the 347 t caught in 2011. The combined Red Snappers catch was 212 t, a decrease of 22% from the 273 t caught in 2011.

Total catch of ‘group’ species was 139 t, an increase of 47% over the 95 t caught in 2011. The group species included various species of rock cod, sea bream, grouper, emperor and tropical snapper.

Effort

During 2012, seven vessels actively fished over a period of 938 boat days, an increase of 14 boat days 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 efficiency in the fishery (Figure 4).

**Figure 3.** Commercial catch and effort for the Timor Reef Fishery, 1995 to 2012

**Figure 4.** Commercial catch per unit effort (CPUE) for the Timor Reef Fishery, 1995 to 2012

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 crabs (*Portunus* spp.) mixed tropical snappers (*Lutjanus* spp.), triggerfish (Balistidae), catfishes (Ariidae), red bass (*Lutjanus bohar*) and Chinaman fish (*Symphorus nematophorus*). The observed amount of bycatch (non-retained species) in the fishery was around 9% of the total catch weight, which is within the objectives of the management framework.

Threatened Species Interaction

In 2012, 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 stand-down of fishing activity.

Fish trawling within the area of the fishery was prohibited in the late 1980s. The 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 2012, the overall catch value of the fishery was $4.72 million. The Goldband Snapper component was valued at $2.83 million and the combined Red Snapper component was valued at $1.06 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 to whom it was sold. This information enables effective tracking of quota and reduces compliance costs significantly.

During 2012, an 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 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 Snappers have not been overfished and that harvest rate is approaching Fmsy (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 2%. 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 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 t from the fishery. A stock assessment for Red Snapper, using the SRA model, will be completed in 2013 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 (ear bone) 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 the current Australian harvest rate.
* More complete age information for Goldband Snapper.
* Catch and effort information from Indonesian fisheries.

Given the proportion of Red Snappers in the catch, similar parameters are also required for future assessment of those species.

Research

Summary

The stock structure of Goldband Snapper (*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 part of the Queensland Department of Agriculture, Fisheries and Forestry. 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 in 2011 (O’Neill et al. 2011). The project assessed current monitoring and logbook datasets across three jurisdictions (Queensland, Western Australia and the NT) 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.

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 ITQs 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*. 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, WPS has the power to investigate the records of wholesalers and licensees. No domestic compliance issues were recorded in this fishery in 2012.

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

References

Lloyd, J. and Puig, P. (2009). The Utilisation of GIS Spatial Statistical Methods to assist in the Development of Ecosystem-based Fishery Management Strategies using the Northern Territory Demersal and Timor Reef Fisheries as Case Studies. Final Report. Fisheries Research and Development Corporation project 2005/047. Darwin, NT Department of Regional Development, Primary Industry, Fisheries and Resources *Fishery Report* 99.

Newman, S. J., Steckis, R.A., Edmonds, J. S. and Lloyd, J. (2000). Stock structure of the Goldband Snapper *(Pristipomoides multidens)* (Pisces: Lutjanidae) from the waters of northern and western Australia by stable isotope ratio analysis of sagital otolith carbonate. *Marine Ecology Progress Series* **198:** 239-247.

O'Neill, M. F., Leigh, G. M., Martin, J. M., Newman, S. J., Chambers, M., Dichmont, C. M. and Buckworth, R. C. (2011). Sustaining productivity of tropical Red Snappers using new monitoring and reference points. Final report to the Fisheries Research and Development Corporation Project number 2009/037. Queensland, Department of Employment, Economic Development and Innovation.

Ovenden, J. R., Lloyd, J., Newman, S. J., Keenan, C. P. and Slatter, L. S. (2002). Spatial genetic subdivision between northern Australia and South-East Asian populations of *Pristipomoides multidens*: a tropical marine reef fish species. *Fisheries Research* **59:** 57-69.

Ramm, D. (1994). Estimation of biomass and fishery yield for snapper stocks in northern Australian waters. *In*: Ramm, D. Australia’s Northern Trawl Fishery, Department of Primary Industry and Fisheries *Fishery Report 32*.

Ramm, D. (1997). Toward the Sustainable Use of Northern Territory Fisheries Resources: A Review Workshop. Led by Carl J. Walters. FRDC project 96/158. *Fishery Report* 39.

Trepang Fishery Status Report 2012

Introduction

The Malayan term *trepang* describes a variety of edible holothurians, commonly known as sea cucumbers. The consumption of trepang is almost entirely restricted to the Chinese, who consider them a culinary delicacy and an aphrodisiac (Schwerdtner Máñez and Ferse, 2010).

Trepang fisheries in northern Australia date back to at least the 1700s, when traders from Makassar (Ujung Pandang) visited northern Australia to fish for the delicacy. Fishing activity in what is now the Northern Territory (NT), but formerly part of South Australia, declined around 1880 and the South Australian Government ceased issuing licences to Macassans in 1907, possibly due to the emergence of a local industry.

Small catches continued until 1945, but exports were almost non-existent from then until the early 1980s. Prior to this downturn, commercial operations were coordinated by European Australians with assistance from the Indigenous people of Arnhem Land.

Increasing interest in the late 1980s led to the re-emergence of the NT Trepang Fishery. There are currently six licences in the fishery, all owned by one licence holder.

The primary target species is the Sandfish, (*Holothuria scabra*), which prefers coastal areas with soft sediments and seagrass beds, the latter playing an important role in its larval settlement.

Management arrangements for the NT Trepang Fishery were re-assessed against the Guidelines for the Ecologically Sustainable Management of Fisheries by the Australian Department of the Environment (DotE, previously known as the Department of Sustainability, Environment, Water, Population and Communities) in August 2011. The fishery was subsequently accredited as a Wildlife Trade Operation (WTO) under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act) for a period of three years. The accreditation demonstrates that the fishery is managed in such a way that stocks are not subject to overfishing and fishing operations have minimal impact on bycatch and the broader marine environment. The next assessment of the fishery is due in 2014.

Profile of the Fishery

Commercial

Area

The fishery operates in marine waters to 3 nautical miles (nm) seaward of the high water mark. Most activity occurs along the Arnhem Land coast, with the primary harvest areas being around Cobourg Peninsula and Groote Eylandt.

Fishing Method

Sandfish are harvested by hand from the inter-tidal and sub-tidal zones either on foot or by diving on snorkel, SCUBA or hookah. Collection is generally restricted to neap tides during the dry season when water clarity improves.

Catch

The commercial harvest of trepang in 2012 was 33.0 tonnes (t) and consisted entirely of Sandfish. A minimum legal length of 16 cm applies to this species, with other limits in place for related species not currently harvested.

It is important to note that a conversion factor of two was incorrectly applied to several years of trepang catch data in the 2011 status report. This multiplier should have only been applied to the catch from one vessel for two years (2006 and 2007). The corrected data is shown in Figure 1.

Trepang harvest peaked in 1999 at 285 t (data not shown) and declined thereafter for a variety of reasons. The hand collection method of the fishery is highly selective with little byproduct (of other sea cucumbers) and no bycatch.

**Figure 1.** Catch (tonnes), effort (hrs ÷ 10) and catch per unit effort (CPUE; kg/hr) for the commercial Trepang Fishery, 2003 to 2012

The average weight of trepang harvested in 2012 was 5% less than that in the previous year. This decrease is not considered significant given that Sandfish can expel variable amounts of water during handling and processing.

Effort

Trepang fishing effort in 2012 was 1258 diver hours, close to the previous four year average of 1277 diver hours. The four year average prior to 2008 was much higher, at 5305 diver hours.

This large decline in effort (and consequently catch) is due to a range of factors (affecting or determined by the single licence owner) which include: difficulties in sourcing skippers/divers, operators choosing to fish in other jurisdictions and the allocation of resources to research on trepang culture and ranching.

Catch Rates

The catch per unit effort (CPUE) of trepang in 2012 was 26.2 kg/diver hr, 40% up on the previous three year average.

Please note that the annual CPUE estimates for 2008 to 2010 were comparatively low (Figure 1), the reason being that new skippers and divers entered the fishery and there was little transfer of knowledge from their predecessors as to the best fishing spots. This is the primary reason why the CPUE trigger reference point (which is benchmarked against the average CPUE for the previous three years) was exceeded in 2012 (see Table 1).

Marketing

Trepang are washed, gutted, blanched (in boiling water) and dried prior to sale. The vast majority 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 any of the three recreational fishing surveys conducted in 1995-96 (Coleman 1998), 2000-01 (Coleman 2004) and 2009-10 (West et al. 2012). The local Chinese community may take limited amounts for personal consumption.

Fishing Tour Operator Sector

There were no reported captures of trepang by Fishing Tour Operator clients in 2012.

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 survey visits suggested that trepang were never used as food by the Indigenous people of the NT.

Non-retained Species

Trepang harvesting is 100% selective and all catch is retained.

Ecosystem Impact

Hand collecting of trepang is unlikely to have an impact on the sea floor. The effect of removing trepang from the ecosystem is not known but is considered negligible due to the small catch and selective fishing methods used.

Economic Impact

Confidentiality constraints prevent the publication of this information.

Stock Assessment

Monitoring

Licence holders are required to complete and submit logbook returns that report details of each day’s fishing. This provides important information on the catch (by weight and number), the location of fishing activities (as latitude and longitude) and the time spent fishing.

Sandfish are soft-bodied organisms that can rapidly change both weight and length by absorbing or releasing water. Given this ability, average trepang weights derived from logbook data can only provide a course indicator of patterns in weight over time.

Stock Assessment Methods and Reliability

A stock assessment of the NT Trepang Fishery has not been undertaken. Uncertainties regarding the state of the product when weighed (i.e. whole or gutted and blanched), combined with the relatively small and sporadic catch over the past five years, currently preclude a meaningful assessment of the harvest rate of trepang.

Current Exploitation Status

The CPUE trigger reference point for the fishery was exceeded in 2012 (see Table 1) and a report has been forwarded to the Executive Director of Fisheries (see explanation in catch rate section above).

The depletion of Sandfish in some other domestic trepang fisheries has resulted in fishers switching to other, lower-value species to maintain an income. Skewes et al. 2006 describes an example of this phenomenon in the Torres Strait.

Despite the presence of other holothurians in the NT, Sandfish is the only species currently harvested and a catch composition trigger is in place to detect any transition to the harvest of lower-value species.

Future Assessment Needs

The future assessment needs for the NT Trepang Fishery are uncertain. The single licence holder is currently investigating methods for trepang aquaculture and ranching, which may result in reduced effort in the wild harvest fishery. Assessment needs will be evaluated if and when there is a steady increase in trepang catches over time.

Research

Summary

A genetic study of Sandfish stocks along the NT coast (by the industry and Flinders University) was recently completed. It found that Sandfish between Cobourg Peninsula and Milingimbi are genetically distinct from those between the Wessel Islands and Groote Eylandt (Mike Gardner, Flinders University, personal communication).

Incorporation into Management

The appropriateness of the current boundary between the two trepang management zones (see below) may need to be reviewed given that Sandfish on either side of the Wessel Islands appear to be genetically distinct.

Current Research

Industry is conducting research into hatchery and growout techniques for Sandfish with a view to transitioning to aquaculture production. This work is providing a greater understanding of the larval biology and growth of Sandfish from the NT.

Management/Governance

Management

Objective

As custodian of the resource, the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) seeks to conserve, enhance, protect, utilise and sustainably manage trepang stocks in the NT. Management arrangements for this fishery include:

* A limit on the number of commercial licences (i.e. six).
* Minimum legal lengths for commercially important Holothurians.
* Two management zones, with no more than three licences to operate in either.
* A conservative harvest area (i.e. no more than 3 nm from the high water mark).
* Limits on the number of active collectors (i.e. four).
* Collection limited to hand-collection only.

The fishery is also managed according to the management objectives, performance indicators, triggers and management actions agreed to by the industry, NT Fisheries and DotE during the WTO accreditation process (Table 1). These measures, combined with weather induced limits on the duration of trepang harvest (through storms, cyclones and poor water clarity in the wet season), mean that the risk of overfishing trepang in the NT is negligible.

History

In the 1980s, six licences were issued for the harvesting of trepang. The fishery was initially divided into three management areas, with two licences permitted to operate in each. Soon after fishing commenced, licensees in the far western area indicated that there was insufficient product for their operations to be economically viable. For this reason, the central and western zones were merged. The revised management areas extend east and west of Cape Grey to the Queensland and Western Australian borders, respectively. No more than three licence holders can operate in either area at any time.

Current Issues

New research on the stock structure of Sandfish suggests that the boundary of the two trepang management zones may need to be reviewed.

The magnitude of illegal, unreported and unregulated (IUU) fishing for trepang in northern Australian waters is not known. NT Fisheries continues to work with the Australian Government to ensure adequate resources are allocated to mitigate any impacts of IUU fishing on local 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*. 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 licence holders.

No significant compliance issues were detected in the Trepang Fishery in 2012.

Consultation, Communication and Education

Periodic consultation occurs between NT Fisheries, the single Trepang Fishery licence holder and the NT Seafood Council on matters related to the 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 Mark Grubert

References

Coleman, A. P. M. (1998). Fishcount: A Survey of Recreational Fishing in the Northern Territory. Department of Primary Industry and Fisheries *Fishery Report* 43.

Coleman, A. P. M. (2004). The National Recreational Fishing Survey: The Northern Territory. Department of Business, Industry and Resource Development *Fishery Report* 72.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project 99/158. NSW Fisheries Final Report Series No 48.

Schwerdtner Máñez, K. and Ferse S. C. A. (2010). The history of Makassan trepang fishing and trade. PLoS ONE 5(6): e11346 doi:10.1371/journal.pone.0011346.

Skewes, T., Taylor, S., Dennis, D., Haywood, M. and Donovan, A. (2006). Sustainability Assessment of the Torres Strait Sea Cucumber Fishery. CSIRO Marine and Atmospheric Research and CRC Torres Strait.

West, L. D., Lyle, J. M., Matthews, S. R., Stark, K. E. and Steffe, A. S. 2012. A survey of recreational fishing in the Northern Territory, 2009-10. Department of Primary Industry and Fisheries. *Fishery Report* 109.

**Table 1.** Management objectives and harvest status against performance indicators for the NT Trepang Fishery in 2012

| **Species or group** | **Management**  **objectives** | **Performance indicator** | **Trigger reference point (TRP)** | **Current harvest status** | **Management actions (for all TRPs)** |
| --- | --- | --- | --- | --- | --- |
| Target species | Ensure intergenerational equity by maintaining ecologically sustainable annual catches in all sectors. | Sustainable yield estimates developed.  Change in total catch. | Total annual catch exceeds 300 tonnes (t). | Trepang catch in 2012 was 33.0 t - TRP not reached. | The Executive Director of Fisheries (EDF) to be notified within 60 days if TRP exceeded. |
|  |  | Change in CPUE. | CPUE for *Holothuria scabra* increases or decreases by 30 % compared with the mean of the previous three years. | The 2012 CPUE value was 26.2 kg/diver hr; 40% more than the previous three-year average - TRP exceeded | Internal examination of causes and implications of the TRP being exceeded, with a report forwarded to EDF within six months. |
|  |  | Change in average weight. | Average weight of trepang decreases by more than 20% in one calendar year. | The average weight of trepang decreased by 5% between 2011 and 2012 - TRP not reached | Consultation with industry and other stakeholders on need for alternate management strategy or action if necessary and agreement on the type of action. |
|  |  | Change in catch composition. | Catch of trepang species other than *H. scabra* increases to over 30% of total catch. | *H. scabra* was the only species harvested in 2012 - TRP not reached. | If appropriate, any new arrangements to be implemented within 12 months of TRP being exceeded. |
|  |  | Change in licence ownership. | Any licences traded | There were no licences traded in 2012 - TRP not reached. |  |
| Byproduct and bycatch species | Ensure sustainability of byproduct and bycatch species taken in the NT Trepang Fishery. | Monitoring logbook.  On-board monitoring. | NA - no byproduct or bycatch in the fishery. |  | NA |

RECREATIONAL

Fishing Tour Operator Status Report 2012

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’s decision to reallocate 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 with logbook return provisions in 1993. Licence numbers peaked at 218 in 1997.

FTOs operating in Kakadu National Park require an additional permit issued by the Australian Department of Environment (previously Department of Sustainability, Environment, Water, Population and Communities).

Most FTOs target Barramundi in coastal and inland areas, while others operate offshore targeting different species. Vessels range in size from small dinghies up to luxury mother ships. FTO clients observe the same fishing controls as other recreational fishers and none of their catch may be sold or bartered.

Reef and bottom fishing is the most popular fishing method employed by FTOs after Barramundi fishing. This is largely due to the high table quality of many of the reef species. Black Jewfish, Red Emperor, Coral Trout and a range of tropical snappers are significantly targeted. Increasing impacts of targeting these and other key reef species require close monitoring, especially in more populated areas and there is increasing awareness that many reef fish caught and released in water deeper than 10 metres (m) do not survive.

Profile of the Fishery

Area

The majority of FTOs operate in areas which are accessible to the general public. Most operate from Darwin while others are based on the big inland tidal rivers and Aboriginal land. Some FTOs maintain financial agreements with landholders to operate exclusively from land of Aboriginal and other tenure. They 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 the NT’s Parks and Wildlife Commission.

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 the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) for each day spent fishing. Numbers of various species caught and released are recorded together with the number of line hours spent Barramundi fishing, game fishing, reef and bottom fishing, crabbing or using other methods, such as cast netting or drag netting. This data helps identify annual trends in catch and effort in relation to each fishing method.

Catch and Effort

In 2012, the total FTO catch was 150 385 fish, representing a 27.6% decline from the peak catch of 207 858 in 2006 (Figure 1).

Barramundi continued as the species most frequently caught with a total catch of 57 396 in 2012, a 10.1% decrease from the peak annual catch of 63 859 in 2011 (Figures 2 and 3). Most Barramundi (87.3% average over a 19-year period) caught by FTO clients are released. In 2012, 51 341 Barramundi (89.4% of the catch) were released.

The four other species most commonly caught were Golden Snapper (13 780), Stripey Snapper (13 245), Grass Emperor (7004) and Trevally (5848) (Figure 2). While Trevally had the highest rate of release (94.7%), 47.8% of Golden Snapper, 72.8% of Stripey Snapper and 55.4% of Grass Emperor were also released in 2012. The total release rate for all species caught by FTO clients in 2012 was 78.1%.

In 2012, 170 545 line-hours were spent fishing, representing a decline of 12.1% from the peak of 194 085 line hours in 2008 (Figure 1). Barramundi fishing has traditionally accounted for the majority of FTO fishing effort. Although reef and bottom fishing was the predominant fishing method in 2008 and 2009, Barramundi fishing was the most common method in 2010, 2011 and 2012. Barramundi fishing accounted for 50% of all the fishing effort in 2012 with 85 275 line-hours. A total of 71 226 line-hours were spent reef and bottom fishing, representing 41.7% of all FTO effort (Figure 4).

The number of fish caught by FTOs while reef fishing has declined from 1.72 per line hour in 2000 to 0.9 in 2012. This indicates declining reef fish stocks. A range of new possession and size limits aimed to recover depleted stocks were proposed for public comment in 2012.

**Figure 1.** Catch, release and total line hours fished by FTOs, 1994 to 2012

**Figure 2.** The five species most frequently caught by FTOs, 1994 to 2012

**Figure 3.** Total Barramundi catch, release and line hours fished by FTOs, 1994 to 2012

**Figure 4.** Time spent fishing by FTOs using various fishing methods, 1994 to 2012

Non-retained Species

More than 78% of all fish caught by FTOs were released in 2012. While NT Fisheries research has shown that lure-caught Barramundi are resilient to catch and release fishing, similar studies on coastal reef fish indicate that many reef species caught from water deeper than 10 m are susceptible to pressure-induced injuries (barotrauma) that greatly increase post-release mortality. Black 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. However, combined fishing pressure from all sectors is negatively impacting on reef fish stocks near Darwin. New management arrangements are being investigated for all sectors to reduce this impact and ensure long-term sustainability of reef fish stocks.

**Social Impact**

There was a consistent increase in the number of ‘client days’ fished between 1994 (5467 client days) and the peak in 2008 (34 348 client days). In 2012, there were 27 715 client days fished, representing a 19.3% decline compared with 2008. Most client days in 2012 were fished by anglers from Victoria (6655), New South Wales (6371) and the NT (5867). Only 538 clients (1.9%) were from other countries (Figure 5).

**Figure 5.** Numbers of FTO client days fished and client origins, 1994 to 2012

Economic Impact

The guided fishing industry is an important part of the Territory’s tourism sector, with 78.8% of FTO clients being visitors from interstate or overseas who bring new money to the Territory’s economy. A valuation of the NT guided fishing industry for the three years 2008-09 to 2010-11 indicates an average value of production of over $15 million per annum. The industry’s total economic contribution for the same three year period is estimated at over $26 million per annum, with approximately 80% ($22 million) of this expenditure attributed to interstate and overseas tourists. The industry employs about 100 people directly and over 300 people indirectly.

Stock Assessment

Monitoring

The guided fishing industry is monitored primarily through FTO logbook returns data. 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 numbers and origins.

Stock Assessment Methods and Reliability

Data from FTO logbook returns and recreational fishing surveys is 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 78% of their total catch, current levels of reef and bottom fishing effort are generating concern for 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 not appropriate and management strategies to conserve reef fish stocks are being developed.

Future Assessment Needs

The FTO logbook returns system provides essential data to fishery managers. These are combined with data from recreational fishing surveys to provide an overview of the NT’s recreational fishing sector. Results from the most recent recreational fishing survey were released in 2012.

Research

Summary

All fisheries research on recreationally significant species is important to FTOs. The current research programs relevant to FTOs focus on coastal reef fish, particularly Golden Snapper and Black Jewfish.

Incorporation into Management

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 native title claims.

Current Research

Although FTO clients release the majority of the fish they catch, they and other recreational fishers do impact on the sustainability of key reef species, particularly the more sedentary species and those affected by barotrauma. NT Fisheries is currently working with both sectors to study barotrauma and to better understand catch composition (e.g. size and age classes of different reef fish caught).

Current research is focused on the sustainability of key species, including a range of tropical snappers and Black Jewfish. Details of these research programs can be found in the relevant Fishery Status Reports.

Management/Governance

Management

Objective

NT Fisheries’ primary management objective for the guided fishing industry is to ensure that it is managed sustainably.

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 6 illustrates the number of FTO licences issued each year since 1994 and those actively operated.

**Figure 6.** The annual number of FTO licences issued and those actively fished from 1994 to 2012

Future Plans

In 2012, NT Fisheries continued working with the NT Guided Fishing Industry Association (NTGFIA) focussing primarily on the sustainability of key target reef fish species, refining the existing licensing framework and improving safety standards and industry professionalism. A range of proposals relating to these matters was made available in a discussion paper released for public comment late in 2012.

Compliance

The Water Police Section of the NT Police, Fire and Emergency Services is responsible for monitoring and enforcement of fishery regulations.

Consultation, Communication and Education

NTGFIA provides a consultation and communication link between government agencies and the guided fishing industry.

Aquatic Resource Management Officer, Recreational Fishing – Mr Phil Hall

Recreational Fishing Status Report 2012

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’s 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 is 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, including Manton Dam near Darwin. The months preceding the Top End’s wet season are also highly productive and many Barramundi are caught during that time in coastal saltwater environments and freshwater billabongs.

Although Barramundi are a famous table fish, the majority (72%) of those caught by NT and visiting anglers are released. Clients of fishing tour operators (FTOs) release nearly 90% of the Barramundi they catch.

Part of the attraction of Barramundi fishing is the diversity of fish species, habitats and fishing methods that anglers experience. Other species that are 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 also often caught. Mud crabs are best targeted in the dry season when they are most abundant and can be easily caught.

Reef and bottom fishing is the most popular target fishing method after Barramundi fishing. This is largely due to the high table quality of many of the reef species. Black Jewfish, Red Emperor, Coral Trout and a range of tropical snappers are significantly targeted. Increasing impacts of targeting these and other key reef species require close monitoring, especially in more populated areas, and there is increasing awareness that many reef fish caught and released in water deeper than 10 m do not survive.

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 land-based 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 benefit recreational fishing and tourism. All waters within Kakadu National Park are also 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 annual fishing tournaments are conducted. Most tournaments are Barramundi-specific with rules that promote catch and release fishing. There are also various 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 NT’s non-Indigenous population fish in Territory waters each year. Further surveys in 2001 and 2010 showed that this participation had declined to 29% and 22% respectively. Reports on each of these surveys are available from NT Fisheries. The information below relates primarily to the 2010 survey. Because visitor data collected in this survey was limited in parts of the NT, some of the information below relates specifically to NT residents. The following information does not relate to FTOs. Specific FTO data is shown separately in this publication.

Area

The 2010 survey showed that over 80% of days fished by NT residents were spent on marine waters, primarily estuaries. Estuary fishing accounted for 47% of all resident days fished while 27% of the total effort occurred less than 5 km from the coast and 8% occurred more than 5 km from the coast. Nearly all remaining resident days fished were spent on freshwater river systems. Figure 1 shows percentage levels of resident effort in each survey zone.

Spatial distribution of fishing effort by fishing zone for the non-Indigenous resident population of the NT aged five years and older who fished recreationally in the NT during 2009-10

**Figure 1.** Spatial distribution (percentage) of fishing effort (fisher days) by fishing zone for the non-Indigenous resident population of the NT aged five years and older who fished recreationally in the NT during 2009-10

Fishing Method

Most (81%) NT resident fishing in 2010 was boat based and 99% of resident fishers reported the use of lines at least once, representing 95% of the resident days fished in that year. Nearly a quarter (24%) of resident fishers used a pot or trap at least once, accounting for 11% of resident days fished, while 5% used cast nets, accounting for 3% of resident days fished. Numbers of days spent fishing using other methods were very low by comparison.The majority (81%) of the total resident catch was taken using lines, 11% was taken using cast nets and 7% was taken using pots or traps. Other methods accounted for very little of the total resident catch.

Catch

The 2010 survey reported that Barramundi is the species most predominantly targeted by NT resident anglers, accounting for 21% of all fish caught. Golden Snapper comprised 12% of fish caught followed by small baitfish (8%), catfish (6%) Saddletail/Crimson Snapper (5%) and Mullet (5%). Individually, each of the other fish species caught contributed to less than 5% of the total catch. Collectively, however, snappers of the genus Lutjanus (Red Emperor, Golden Snapper, Mangrove Jack, Moses’ Snapper Saddletail/Crimson Snapper and Stripey Snapper) accounted for almost a quarter of all fish caught by NT residents. Mud Crab accounted for 78% of all crustaceans caught by NT residents.

Effort

The 2010 survey reported that 30 538 NT residents fished a total of 150 502 days within the NT during that year at an average of almost 5 days per person. Seventy-eight per cent of fishers came from the “Darwin and Rural” area while “Other Coastal” residents represented 19% of those who fished.

Regionally, Darwin Harbour together with the Darwin Surrounds zone accounted for 45% of the total fishing effort, followed by the Mary/Alligator rivers (17%) and the West Coast and Bynoe/Finniss Area zones (10% each).

Non-retained Species

About 54.4% of all aquatic animals caught by NT residents during the 2010 survey were released. 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 enviro-nets and non-offset 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 10 to 15 m 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 deeper water.

Ecosystem Impact

The National Policy for Recreational Fishing and the National Code of Practice for Recreational and Sport Fishing promote the importance of ecological awareness. Although no significant studies have been conducted on the effects of recreational fishing on natural NT ecosystems, no major detriment has been identified. However, there are current concerns regarding the sustainability of reef fish populations in the Greater Darwin area. New possession and size limits aimed to recover reef fish stocks were proposed for public comment in 2012.

Social Impact

The 2010 survey found that an estimated 30 538 (22%) of non-Indigenous NT residents fish for recreation. While this survey did not query reasons why people fish, the 2001 survey found that most anglers fish to be outdoors and to relax and unwind, while others mainly fish to be with family and friends. While catching fish for the table and sport were also important factors, 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 2010 survey did not fully evaluate expenditure by visitors who fished in the Territory. However, it did indicate that $47 million was spent directly on recreational fishing in that year by NT residents alone. Boat and trailer purchases accounted for almost two thirds of this expenditure, while travel and fishing and camping gear accounted for the majority of the remaining expenditure.

Stock Assessment

Monitoring

Broad scale recreational fishing surveys were conducted in 1995, 2001 and 2010. Annual funding has been made available to collect on-going data in significant areas of the Territory over the next few years.

Many NT Fisheries research programs focus on the species that are important to recreational, commercial and Indigenous stakeholders. Current research on coastal reef fish is particularly important to recreational fishers. Outcomes of this research will influence future management decisions. More specific information on research programs relevant to recreational fishing is provided in individual status reports in this publication.

Some fishing tournament organisers provide NT Fisheries with annual catch and effort information, which enhances knowledge of Barramundi populations in specific rivers. For example, details of all fish caught, measured, tagged and released in the NT Barra Classic held on the Daly River are reported to NT Fisheries each year.

All relevant data sources are combined and analysed to inform the on-going management of the recreational fishery.

Stock Assessment Methods and Reliability

Research, survey, FTO and commercial fishing data is used for fishery stock assessment purposes. Details are included in other fishery status reports in this publication.

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 exceeds the maximum sustainable yield and changes to the management arrangements will be needed to ensure stock sustainability over the longer term.

Future Assessment Needs

There is a need to obtain a better understanding of catch and effort in the recreational fishing sector. To address this requirement, NT Fisheries will dedicate significant resources to the on-going collection of recreational fishing data commencing in 2013.

Research

Summary

Fishcount 95 provided a valuable database, which was updated by the NT component of the National Recreational Fishing Survey in 2001 and the Survey of Recreational Fishing in the Northern Territory in 2010. The new recreational fishing data collection program will complement this database commencing in 2013.

Fisheries research is generally species or area-specific. Many species currently researched are important to recreational, commercial and traditional fishers. The most important current research focuses on the recovery of depleted coastal reef fish populations in the greater Darwin area. Specific details on researched species are provided in individual fishery status reports in this publication.

Incorporation into Management

Information obtained through recreational fishing surveys and FTO data has been a key consideration in decisions to close many popular areas to commercial Barramundi gillnetting. In 2012, all commercial Barramundi fishing was prohibited between the Finniss River and the Wildman River for the benefit of recreational fishers and FTOs.

Current Research

The most significant current research for recreational fishers relates to Golden Snapper and Black Jewfish. Research on the susceptibility of both species to overfishing and barotrauma continued throughout 2012 with on-going tagging of Golden Snapper to gain a better understanding of the species’ movements throughout its lifecycle. 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*, 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 crab (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 enhance the recreational fishing experience.

Permits are required to fish waters within Aboriginal land. A permit requirement to fish in tidal waters overlying Aboriginal applied throughout 2012 and will continue until 30 June 2013. Information on permit requirements is available from the Northern Land Council.

More information regarding NT recreational fishing controls can be found in NT Fisheries’ Recreational Fishing Controls booklet or on the department’s 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 onboard.

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 Territory-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.

To enhance recreational fishing and tourism, the Mary River was closed to commercial Barramundi gillnetting in 1988. This was followed by a similar closure of 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, the Finniss River and Bynoe Harbour in 2010 and all areas between the Finniss River and Wildman River in 2012. These closures have been implemented together with voluntary commercial fishing licence buy-backs.

Barramundi Stocking

To provide alternative recreational fishing opportunities, NT Fisheries continued stocking Manton Dam in 2012 with the release of 2000 Barramundi fingerlings grown out to 180 mm.

Current Issues

The maintenance of access rights to historic fishing areas is a current issue for recreational fishers in the NT. The sustainability of reef fish populations is another issue requiring close attention. The 2010 survey showed that recreational fishers are having a significant impact on reef fish stocks, particularly in the Darwin area, and that changes to recreational fishing controls are needed. Late in 2012, a discussion paper proposing reductive catch controls aimed to address this issue was released for public comment.

Future Plans

The Recreational Fishing Development Plan was endorsed by the NT Government for adoption in October 2012, with a focus on future sustainable management, improved data collection, ensuring effective catch controls, access and infrastructure requirements, industry development, resource sharing and improving community stewardship of fishery resources. 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 and tourism establishments throughout the Top End of the NT.

Consultation, Communication and Education

The Amateur Fishermen’s Association of the NT (AFANT) represents recreational fishing interests 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.

The formation of a recreational fishing advisory committee was announced in 2012. Initial meetings will be scheduledin 2013. AFANT and the NTGFIA will be represented on the new committee. A television education campaign was also commenced in 2012 with a focus on reef fish sustainability and fishing and boating safety. This campaign will be continued in 2013 and beyond.

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

References

Coleman, A. P. M. (1998). Fishcount: A Survey of Recreational Fishing in the Northern Territory. Department of Primary Industry and Fisheries *Fishery Report* 43.

Coleman, A. P. M. (2004). The National Recreational Fishing Survey: The Northern Territory. Department of Business, Industry and Resource Development *Fishery Report* 72.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project 99/158. NSW Fisheries Final Report Series No 48.

West, L. D., Lyle, J.M., Matthews S. R., Stark, K. E. and Steffe, A. S. (2012). Survey of Recreational Fishing in the Northern Territory, 2009-10. Northern Territory Department of Primary Industry and Fisheries *Fishery Report* 109.

AQUACULTURE

Aquaculture Industry Support and Development Status Report 2012

Summary

The Northern Territory (NT) aquaculture industry’s total value increased by 52% in 2012 to $23.3 million compared with $15.35 million in 2011. This increase was due to a 20% rise in Barramundi production and a 52% rise in pearl production.

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. The Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries) released a stock enhancement policy in 2012 to provide guiding principles for the assessment of proposals for fisheries enhancements, including ranching, stock enhancement and restocking.

An additional sea cucumber ranching trial continued on Goulburn Island in 2012 in collaboration with 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 in 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 continued in 2012 with Charles Darwin University (CDU), 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 (FRDC) and the National Climate Change Adaptation Research Facility funded the research.

In 2012, research funded by the Australian Centre for International Agricultural Research continued 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.

In 2012, social research was conducted on Goulburn Island to determine Indigenous women’s aspirations for low technology aquaculture. Results led to strategies and associated research to improve enterprise facilitation, cross-cultural communication and knowledge exchange. FRDC funded this research in December 2012.

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 the 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 growout trials to assess the viability of sea cucumber farming based on hatchery production.

A private pearl oyster research hatchery and a nursery facility that were established at DAC continued to operate and a number of successful trials were conducted in 2012.

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 2012. This work is conducted jointly between NT Fisheries 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 2012 to refine the juvenile rearing process. Export approval was sought from the Australian Government to allow DAC to conduct trials to assess the potential of clam exports. Sea-based growout trials with two Aboriginal communities continued in 2012.

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 continued in 2012 to assess oyster growout techniques.

DAC set up an aquaponics demonstration unit in 2012 to assist home hobbyists in infrastructure design and operational management. DAC staff worked with the Vocational Education and Training (VET) school at CDU, offering aquaponics workshops for VET students and adult groups.

Aquatic Animal Health

The Department of Primary Industry and Fisheries’ Berrimah Veterinary Laboratories continued to provide a valuable health service in 2012, 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 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 2012

Introduction

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 Northern Territory (NT) aquaculture industry. Those problems were addressed through a cooperative approach between the industry, the Fisheries Division of the Department of Primary Industry and Fisheries (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.

Barramundi and pearl oysters are the major aquaculture species that receive animal health services from NT Fisheries. The aquatic animal health program of NT Fisheries 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.

Significant Disease Events and Surveillance

Epizootic ulcerative syndrome (or red spot disease) was diagnosed in several wild caught Sleepy Cod (*Oxyeleostris lineolatus*) from the Mary River Bridge Billabong in July (dry season). Fish showing symptoms of the disease, which is endemic in certain streams and rivers in the NT, presented with skin lesions. The disease causing fungal pathogen, *Aphanomyces invadans*, was detected by histopathology and was confirmed by molecular testing.

A myopathy syndrome (muscular disease resulting in weakened muscles) was detected in a small percentage of harvested fillet-size aquaculture Barramundi. The syndrome is characterised by bilateral symmetrical degeneration or necrosis of lateral musculature at the cranial peduncle (base of the skull). The syndrome was a marketing rather than a mortality issue. The pathogenesis was suspected to result from circulatory disturbances in which the heavily-muscled area becomes swollen and ischaemic (with restricted blood flow to the area) when muscle fibres are subjected to vigorous or exhaustive contraction. Risk factors appeared to include low water temperature and prolonged crowding and harvesting activity.

Passive surveillance of the bacterium *Edwardsiella ictaluri* has been continuing for the past two years since its first detection in captive native catfish species in 2010. However, this bacterium has never been detected in wild fish species in NT waterways.

Passive and active surveillance of viral encephalopathy and retinopathy (also known as viral nervous necrosis), a viral disease in fish caused by a piscine betanodavirus, did not yield any positive viral detection this year.

## Health Certification

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 and 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 culture sites interstate.

Juvenile Barramundi (*Lates calcarifer*) progeny from broodstock held at the Darwin Aquaculture Centre (DAC) were examined routinely by histopathology and tested specifically for betanodavirus by PCR (polymerase chain reaction) and *Streptococcus iniae* by bacterial culture 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 growout purposes.

## Fish Kill Investigation

Two fish kill incidents were reported and investigated in October (early wet season), one at ‘Galloping Jacks’ on the Katherine River and the other in Channel Marker Creek of Anson Bay. In both cases, several thousand fish of mixed species and sizes were affected. No significant fish pathogens or microscopic disease processes were detected from the samples taken. The former kill was suspected to be due to low dissolved oxygen, which was considered a natural event during the period prior to the wet season when occasional heavy storm activity washes large amounts of organic matter downstream. The latter kill was suspected to be caused by an algal bloom, *Trichodesmium* sp. Both events resolved several days after being reported.

## Research Activity

The final report of a collaborative research project on Nodavirus funded by the Aquatic Animal Health Subprogram of the Fisheries Research and Development Corporation (FRDC) was published. After more than three years of intense observation and testing at DAC, it was concluded that broodstock Barramundi did not appear to be a source of infection for batches of larvae, despite some broodstock having been exposed to the virus. There was no apparent relationship between infected batches of larvae and the test results on broodstock. It is most likely that the affected fish became infected during larval rearing or growout via the hatchery water supply. To prevent outbreaks of the nervous necrosis virus (NNV) in hatcheries, the findings support management emphasis on protecting larval fish from exposure to NNV rather than on broodstock testing. Larval fish being reared in an endemic region should be provided with UV-treated filtered water to reduce the likelihood of exposure to NNV for as long as possible before transferring fish to growout areas. The full report, including initial test development and recommendations for improved biosecurity protocols, can be downloaded from the FRDC website (FRDC 2008/041: Tools for investigation of the nodavirus carrier state in marine, euryhaline and freshwater fish and control of NNV through integrated management).

Aquatic Animal Health Pathologist - Dr Kitman Dyrting

Barramundi Farming Status Report 2012

Summary

Farmed Barramundi (*Lates calcarifer*) production (tonnes of whole fish) increased by 20% in 2012. The combined production in 2012 from the three pond-based farms was 863 tonnes (t), compared with 720 t in 2011. The total production value significantly increased from $5.72 million in 2011 to $8.37 million in 2012.

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 683 500 in 2011 to 488 000 in 2012. About 800 000 larvae were sold interstate. Only DAC sold fingerlings during the year. Approximately 99% of the fingerlings (488 000) were sold locally and 0.24% (1200) were sold interstate. The size of the fingerlings supplied to local farmers ranged between 33 mm and 25 mm; for interstate farmers it was 50 mm.

Farm Production

Six aquaculture licences were endorsed to produce Barramundi. Three companies marketed fish in 2012: Australian Barramundi Culture Pty Ltd (Humpty Doo), Arda-Tek (Berry Springs) and Wild River Farmed Seafood (Berry Springs). Arda-Tek continued to operate 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 2000 fingerlings of approximately 200 mm in size to Manton Dam in 2012. A further 3525 fingerlings were provided for restocking the water ways around Durack, ranging in size from 80 to 160 mm in length.

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 2012, most of the fish produced on farms was sold either directly or indirectly to interstate markets. A small volume was sold directly off a farm through a tourism fishing operation. Only whole fish were sold with the majority weighing over 1.0 kg. About 9% of the fish sold weighed less than 1.0 kg.

Employment

Permanent and casual labour employed in the growout and hatchery/nursery sectors of the industry remained steady and both averaged 9.5 in 2012 compared with 10.5 and 8, respectively in 2011.

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 hold 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 the Department of Primary Industry and Fisheries’ 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 helped 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 sea-cage farms peaked at just over 1000 t 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 continues to secure a key role in proposed programs 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 2013 is estimated to be approximately 1 000 000.

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 licence holders are represented by the NT Seafood Council through the Aquaculture Licensee Committee.

Manager, Aquaculture – Dr Ann Fleming

INDIGENOUS

Indigenous Fishing and Economic Development Status Report 2012

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).

The NT *Fisheries Act* makes provision for Aboriginal people to continue traditional use of fish and aquatic life.

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 Indigenous people and are therefore of great cultural significance.

Most Indigenous fishing activities, which occur close to communities and outstations, are widespread across the northern part of the NT. These activities occur in inshore waters (61%), estuarine waters (11%) and on rivers (17%) (Henry and Lyle 2003).

Indigenous fishing is not just about catching fish for a feed; it is inclusive of recreational, commercial and environmental aspects. Indigenous people get to socialise with friends and family the same way as recreational fishers do when they go fishing. In many instances, fish are shared with other community members; sometimes they are bartered as an economic activity. In addition, Indigenous people are also responsible for the protection and management of their resources. This form of management is similar to Western management regimes and includes protected areas, such as marine sacred sites and totemic or culturally significant species that may restrict people from harvesting them.

Most coastal Indigenous groups continue to practise customary management, education and law relating to the sea. These customary laws have been passed down through 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. Indigenous 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).

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 the traditional management practices that may be incorporated into contemporary 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 the Fisheries Division 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.
* Developing guidelines for NT Fisheries research to be inclusive of Indigenous marine/sea ranger groups.
* Implementing the East Arnhem Indigenous Fisheries Network program to enhance engagement in economic activities and improve training coordination.
* Developing and implementing the Indigenous Fisheries Development Strategy 2012-14.

Consultative Committees

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 in the late 1990s. One of the principal roles of AFCCs was to provide a mechanism that allowed information flow between Indigenous 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. For example, the introduction of a recreational possession limit for painted crayfish resulted from a meeting with Indigenous leaders. In addition, AFCCs provided Indigenous 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 were seven established AFCCs in the NT; however, only three committees remain and just one met during 2012. The composition of Indigenous members on each committee is determined by the relevant community. AFCCs also have representatives from the Water Police Section of the NT Police, Fire and Emergency Services, NT Fisheries, the Amateur Fishermen’s Association of the NT, the NT Seafood Council and other NT Government agencies as required.

NT Fisheries committed to enhancing consultation and input from Indigenous communities into fisheries management and decision making. This is closely linked to government discussions with Traditional Owners in relation to the Blue Mud Bay negotiations.

Government Liaison and Community Involvement

The maintenance of open communication with Indigenous communities has enabled NT Fisheries to build capacity among Indigenous people to participate in the long term sustainable management of aquatic resources in the NT.

Through community visits, local meetings and various other forms of consultation, NT Fisheries conducts discussions, and plans and implements new fisheries initiatives relevant to coastal Indigenous communities. This may include exploring commercial development opportunities for remote coastal communities, which may help resolve social and economic problems that many communities face. 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 an Indigenous Development Unit (IDU) which employs a manager, a marine ranger coordinator, three Indigenous support officers and an Indigenous Fishing Mentor (IFM) 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, 20 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). In 2012, NT Fisheries also employed a second Indigenous Cadet to undertake a four year degree in Environmental Science.

During 2012, IDU officers spent 91 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 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 81 patrols and 50 fisheries training days in 2012.

Some ranger groups are becoming more involved in fisheries research activities, including ranger groups not currently funded by NT Fisheries. NT Fisheries has also been working with a number of these ranger groups in fisheries compliance activities that includes the engagement of Water Police.

A nationally accredited Certificate II Fisheries Compliance (Seafood Industry) course was delivered in conjunction with Charles Darwin University in August/September. The 2012 course was developed specifically for Indigenous marine rangers and provided an opportunity for 14 rangers across the NT to meet and develop their skills in a culturally appropriate manner. 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

Indigenous people make up about 32% of the NT population; 80% of them 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 Indigenous groups to increase their economic development and employment opportunities.

A number of Indigenous 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.

IDU officers visited 11 remote communities in 2012 to conduct a range of activities, including training and providing advice on economic development opportunities.

Some Indigenous 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 Indigenous 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 Australian Department of Education, Employment and Workplace Relations. The network aims to provide a support base to Indigenous people seeking to be actively involved in commercial fishing and aquaculture by providing advice, training coordination, mentoring and business development assistance.

NT Fisheries employed an IFM to work closely with Indigenous people across Arnhem Land that have an interest in various forms of commercial fishing. In 2012, the IFM visited eight communities in over 17 separate trips and mentored 36 Indigenous people.

Social Benefits

Fishing is an important lifestyle activity for Indigenous 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 Indigenous people. Seafood has also been shown to contribute a large proportion of caloric intake of 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 Indigenous 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 Indigenous people as natural resource managers.

Traditional subsistence fishing does not value individual species in the same manner as 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 Indigenous people. There is also a shortage of fishing-industry related skills in remote areas. Coastal Indigenous 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, such as marine rangers and fishing tourism.

Research

Through ICMRP, many Indigenous groups are becoming active in monitoring community fishing and assisting fisheries in core research activities.

In 2012, research training and capability were significantly increased in Indigenous communities in partnership with eight 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 IDU. Further information on these projects can be found in the Timor Reef Fishery Status Report and the Mud Crab Fishery Status Report in this publication.

In 2012, Indigenous marine ranger groups were engaged in three fisheries research projects: a sawfish survey, giant clam growout, and identifying and monitoring of fish stocks in the upper Daly River.

In collaboration with NT Fisheries, 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

References

ABS (2006). Australian Bureau of Statistics. Commonwealth of Australia 2007. ABS website.

Davis, S. (1983). A Report on the Bathurst and Melville Island Sea Closure Application. LANDSEARCH, Darwin.

Henry, G. W. and Lyle, J. M. (2003). The National Recreational and Indigenous Fishing Survey. FRDC Project No. 99/158. NSW Fisheries Final Report Series No 48.

Saunders, T. and Carne, R. (2010). A Survey of Customary Fishing of Sharks and Stingrays - Groote Eylandt. NT Government, Australia. *Fishery Report* 105.

AQUATIC BIOSECURITY

Aquatic Biosecurity Status Report 2012

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 detection and successful eradication 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 increase costs or limit interstate trade. Destination ports wishing to remain free of aquatic pests may restrict the entry of vessels from infested ports unless it can be shown that the vessels are free of the pest.

Environmental Assessment

The monitoring of water quality and marine bio-fouling 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 2012 with assistance from the local industry. Monitoring at locations along the NT coastline also continued in cooperation with the industry at Gove Harbour (Rio Tinto Alcan Pty Ltd) and Milner Bay (Groote Eylandt, GEMCO).

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 in the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries). Through this training, marine rangers are encouraged to be involved in regular monitoring activities.

Monitoring Results

No recognised marine pest species were detected during 2012 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 introductions. 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. 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 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

Two reports were received of suspected marine pests during 2012. Following investigations, both were identified as known marine pest species. Asian green mussels were detected on a naval vessel during routine pre-deployment inspections. The species was confirmed by the Curator of Molluscs at the Museum and Art Gallery of the NT. The vessel was subsequently slipped and treated to remove the marine pest from the hull.

An ascidian that has caused significant losses on a pearl farm near Nhulunbuy for many years by smothering juvenile pearl oysters was formally identified by DNA analysis as *Didemnum perlucidum*. This species has recently been recorded in multiple locations along the Western Australian coastline; however, it has been found in the NT only at this pearl oyster farm.

Two freshwater pest reports were received and investigated during 2012. 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.

Following a report of suspected Tilapia at Corroboree Rock Hole, the area was methodically sampled using electrofishing. No Tilapia were detected. Evidence suggests that a Sooty Gunter was mistaken for Tilapia.

*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 into 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, and 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 Australian Fisheries Management Authority (AFMA) and the Australian Department of Agriculture’s, Biosecurity Division 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 2012, 123 vessels were inspected and/or treated compared with 92, 143 and 133 in 2011, 2010 and 2009, 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, 2009 to 2012

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, gas, and other 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, the Department of Agriculture’s Biosecurity Division 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 in 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

Fisheries Licensing and compliance

Fisheries Compliance Status Report 2012

Introduction

The Water Police Section (WPS) of the Northern Territory Police, Fire and Emergency Services (NTPFES) is responsible for fisheries compliance in the Northern Territory on behalf of the Fisheries Division of the Department of Primary Industry and Fisheries (NT Fisheries). Both agencies work together to encourage voluntary compliance with fisheries regulations by both the commercial fishing industry and the recreational sector. This is achieved through a combination of pro-active patrolling and targeted operations designed to prevent, disrupt or to detect and prosecute offenders as both a general and specific deterrent to future offending.

WPS consists of 15 members led by a Senior Sergeant and comprises three Sergeants and 11 Constables.

In addition to providing this service to NT Fisheries, WPS has other responsibilities, which include:

* Marine search and rescue coordination and operations.
* Marine safety compliance and enforcement.
* Investigation of marine incidents and accidents.
* Security of visiting foreign warships.
* Marine support to the Tactical Response Section.
* Counter Disaster Operations (floods/cyclones)
* Assisting with the management of the NTPFES fleet and training of members.
* Assisting with operational training of Indigenous Marine Rangers.

The area of operations includes the entire NT coast and associated river systems. The key geographic areas of operation for WPS are:

* Darwin Harbour, Shoal Bay and Adelaide River.
* Bynoe Harbour, Fog Bay, Finniss River and Dundee Beach.
* The Tiwi Islands.
* The Daly River region.
* The Mary River system.
* Kakadu, including the East Alligator, South Alligator and Wildman rivers.
* The Victoria and Keep rivers near Timber Creek.
* Nhulunbuy, Blue Mud Bay and Bennett Bay.
* The Gulf of Carpentaria, from Port Roper to the Calvert River.

During 2012, patrols were conducted in all areas of operation. These included:

* Completion of 89 day and overnight patrols targeting fishery related activity.
* Investigation of 54 incidents involving offences against the *Fisheries Act.*
* Prosecution via court appearance of 15 persons for a total of 45 fisheries offences.
* Cautioning of 12 persons for minor offences / education.
* Conducting 82 boat ramp compliance checks (total of 2608 vessels inspected).
* Inspection of 18 commercial operations.

Patrols to areas near Darwin were generally of a short duration. All major fishing grounds outside of the Darwin area required extended patrols of between five and 12 days.

High visibility patrols provide a visible deterrent to offending. Incognito patrols facilitate surveillance operations so that specific targets can be effectively monitored. Patrols also form the basis for developing a network of people in key areas who can provide information regarding fishing activity vital to the effective deployment of resources.

Major and minor operations were conducted either in response to periods of high fishing activity, such as the start of the Barramundi season in the commercial sector, or Easter, long weekends, fishing competitions or the ‘run off’ in the recreational sector. Specific operations were conducted to confirm or deny intelligence reports received within WPS.

Water Police assisted with local Indigenous Marine Ranger training. A program of increased contact with ranger units in their patrol locations is planned for 2013.

Senior Policy Officer - Ms Leonie Cooper

Water Police Section – Senior Sergeant Paul Faustman

Fisheries Licensing Status Report 2012

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*. In 2012, 900 licences and 99 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.

Notable differences from 2011 to 2012 are the absence of A16 licences for the Finfish Trawl Fishery coincident with a change in the number of A6 licences issued for the Demersal and Timor Reef fisheries. Details regarding the changes implemented to the management arrangements for the Demersal Fishery to include the use of trawl gear and within a management framework based on Individual Transferable Quota (ITQ) may be found in the Demersal Fishery Status Report 2012 in this publication. The background and implications for the transition to ITQ in the Timor Reef Fishery may be found in the Timor Reef Fishery Status Report 2012 in this publication.

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 www.fisheries.nt.gov.au.

Data

The logbook return information submitted by permit holders and licensees is processed by the Data Services Section. The information is vital for 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 www.fisheries.nt.gov.au.

**Table 1.** The number of licences and permits issued in 2012

| **Licence type** | **Number** |
| --- | --- |
| A1 – Coastal Line Fishery licence | 52 |
| A2 – Coastal Net Fishery licence | 5 |
| A3 – Bait Net Fishery licence | 2 |
| A4 – Spanish Mackerel licence | 16 |
| A5 – Offshore Net and Line Fishery licence | 17 |
| A6 – Demersal Fishery licence | 31 |
| 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 | 0 |
| A15 – Restricted Bait Entitlement | 125 |
| A16 – Finfish Trawl Fishery licence | 0 |
| A17 – Jigging Fishery licence | 1 |
| A18 – Timor Reef Fishery licence | 16 |
| A50 – Development Fishery – Coast Net | 1 |
| B1 – Fish Trader/Processor licence | 35 |
| B2 – Fish Retailer licence | 376 |
| C1 – Aquaculture licence | 13 |
| C2 – Pearl Oyster Culture licence | 8 |
| D1 – Aboriginal Coastal licence | 4 |
| D2 – Fishing Tour Operator licence | 1418 |
| D3 – Aquarium Trader licence | 18 |
| D4 – Net licence | 113 |
| D5 – Public Aquarium licence | 2 |
| D14 – Development permit | 0 |
| S16 – Permit | 77 |
| S17 – Special permit | 27 |
| Total number of licences and permits issued | 999 |

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 |
| CLF | Coastal Line Fishery |
| 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 |
| DotE | Australian Government Department of the Environment |
| EMP | Environmental Management Plan |
| EPA | Environment Protection Agency |
| EDF | Executive Director of Fisheries |
| EPBC Act | *Environment Protection and Biodiversity Conservation Act* (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 |
| 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 | NT 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 |
| SIRC | Shark Implementation and Review Committee |
| SMFMAC | Spanish Mackerel Fishery Management Advisory Committee |
| SRA | Stock Reduction Analysis |
| 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 |
| WPS | Water Police Section, NT Police, Fire and Emergency Services |
| 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

Tel: +61 8 8999 2144

Fax: +61 8 8999 2065

Email: fisheries@nt.gov.au

Web site: [www.fisheries.nt.gov.au](http://www.fisheries.nt.gov.au)

Please visit the website to obtain contacts for fisheries specific and aquaculture information.

Structure of Fisheries Division

During 2012 the roles of Licensing and Data Services (responsible for the management of logbook return information) transferred from the Fisheries Development Branch to the Aquatic Resource Branch reflecting the closer alignment with the provision of Aquatic Resource Management business.

**Executive Director Fisheries**

**Aquatic Resources Branch**

Director, Aquatic Resources

Aquatic Resource Management

Data Services (including Logbook Returns)

Fisheries Research

Licensing, Legislation and Compliance Services

Recreational Fishing and Fishing Tour Operators

**Fisheries Development Branch**

Director, Economic Development

Aquatic Biosecurity

Darwin Aquaculture Centre

Pearling

Fisheries Indigenous Development