

ASSESSING THE ECOLOGICAL SUSTAINABILITY OF THE NORTHERN TERRITORY SHARK FISHERY

A report prepared for the Department of Environment and Heritage
(DEH) as required for assessment under Part 13 and 13 A of the
Environment Protection and Biodiversity Conservation Act (1999)



Black –Tip Shark

Carcharhinus tilstoni, C. sorrah



Northern Territory Government

Department of Business, Industry & Resource Development

**ECOLOGICAL ASSESSMENT OF THE NORTHERN TERRITORY SHARK
FISHERY**

*Against the Guidelines for the Ecologically
Sustainable Management of Fisheries*

**For the purposes of Part 13 and 13A of the
*Environment Protection and Biodiversity
Conservation Act 1999***

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EXECUTIVE SUMMARY

The Northern Territory shark fishery is a pelagic net and longline fishery operating in the area extending seaward from the high water mark to the outer boundary of the Australian Fishing Zone (AFZ) (Figure 1). The fishery is co-managed under the legislative framework of the *Northern Territory Fisheries Act 1988*¹.

Through the *Fisheries Act* the Northern Territory Fisheries Joint Authority (NTFJA) manages all northern demersal and pelagic finfish (including shark species) in waters relevant to the Northern Territory that are shared with Queensland, Western Australia and the Commonwealth.

The low number of operators and precautionary management arrangements in the shark fishery reduce the potential for any adverse impact to the ecosystem and the environment. Input and output controls together with specific management objectives, performance indicators and triggers provide the necessary tools to ensure the ecological sustainability of target, byproduct, and bycatch species.

The principal species harvested in the shark fishery at present are the black tip sharks (*Carcharinus tilstoni* and *C. sorrah*) and grey mackerel (*Scomberomorus semifasciatus*).

The fishery is monitored by logbook data coupled with regular biological sampling collected by Fisheries Research Officers. This information provides the necessary biological data for regular stock assessments.

Stock assessment workshops are conducted (in an open forum) regularly and involve all stakeholders, including national and international expertise in stock assessment and industry and government representatives. These workshops review the current status of the fishery and provide future strategic management research and direction.

An annual status report is published and distributed to all stakeholder groups and the wider community to ensure all with an interest are fully informed about the current and predicted future status of the resource.

The most recent stock assessment workshop provides sustainable yield estimates based on all available information for the key target shark species *C. tilstoni* and *C. sorrah*. While the reliability of the assessment is considered low, it does provide a basis for precautionary management arrangements and triggers to ensure the sustainability of these target species.

The shark fishery as a low participant fishery with strict input controls such as limited entry, a 3 for 1 licence reduction program, and gear restrictions is considered a low threat to ecological sustainability. Catch levels of target species indicate the fishery is continuing to operate well below estimated sustainable yields, while byproduct and bycatch levels are minimal and below triggers for review of management arrangements. In addition, the shark fishery management arrangements are continually reviewed and assessed by international and interstate expertise to ensure the ecological sustainability of the fishery.

¹For the purpose of consistency the *Northern Territory Fisheries Act 1988* will be referred to as the *Fisheries Act* for the remainder of this report.¹
Shark fishery ESD Report 2003

A new shark fishery Code of Conduct to be completed in the next 12 months by commercial operators, together with the current complementary management and research undertaken in complying with the National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks), further ensure the ecological sustainability of the fishery. The NPOA – Sharks has been formulated to ensure that the management of shark fisheries complies with a range of national and international conventions.

Consequently, the management arrangements for the shark fishery meet the *Guidelines for the Ecologically Sustainable Management of Fisheries*. Detailed justification for this conclusion is documented within the remainder of this application.

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OVERVIEW OF APPLICATION

A report prepared for the Department of Environment and Heritage to assess the environmental performance of the shark fishery against the Australian government *Guidelines for the Ecologically Sustainable Management of Fisheries*. The report is necessary to meet the requirements under Part 13 and 13A of the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, to continue the listing of all species harvested in the shark fishery in section 303DB of the *EPBC Act*.

DESCRIPTION OF THE FISHERY

AREA OF THE FISHERY

The shark fishery operates in the area extending seaward from the high water mark to the outer boundary of the Australian fishing zone (Figure 1).

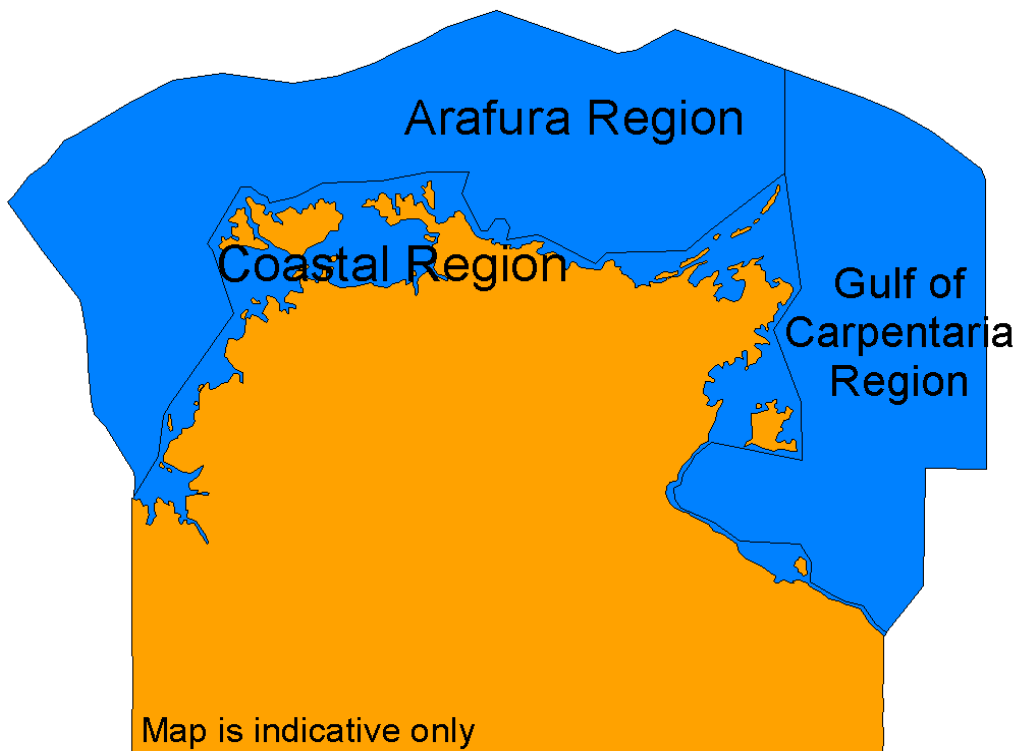


Figure 1. The shark fishery locality map.

Operators are generally authorised to fish in a number of managed zones, with spatial restrictions placed on the use of certain gear. The three management zones are Coastal, Arafura and Gulf of Carpentaria (GoC). Current management arrangements, including zoning, reflect historical jurisdictional arrangements.

The holder of a shark fishery licence shall not use a pelagic net within the Mary River Fish Management Zone described in schedule 3 of the Barramundi Fishery Management Plan.

HISTORY OF THE FISHERY

A large commercial shark fishery commenced in the waters of northern Australia in the early 1970s when a Taiwanese gillnet fleet targeted a range of pelagic shark and fish species, including various mackerel and tunas. Foreign fishing vessels worked within 12 nautical miles (approximately 22 km) of the coast prior to 1978, but were excluded from the Gulf of Carpentaria in 1979.

With the declaration of the Australian Fishing Zone (AFZ) in 1979, the foreign fishing fleet's exclusion zone adjacent to Arnhem Land and the Wessel Islands increased to between 40 and 50 nautical miles offshore. A bilateral agreement between Australia and Taiwan permitted access for 30 gillnetters to land up to 7,000 tonnes of shark from northern Australian waters. Further restrictions were introduced in 1986 as the result of declining catch rates and concerns about the incidental capture of dolphins. These restrictions limited the length of gillnets to not more than 2.5km. Such controls rendered the Taiwanese gillnetting fleet uneconomical, and despite the trialing of baited longlines, foreign fishing operations in northern Australian waters ceased in late 1986.

Direct involvement by domestic fishers in coastal waters began in the early 1980s, with the Northern Territory government actively encouraging the development of the inshore component of the fishery. Landings remained low with catches ranging from 100 to 500 tonnes until the early 1990s, with shark fillets sold on established food markets throughout southern Australia.

Number of Licences

There are currently 19 licence entitlements (licences) operating in the shark fishery. A licence reduction program commenced in 1995 to reduce fishing capacity with the aim of ensuring sustainability and to provide an adequate level of profitability for the remaining operators. Overall capacity has been reduced from 39 to the current 19 entitlements. These 19 licences are comprised of 10 "unrestricted" and 9 "restricted" licences. After full rationalisation, there will be 13 "unrestricted" licences remaining in the fishery.

Under the legislation a "restricted" licence means a licence which can be permanently transferred, but not temporally transferred. Once permanently transferred, the acquired licence cannot be fished until it has undergone the 3:1 process. An "unrestricted" licence is one which has undergone the 3:1 process and is a fully transferable licence. New entrants must acquire and surrender 3 "restricted" shark fishery licences for the issuance of an "unrestricted" fishery licence. The licence reduction program is still in place.

FISHING METHODS OF THE SHARK FISHERY

Commercial

Operators may use either pelagic nets or longlines. Bottom set gillnets are prohibited. A ban on the use of bottom set gillnets was introduced in 1992 to minimise the interaction with turtles.

Pelagic nets

Most shark fishing is undertaken using pelagic nets. Nets are constructed of monofilament nylon with a drop of 50 meshes. The specific construction of individual nets may vary but most conform to the following. A near surface monofilament mesh net of maximum 2500m length, 150mm – 250mm mesh by 50 to 100 mesh drop is used. Both head rope and lead line are of poly rope 10mm and 8mm respectively. The head rope is buoyed at regular intervals of about 10m, with polystyrene floats of 300mm diameter, which are attached on droppers (short length of rope) of 2m. Floats are attached with shark clips as the net is fed out from the boat. The leadline has lead weights of approximately 90g attached at intervals of 2m along the length of the line. Bait, contained within a protective baskets are used for some shots. These are large enough to fit a couple of small mackerel heads in and are attached via a short rope and shark clip to the headline. Approximately 20 baskets are used for the length of net.

Importantly, nets can only be set attached from the licensed vessel (mothership). Staked or unattached nets are prohibited in the shark fishery. The setting of the net is dependent on current, wind conditions and tidal flow. The net is shot out the stern of the fishing vessel either with or perpendicular to the wind and then attached to the bow of the boat. The boat and net then drift with the tide and/or wind for about 2–3 hours before being hauled. Nets are retrieved on a mechanically powered net drum and the catch sorted processed and generally frozen onboard.

Longlines

Demersal longlines may be used in all regions of the fishery while pelagic longlines are only permitted in the Arafura and GoC region provided the total length does not exceed 20nm at any time.

Recreational

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

CATCH COMPOSITION

The current target species of the shark fishery are black-tip sharks (*C. tilstoni* and *C. sorrah*) and grey mackerel (*S. semifasciatus*) with a variety of other sharks and pelagic finfish landed. The total reported catch of all species for the fishery in 2002 was 1167 tonnes (t) with a total catch of sharks of 670 tonnes. Black tip sharks comprised 465 t, or 40% of the total catch (Figure 2) while grey mackerel comprised 42% (479 t) of the catch. Other shark species made up 17% (205 t) with pelagics (<1%) such as tuna contributing to the remainder of the catch (Figure 2).

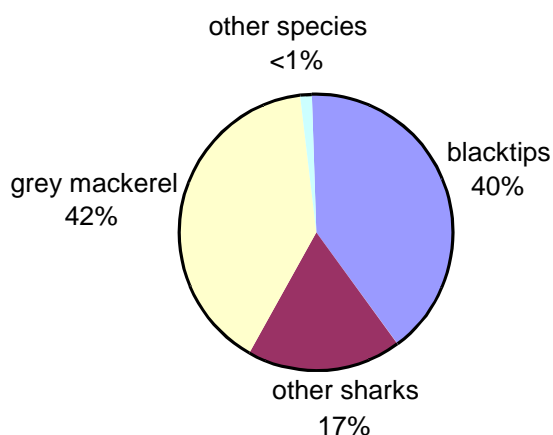


Figure 2. Relative catch composition from 2002 logbook data for the shark fishery.

Since 1998 there has been a large increase in the catch of sharks other than black tips from 49 tonnes to 205 tonnes in 2002 (see section 1.1.5, Figure 4). This shift in catch composition may be due to the redistribution of effort to new fishing grounds during this time and the change in market forces. Of significance is the increasing catch of mackerels (primarily grey mackerel) to the point where catch exceeds the shark catch recorded in most previous years. Sharks are also harvested as incidental catch in a range of commercial fisheries targeting other species. Landings from non-target fisheries have fluctuated from 32 to 64 tonnes since 1994.

CATCH AND EFFORT

Catch and effort details are obtained from commercial fisher's logbooks. Fishing effort, catch type and species is reported for each fishing session on a daily basis (but before 1998, logbooks were based on monthly information). Licensees provide daily logbooks and marketing details to the Fisheries Group by the 28th day of the following month.

The Fisheries Group has been collecting data on this fishery since the early 1980's. Historically, the shark fishery operators required a combination of Northern Territory and Commonwealth entitlements to fish in the waters off the NT. With the Offshore Constitutional Settlement of 1988, management responsibility was passed to the NTFJA.

Catch rates for shark (Figure 3) have shown substantial variability over the last two decades. Catch rates for total shark in the shark fishery, for most years between 1983 and 2002, have been between 300 and 500 kg/ day fished. Strong peaks in catch rates in 1995 and 1996 may reflect the operations of two large vessels during this period. These large vessels, with substantially larger processing and storage capacity existed in the fleet prior and subsequent to this period, were able to maximise utilization of high densities of sharks when found. The catch rate peak represents a deviation from the relatively flat trend of the last two decades. Catch rates for blacktip sharks have shown a very similar pattern, between 1997-2002 lying in the range 244-351 kg/ day (Figure 3). Grey mackerel catch rates have shown a steady and marked increase since the early 1990's. Catch rates have grown from 41 kg/day in 1990, to 345 kg/day in 2002. Although some increases in catch rates overall might be expected from increased operational efficiencies, the strong increase in the mackerel catch rates probably represent increased targeting of grey

mackerel. This also explains the relatively static trend of the total shark and blacktip shark catch rates (Figure 3).

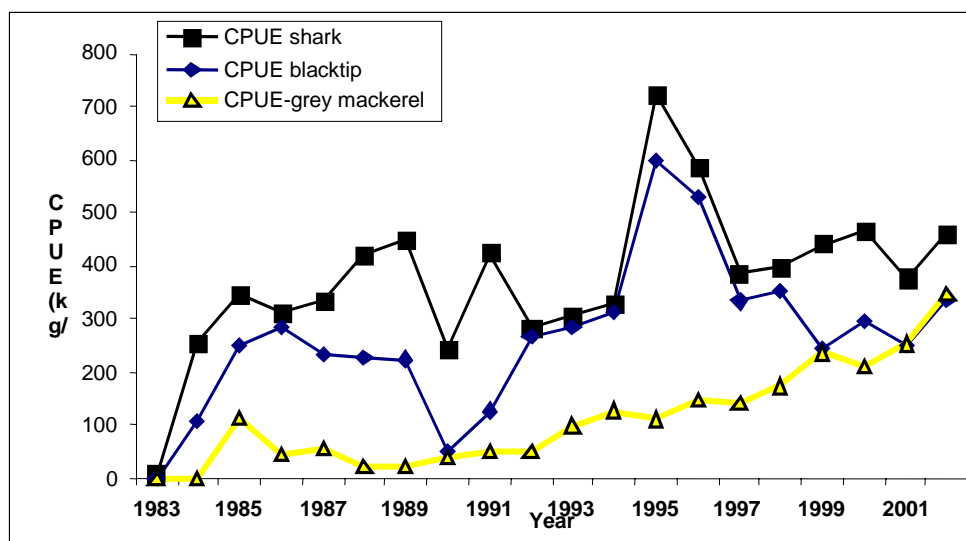


Figure 3. CPUE for the NT shark fishery 1983-2002.

MANAGEMENT OF THE SHARK FISHERY

The NT shark fishery management arrangements are documented and publicly available in the *Northern Territory Fisheries Regulations*² under the legislative framework of the *Fisheries Act*.

The management arrangements for the shark fishery were developed through a consultation process involving broad stakeholder representation. In the early 1990's following the phase out of foreign fishing activity a series of workshops were held with stakeholders to consider the future management options for the fishery. Through these workshops industry agreed that a 3 for 1 licence reduction program be implemented to ensure overall landings do not exceed estimated sustainable limits and to ensure an adequate level of profitability for the remaining operators.

² For consistency the *Northern Territory Fisheries Regulations* will be referred as the *Fisheries Regulations* for the remainder of this report.
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Pre-existing access concessions were recognised with the passage of an Offshore Constitutional Settlement (OCS) in 1995. At that time, existing fishers were issued a "restricted licence" for the zone or zones in which they were authorised to operate. The three management zones previously implemented under a Commonwealth implemented development plan continued. New entrants must acquire and surrender three "restricted" shark fishery licences for the issuance of an "unrestricted" fishery licence. Alternatively, any new entrant may acquire an "unrestricted" licence, that is, a pre-existing licence issued on the surrender of three (restricted) licences.

The Fisheries Group liaises with stakeholders in the shark fishery individually or as needed through the Fisheries Management Advisory Committee, or separate consultative processes catering for specific stakeholder groups (see guidelines for further detail).

The management objectives for all Northern Territory Fisheries as outlined in the *Fisheries Act* are to "conserve, enhance, protect, utilise, and manage the fish and aquatic life resources of the Territory to:

- (a) Promote, develop and maintain commercial and amateur fishing;
- (b) Provide for optimum yields from a fishery and maintain the quality of the yield;
- (c) Ensure that the fisheries of the Territory are not endangered or over exploited;
- (d) Encourage tourist and scientific interest in fish and aquatic life; and/or
- (e) Ensure that the habitats of fish or aquatic life and the general environment is not detrimentally affected".

Specific objectives of the management arrangements for the shark fishery are to ensure the ecological sustainability of target, byproduct, and bycatch species and minimal impact to threatened species and the marine environment (Table 2).

These management objectives are achieved through a combination of input and output controls and include; limited entry, catch restrictions, area and gear restrictions (see section 1.1.7). Complete details of the management controls for the shark fishery are specified in Part 8 Division 5 of the *Fisheries Regulations*.

The trigger points and management actions for the shark fishery are listed in Table 2. An appropriate management response would be made in consultation with stakeholder groups should a trigger point be reached.

The effectiveness of the shark fishery management arrangements are strategically assessed at national and international workshops involving all stakeholders and the annual Northern Australian Fisheries Management Workshop (NAFMW) and Northern Territory Fisheries Joint Authority (NTFJA). Membership to the NTFJA and NAFMW includes state, Territory and Commonwealth Fisheries managers, research and compliance staff together with fisheries representatives from Indonesia and East Timor.

The following submission outlines the management arrangements of the shark fishery against the Australian government *Guidelines for the Ecologically Sustainable Management of Fisheries*. The Fisheries Group has developed complementary management arrangements for the shark fishery to ensure the sustainability of shark species of the Timor and Arafura Sea and Gulf of Carpentaria.

International Plan of Action for the Conservation and Management of Sharks

In accordance with the requirements of the agreed International Plan of Action for the Conservation and Management of sharks (IPOA-Sharks 1999), Australia has undertaken a review of the status of its shark fisheries as a precursor for the National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks). IPOA-Sharks suggests that member countries such as Australia, should adopt an NPOA-sharks if their vessels regularly capture sharks as a targeted or incidental catch.

Implementation of an NPOA-Sharks required the preparation of a Shark Assessment Report (SAR). The report is to be updated regularly to advise on the status of shark stocks as assessments are made and to identify gaps in our understanding of our shark resources. The NPOA report will require the collection and ongoing analysis of compatible data at an appropriate resolution leading to improved species identification and eventually, abundance indices.

The NPOA does not distinguish between targeted and incidental catch; rather, it places obligations on the States/Northern Territory and the Commonwealth to demonstrate that our shark resources are adequately managed. The Northern Territory must demonstrate that adequate management arrangements have been implemented for both the managed shark fishery and sharks landed as an incidental catch, including discards.

The Fisheries Group in satisfying the NPOA adequately manages both the shark fishery and sharks landed in other fisheries including discards as outlined in the *Fisheries Act* and *Fisheries Regulations* and as described in the remainder of this report.

The NPOA was developed in consultation with a range of non-government groups, industry members and government representatives, including officers from the Australian Department of Environment and Heritage (formerly Environment Australia).

An assessment of the management arrangements implemented by the Northern Territory was undertaken in developing the NPOA. Furthermore the status of northern Australian shark stocks was also assessed. The NPOA aims to meet all requirements under the EPBC Act and provides the most comprehensive plan of action for the conservation of sharks ever developed.

Compliance

Compliance with the Northern Territory shark fishery management arrangements are undertaken by the Police, Marine and Fisheries Enforcement Unit (PMFEU) of the NT Police and Fire and Emergency Services under the *Fisheries Act*.

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

The compliance operations for the Shark fishery are appropriate to the size of the fishery. Nonetheless, as a precaution, the Fisheries Group will undertake a compliance risk assessment by December 2005.

SPECIES BIOLOGY

Black-tip reef sharks belong to the family Carcharhinidae, also known as whaler sharks. The most commonly caught 'black-tip' shark species in the shark fishery are *Carcharhinus tilstoni* and *C. sorrah*.

Carcharhinus tilstoni

C.tilstoni occur in continental shelf waters between the mid-coast of Queensland round to the North West Cape in Western Australia (Last and Stevens, 1994). Genetic and tagging studies of *C.tilstoni* show a single stock off northern Australia (Last and Stevens, 1994). *C.tilstoni* is viviparous meaning the mother nourishes embryos through a placental connection and produces live young. Mating occurs in February – March, ovulation in March – April with new born pups born at 60cm in January after a ten month gestation period (Stevens and Wiley, 1986). Litter sizes range between 1 and 6, with an average of 3 pups (Stevens and Wiley, 1986). Sexual maturity is reached at 3-4 years for females (Davenport and Stevens, 1988). The size at maturity for males is 110cm and 115cm for females (Stevens and Wiley, 1986).

The diet of *C.tilstoni* consists mainly of teleosts (many pelagic), cephalopods and crustaceans.

Carcharhinus sorrah

C.sorrah occur throughout the Indo-West Pacific and in similar waters in Australia as *C.tilstoni*. Genetic and tagging studies of *C.tilstoni* show a single stock off northern Australia (Last and Stevens, 1994). *C.sorrah* are viviparous, producing between 1 and 8 pups (average 3) after a 10 month gestation period. The length at birth is between 45 and 60 cm (Stevens and Wiley, 1986). Growth rates are rapid in pups (approximately 25 cm in the first year) and sexual maturity in females is reached in 2 to 3 years (Davenport and Stevens, 1988). The size at maturity for males is 90cm and females is 95cm (Stevens and Wiley, 1986).

The diet of *C. sorrah* comprises of teleosts, cephalopods and crustaceans.

Grey mackerel (*Scomboromorus semifasciatus*)

Grey mackerel is one of the four species of mackerel in the genus *Scomberomorus*. *S. semifasciatus* occur between Shark Bay in Western Australia across the Northern Territory and as far south as northern New South Wales. (Collette and Nauen 1983; Collette and Russo 1984; Kailola *et al.* 1993).

Grey mackerel often school around rocky reefs and underwater structures from the edge of the continental shelf to shallow inshore waters. They inhabit river mouths and estuaries and have a tolerance to low salinity (Jenkins and Hartwick, 1985). Grey mackerel grow up to 120cm and can weigh up to 10 kilograms although the average weight is between 2 and 5 kgs.

There is no information on the spawning of Grey mackerel in the NT however a study was conducted in QLD which described *S. semifasciatus* as a seasonal breeder that repeatedly spawns between October and February. The larvae of this species inhabit coastal bays and the lagoon areas influenced by fresh water run-off and low salinity surface waters between the coast and the Great Barrier Reef (Jenkins and Hartwick. 1985).

General requirements of DEH Guidelines

The management arrangements must be:

Documented, publicly available and transparent

The management regime for the shark fishery is documented in Part 8, Division 5 of the *Fisheries Regulations* as a component of the *Fisheries Act*.

The *Fisheries Act* is publicly available on request from the Department of Business, Industry and Resource Development (DBIRD) or from the Northern Territory Government website at www.nt.gov.au/dpif/fisheries/index.shtml. Any discussion papers or proposals for amendments to the shark fishery management arrangements are distributed widely to stakeholder groups and other interested individuals.

Prior to participating in the commercial fishery, all fishers are briefed on the regulations and licence conditions when they undertake their compulsory interview with the Management Officer responsible for the fishery.

An annual status report is published and distributed to all stakeholder groups to ensure that management advice is transparent and that the community is fully informed about the current and predicted future status of the resource. Annual status reports are also available on line www.nt.gov.au/dpif/fisheries/index.shtml or as requested from the Fisheries Group.

As of 2004, the annual status report will report on management objectives, performance indicators and triggers and how the fishery is performing against these criteria.

The NTFJA report also details the management arrangements and activities in the shark fishery over the last financial year.

The management arrangements were also reviewed in developing the National Plan of Action – Sharks. Complete details appear in the Australian Shark Assessment Report (2001).

Developed through a consultative process providing opportunity to all interested and affected parties, including the general public that ensures a range of expertise and community interests is involved in individual fishery management and during the stock assessment process.

The current management arrangements for the shark fishery were developed through a consultation process involving broad stakeholder representation.

Direct involvement in the then Northern Shark Fishery (extending from Cape York to a locality near Port Hedland in Western Australia) by domestic gillnetters began in about 1980 (McLoughlin and Ramm, 1995). In the early 1990's a series of industry workshops, involving all stakeholders, were held to consider future management arrangements for the NT shark fishery. Through these industry workshops it was agreed that a 3 for 1 licence reduction program should be implemented.

Following the workshops (1991), the Commonwealth released a development plan for the Northern Shark Fishery. It was at this time applications were called to participate in the Northern Shark Development Fishery. The Northern Shark Fishery

Development Plan of 1991 resulted in the issue of permits for the Gulf of Carpentaria region (GoC zone), the Arafura Sea (Arafura zone) and the Timor Sea region west of the WA/NT border (WA zone).

Members were appointed to the shark fishery Management Advisory Committee (SharkFMAC) in early 1993. Due to the lack of issues the SharkMAC is no longer in existence. However, legislation is in place to convene a meeting as needed or as issues arise (such as proposed management amendments). When convened, the SharkFMAC formally represents all stakeholders and provides a forum for comment on any proposed amendments to the management regime (Section 24, *Fisheries Act*).

In 1995, a revised Offshore Constitutional Settlement arrangement was agreed in Northern Australia. Management responsibility for the former Commonwealth managed offshore component and the Northern Territory managed inshore fishery passed to the Northern Territory Fisheries Joint Authority. Day to day management of the fishery is achieved under NT legislation.

The current consultative processes provide the framework for the involvement of industry and other affected parties on any new management issues that potentially impact the functioning of the fishery and contribute to the development of any new management arrangements.

The NPOA – Sharks was developed through a consultative process involving local and interstate government and non-government interest groups.

Ensure that a range of expertise and community interests is involved in individual fishery management committees and during the stock assessment process.

There is a broad stakeholder involvement (including community and conservation representatives) and expertise in determining the management and reviewing stock assessments of the shark fishery.

Section 24 of the *Fisheries Act* allows the Minister to appoint members to an advisory committee as needed (see above).

In recognising the specific cultural needs of indigenous stakeholders a separate consultative process has been established by the Fisheries Group for considering fishery related issues. Stock assessment workshops are conducted on a regular basis involving specialised scientists, broad stakeholder representatives including non-government organisations and advisory committee members. The assessment process involves community participation through regular workshops as outlined in section 1.1.2.

The recently established Aquatic Resource User Group Forum consists of representatives of the principal user groups of the NT aquatic resources which provides advice to the Minister on issues concerned maintaining with sustainability and cross-sectional fishery issues. The Forum members are at the Chief Executive or senior level of their respective organisations and include: 2 representatives from the NT Fisheries Group, 3 representatives of the Northern Land Council (NLC), 1 representative of the Tiwi Land Council, 1 representative of the Anindilyakwa Land Council, 3 representatives of the Amateur Fisherman's Association of the NT (AFANT) and 3 representatives of the NT Seafood Council (NTSC).

Conservation groups and non-government organisations are advised and consulted on topical fisheries issues, including the shark fishery, through monthly advisory meetings with senior fisheries officers and the Executive Director of Fisheries. Conservation groups support the consultation process, particularly given their current level of resources.

Members of the public, including community and conservation groups are also invited to provide their views to the Fisheries Group through the release of public discussion papers and other consultative processes.

Be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements are measured

The management objectives for Northern Territory Fisheries as outlined in the *Fisheries Act* are to "conserve, enhance, protect, utilise, and manage the fish and aquatic life resources of the Territory to:

- (a) Promote, develop and maintain commercial and amateur fishing;
- (b) Provide for optimum yields from a fishery and maintain the quality of the yield;
- (c) Ensure that the fisheries of the Territory are not endangered or overexploited;
- (d) Encourage tourist and scientific interest in fish and aquatic life; and/or
- (e) Ensure that the habitats of fish or aquatic life and the general environment is not detrimentally affected".

In addition to the *Fisheries Act* the management arrangements of the Shark fishery must also satisfy the objectives of the NTFJA (Appendix 1).

The principal management measures of reducing the number of participants (latent effort), gear controls, area restrictions, monitoring of catch, byproduct and bycatch and regular reviews of management arrangements provide the means to achieve these objectives. Sustainability of target, byproduct, bycatch, protection of threatened species and the environment are achieved through the management objectives and performance indicators listed in Table 2.

The objectives and performance criteria (Table 2) provide the ability to strategically assess the effectiveness of the shark fishery management arrangements at regular interstate and international workshops. The effectiveness of the management arrangements is also assessed at the annual Northern Australian Fisheries Management Workshop (NAFMW). Membership to the workshop includes State, Territory and Commonwealth Fisheries managers, researchers and compliance staff.

Finally, Phase 1 of the National Plan of Action of Sharks aims to "Review existing conservation and management measures" for all fisheries agencies, including the Northern Territory.

NPOA includes specific criteria and time lines for assessing the success of management and includes a high level group (Shark Advisory Group) to assess its implementation.

Be capable of controlling the level of harvest in the fishery using input and/or output controls

The *Fisheries Act* provides the legislative framework to control the level of harvest within the shark fishery. This is primarily achieved through input controls, namely limiting the total number of operators in the fishery, a licence reduction scheme, catch restrictions and gear restrictions. Assessment of the effectiveness of these arrangements indicates that they are appropriate to control the level of harvest in the Shark fishery and enable the Fisheries Group to meet this guideline.

The management objective when using input controls is to link the number of licences, gear or area to sustainable yield estimates of the principal target species. By linking these input controls to sustainable yield estimates, management is able to control the level of fishing effort within the fishery and therefore the level of take. In the shark fishery current catches are significantly lower than sustainable yield estimates. Once catches approach sustainable yield estimates management arrangements will be reviewed to ensure overall landings remain at or below sustainable yield. When sustainable yield estimates are not available (e.g. grey mackerel) precautionary management arrangements to achieve sustainability objectives have been implemented. As sustainable yield estimates become available more defined triggers will be legislated to monitor the performance of management objectives. A complete overview is provided in section 1.1.6.

In addition, the Fisheries Group and the current management arrangements comply with the decisions set out in the NPOA – Sharks to ensure the sustainable harvest of shark species.

Contain the means of enforcing critical aspects of the management arrangements

The management regime meets this guideline through enforcing critical aspects of the management arrangements as documented in the *Fisheries Act*.

The Police, Marine and Fisheries Enforcement Unit (PMFEU) of the Police and Emergency Services undertake compliance on behalf of the Fisheries Group. The PMFEU effectively monitors and enforces critical aspects of compliance through the inspection of arrival and departure of shark fishery vessels from the single port of Darwin. Monitoring of shark vessels at sea is infrequent due to the distances away from port and the comparatively low number of vessels active in the fishery. The principal management arrangements can be monitored in port. This includes verification of catch returns against processor returns (ie requirement for all operators to specify where they are selling their product). The PMFEU has the power to investigate on reasonable ground records of wholesalers and licences.

The compliance operations for the shark fishery are appropriate to the size of the fishery. Nonetheless, as a precaution, the Fisheries Group will undertake a compliance risk assessment by June 2005.

Provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria

The Fisheries Group is meeting this guideline through periodic workshops to review and undertake assessments of the fishery in line with current management strategies and objectives. These are public forums in which all stakeholders, and the wider community, are provided with an opportunity to participate. Outcomes from the

workshops are widely publicised through technical reports, annual status reports and the annual report of the NTFJA.

The strategic management directions of the shark fishery are also reviewed and assessed at the annual NAFMW, international workshops and in compiling the annual status report.

In addition the NPOA imposes another level of periodic review for current research and management to ensure the ecological sustainability of sharks and rays and assessment of impacts on non-target species and the environment (see action plan for further details).

Capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates.

A complete overview of the impacts of the fishery on the wider marine ecosystem is addressed in sections 2.2.1 – 2.3.5 of this report. This includes the capacity for assessment, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem.

Section 29 of the *Fisheries Act* provides for the Minister, to impose emergency restrictions if the ecosystem is adversely affected by fishing operations.

The NPOA under Issues 7, 14 and 15 identifies priority actions for the protection of the wider marine ecosystem (see NPOA for details).

Require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy.

The management arrangements of the shark fishery comply with all relevant threat abatement plans and recovery plans for species where there are significant interactions. This includes compliance with the National Policy on Fisheries Bycatch. Details are provided below and in sections 2.2.1-2.2.6.

Threat Abatement Plans

There are no threat abatement plans implemented in the area or for species of relevance to the shark fishery. If a threat abatement plan does become relevant, the Fisheries Group will ensure that its recommendations are incorporated into management arrangements.

Recovery Plans

There are three recovery plans that may relate to the shark fishery. The first is the draft *Recovery Plan for Marine Turtles (RPMT) in Australia* prepared by the DEH (formerly Environment Australia). The capture of marine turtles is an extremely rare occurrence in the shark fishery. Gear restrictions have been implemented to avoid interaction with these species (e.g. pelagic nets must be set 2m off the seabed).

National Plan of Action for Sharks

The Fisheries Group in complying with the NPOA-Sharks is contributing to the risk assessment of shark species as part of the FRDC Shark Phase 2 study. Shark species are being managed with a precautionary approach until the risk assessment is complete in 2005. The International Union for the Conservation of Nature (ICUN) and DEH have identified a recovery plan for freshwater sawfishes (*Pristis microdon*) and Sharks (*Glyphis sp.*). These species do not interact with the shark fishery. No catches of these species have been recorded (logbook or observer data) during normal operations of the fishery.

National Policy on Fisheries Bycatch

Bycatch in the shark fishery is comparatively low and there is little recorded or observed interaction with threatened species (section 2.2.2). According to observer data the current level of bycatch is < 2%. Subsequently a bycatch reduction plan is not required for this fishery. If the level of bycatch should increase to 10% of the catch in successive calendar years, legislation under the *Fisheries Act* will initiate a review of management of the fishery or evoke an emergency response to reduce the level of bycatch (see 1.1.6 for further details).

Although considered low, the Fisheries Group will undertake a risk assessment of bycatch vulnerability caught in the fishery by December 2005. This risk assessment will complement the risk assessment undertaken as part of the FRDC Shark Phase 2 (see section 1.1.1). Concurrent with the risk assessment, the Fisheries Group will, by June 2005, formalise guidelines for reviewing management arrangements once target, byproduct and / or bycatch reference points and triggers are reached.

PRINCIPLE 1

A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover.

OBJECTIVE 1. THE FISHERY SHALL BE CONDUCTED AT CATCH LEVELS THAT MAINTAIN ECOLOGICALLY VIABLE STOCK LEVELS AT AN AGREED POINT OR RANGE, WITH ACCEPTABLE LEVELS OF PROBABILITY.

1.1.1 There is a reliable information collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring.

Fishery dependent and fishery independent data, are collected as part of the assessment process for the shark fishery. Due to the small size and minimal byproduct of the fishery, research and assessment are focused upon the primary target species.

Fishery Dependent

Logbooks

Commercial shark fishers are required by legislation to complete and return daily logbook data (Appendix 2). The logbook must be completed for each day that fishing takes place and includes; fishing method (pelagic net or longline); catch (by whole

weight); effort (number of shots and fishing time); depth fished and fishing location (Licence region and Grid reference).

Operators report on all species of shark caught in addition to the targeted grey mackerel and the byproduct species of Spanish mackerel and tuna. Information is recorded to species level for the principal target species and at generic levels (eg trevally sp.) for minor species.

Compulsory logbook data must be returned together with monthly market summary sheets by the 28th day of the following month. The market summary sheets provide marketing details including point of sale, the level of processing undertaken and the combined weight of individual species sold (Appendix 3). This information also provides a validation mechanism for assessing the catch reported in the logbook.

Fishing Tour Operators also complete a daily logbook, reporting all species landed and released including shark and grey mackerel (Appendix 4).

The logbook data provides valuable catch and effort information used specifically for the stock assessment. Commercial logbook data has been collected from fishers operating in the shark fishery since 1983 and from fishers operating specifically under the conditions of the shark fishery licence since 1995.

Logbooks have been designed to provide the necessary details for stock assessment modeling. The level and reliability of information is appropriate given the size and extent of the fishery. Nevertheless, the Fisheries Group will continue to refine the logbook data entry process together with the validation of market returns.

The level of bycatch in the shark fishery is low (< 2%) and includes a variety of individual species (Appendix 2). It is appropriate that monitoring of bycatch continues to be undertaken by independent observers. A rise in bycatch to 10% of the total catch in successive calendar years will trigger a review of management arrangements to ensure the protection of bycatch species (Table 2). Current observer monitoring is undertaken in accordance with objectives of the *Northern Australian Sharks and Rays: sustainability of target and bycatch fisheries, Phase 1 (FRDC project 2001/077)* as detailed below.

The *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* requires fishers to report any interaction with listed threatened species found in Commonwealth waters. As of July 2003 all NT Fisheries Logbook cover sheets will provide details of the legislative reporting requirements to the Commonwealth of any interaction with threatened species.

Monitoring

The current FRDC project: *Northern Australian sharks and rays – the sustainability of target and bycatch fisheries* has an observer component for the collection of catch composition data from target shark fishing vessels and bycatch fishing in order to improve stock assessments. Four observer trips have been undertaken so far on commercial fishing vessels, with a further 12 budgeted to be undertaken during 2004. The observer trips provided valuable information on all species landed, including byproduct, bycatch and threatened species. While onboard, observers validated catch returns and the manner in which commercial fishers completed logbook returns. Observers also documented vessel and gear information, location and depth fished.

Dependent research

Northern Australian Sharks and Rays; the sustainability of target and bycatch fisheries, Phase 1. (FRDC Project 2001/077).

The Shark Phase 1 project was essentially an initial review project for the larger project Shark Phase 2 (see below). It was conducted for a twelve month period from June 2001 with the objectives;

- to workshop with stakeholders and fishery managers on issues and concerns for the Northern Territory, Queensland, and Western Australia shark fisheries;
- to workshop a new shark Identification manual with shark fishers in Northern Territory, Queensland and Western Australia (developed during FRDC project 2000/105) to improve the quality of data recorded in commercial logbooks;
- to carry out pilot fishery observer programs in Northern Territory, Queensland, and Western Australia shark fisheries to (1) develop fisher cooperation and observer protocols, (2) determine shark composition, and (3) determine conversion ratios for shark fins to whole animal.

The project successfully met all objectives and provided a basis for the following Shark Phase 2 project (see Rose *et al.*2003)

Northern Australian Sharks and Rays: the sustainability of target and bycatch fisheries, Phase 2. (FRDC Project 2002/064).

The shark phase 2 project links the National Plan of Action for the Conservation and Management of Sharks (NPOA-Shark). The project began in July 2002 and is cooperatively managed between CSIRO Division of Marine Research, Northern Territory Department of Business Industries and Resource Development, Fisheries Department of Western Australia, Natural Resources and Environment Victoria, and the Department of Primary Industries, Queensland. The project was initiated in response to the need for information on the composition, size/weight frequency and spatial distribution of chondrichthyan (shark, ray and sawfish) caught in commercial fisheries of tropical Australia. The project additionally aims to identify those species that are vulnerable to over-fishing. The project will provide information for stock assessments of the main target shark species (*C. tilstoni* and *C. Sorrah*) as well as biological information on the sawfishes. Biological information collected on sawfish will enable a more reliable assessment of the impact of fisheries on this group.

The Phase 2 project will be completed in 2005 and includes the following objectives;

1. establishment of long term collection of catch composition data from target shark fisheries in northern Australia (NT Joint Authority Shark Fishery, NT Coastal Net Fishery, QLD Joint Authority Shark Fishery, QLD N9 Shark Fishery, WA Joint Authority Shark Fishery, WA North Coast Shark Fishery, QLD East Coast Net Fishery), in order to improve stock assessments.
2. To determine the appropriate management scale for the target species of northern Australian Shark fisheries, by examining the degree to which stocks are shared across northern Australia and with Indonesia.
3. To evaluate the effect of gillnet fishing on northern chondrichthyans, by determining bycatch composition (QLD N3 Net Fishery, QLD East coast Gillnet Fishery, NT Barramundi Fishery, WA Kimberley Gillnet and Barramundi Fishery).

4. To derive estimates of biological parameters to assess the status of sawfish populations; age structure, reproduction and growth.

5. To re-evaluate the risk assessment of northern chondrichthyans (undertaken in the DEH project), based on the new information collected above. This risk assessment will be compatible with the one undertaken in application FRDC 2002/033 (PI Terry Walker) in line with the NPOA-Shark priority for a national approach to risk assessment for chondrichthyans.

The project aims to enable effective and sustainable management of target shark fisheries within Northern Territory, Queensland and Western Australia. This will be achieved through providing data necessary to (1) enable these fisheries to improve stock assessments, (2) ensure management is at an appropriate scale for stocks, (3) address some of the *EPBC Act* guidelines and (4) align with the NPOA-Shark.

This project will further examine the impact of fishing on chondrichthyans to enable fisheries managers to prioritise species for future management, contribute to the *EPBC Act* assessment of fisheries that catch chondrichthyans as bycatch, and align the broader issues raised in the NPOA-Sharks.

Summary of information and preliminary assessment of grey mackerel, S.semifasciatus, in the NT pelagic net fishery.

The Northern Territory Fishing Industry Research and Development Fund has agreed to support the preliminary assessment of grey mackerel in the NT shark fishery, to be undertaken during 2004 - 2005. The status of this resource has not previously been assessed. Along with shark target species, management of the fishery is highly conservative: precautionary in the face of this information deficit. Conceivably, the grey mackerel resource could actually sustain much larger catches.

The grey mackerel project will collate all information to provide an initial assessment. Specifically the objectives of the project to begin in July 2004 are;

1. Collate and summarize existing literature and available data on grey mackerel;
2. Document the basic fisheries biology of the species; and,
3. Undertake preliminary assessment of the status of grey mackerel in the NT fisheries.

The expected outcomes of the project are to;

1. provide basic biological information for management, and preliminary estimates of sustainable harvest rates and yields;
2. provide a basis for explicit inclusion of grey mackerel in management of the shark fishery;
3. identify the basis of future research by providing a collated set of information, and
4. indicate future research needs.

Additionally, research into stock structure of the northern Australian grey mackerel stock(s) is planned but is subject to availability of funding from the FRDC.

Fishery independent data

Samples supplied by the NT National Parks and Wildlife Habitat mapping program.

Northern Territory Parks and Wildlife project on habitat mapping has provided 160 shark specimens from 12 species for biometric analysis from a variety of locations around the NT coast. Total length, fork length, whole weight and total wet and dry fin weights for each shark were recorded. Sexual maturity was also recorded.

These sharks were combined with those supplied by an individual fisher to develop shark fin conversion ratios. Mean shark fin conversion ratios were calculated for each species that had data for more than five individuals. For three species where there was data for more than 20 individuals, regression analysis was used to examine the relationship between body size and fin weight.

A calculation of a realistic fin weight to body weight ratio will allow fisheries officers the capacity to check that fins retained on board are in ratio to the shark landed. Alternatively the information can be used to assist in the validation of logbook returns.

1.1.2 There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and/or reproductive capacity. Review should take place at regular intervals but at least every three years.

The performance of the shark fishery is reviewed annually and reported through the publication of a fishery status report and the NTFJA annual report. The fishery status report provides current information on catch/effort, stakeholder participation, research, compliance and management together with major issues that have occurred throughout the year. The status report also includes the reporting of objectives, performance indicators and triggers and how the fishery is performing against these criteria. The status report is distributed to all stakeholders and available from the Fisheries Group or online from the Department's website, www.dbird.nt.gov.au.

The NTFJA Annual Report provides information on the status of northern fisheries jointly managed by the Commonwealth and the Northern Territory. This Report provides details of all functions and activities associated with the management of these fisheries, including the shark fishery. The NTFJA annual report is distributed to key stakeholder groups and available on request from the Fisheries Group.

Stock assessment workshops

Strategic periodic review of the shark fishery is provided by assessment workshops conducted by stock assessment scientists, local and interstate fisheries managers and researchers, industry representatives, representatives from non-government organisations and interested members of the general public. These workshops cover all aspects of the fisheries focusing on research and management strategies. Specifically, the workshops aim to:

- Re-assess major fisheries in the Northern Territory

- Advise the Northern Territory Government on the biological status of managed fisheries, any changes required in their management and any necessary changes to future research programs
- Provide comment on stock assessment and management strategies
- Provide Northern Territory fisheries scientists and managers with training in recent stock analysis and resource management methodologies
- Include industry and interested parties in the discussion of workshop results and contribute to the workshop findings (Ramm 1997).

Stock Assessments

Evaluation of yield estimates for tropical sharks was the subject of the 1992 Joint Australian - Indonesian Workshop on the Arafura Sea Fisheries and a follow-up Workshop in 1994. Yield estimates proved inconclusive due to inconsistencies in data collection methods (Australian Shark Assessment Report, 2001).

The joint NTDFIF-CSIRO Pelagic Fish Stock Assessment program estimated that, in waters adjacent to the Northern Territory, the maximum sustainable yield (MSY) for *C. tilstoni* and *C. sorrah* is 3,400 t annually. This estimated yield consists of 1,900 tonnes in the Arafura and Gulf of Carpentaria zones and 1,500 tonnes in the NT zone (Coastal region – figure 1).

In 1997 an assessment team led by Dr Carl Waters of the University of British Columbia, conducted a workshop to review all available information gathered from shark fisheries throughout northern Australia. The teams consisted of Northern Territory, Queensland, Western Australia and Commonwealth scientists and managers. The review workshop commenced with a formal meeting attended by industry representatives, managers and scientists to describe the fishery, management objectives, current research and data available. A separate workshop was then convened to review recent analyses and management strategies. Outcomes were conveyed in an “open meeting” with industry, managers and scientists and other interested individuals.

The 1997 workshop concluded that the long term sustainable yield (MSY) for black-tip sharks is likely to be at least 2000t/yr for the NT, Qld, and WA fisheries combined (Walters and Buckworth 1997). Section 1.1.5 provides a more complete overview of the workshop.

The Phase 2 FRDC funded northern Shark project will provide information for stock assessments of the main target shark species (*C. tilstoni* and *C. sorrah*) as well as biological information on the sawfishes. This includes a rapid assessment of vulnerability of shark stocks. Section 1.1.1 provides more detail on the methods and expected outcomes of the project.

Grey mackerel

There is currently no yield estimate for grey mackerel in Northern Territory waters. Consequently, management arrangements are highly precautionary in light of this information deficit (see section 1.1.7). Cameron and Begg (2002) gathered some preliminary information on the biological and distribution information that will assist future assessments of the species. More information is required.

Section 1.1.1 outlines the grey mackerel project recently funded by the Fishing Industry Research and Development Account. The project aims to determine the status and research needs of the grey mackerel stocks in NT Waters.

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

The distribution and spatial structure of stocks is factored into the management arrangements of the Shark fishery. Spatial distributions of catch and effort for principal target species are available from commercial fishers logbook returns. All assessments take the spatial stock structure into account.

Tagging and genetic studies undertaken by CSIRO suggest *C.tilstoni* and *C.sorrah* form a single large stock throughout northern Australia (Last and Stevens, 1994). However, movement rates both onshore and offshore are relatively restricted, indicating slow exchange rates (1-10 percent/year) between the northern Australia / Arafura area where most Taiwanese gillnetting took place, versus the Gulf of Carpentaria and Joseph Bonaparte Gulf where foreign fishing was either low or totally excluded. This suggests that heavy fishing pressure by Taiwanese vessels offshore was unlikely to have an impact on inshore populations fished by Australian vessels (Stevens *et al*, 1990).

The following outlines the work currently underway to refine spatial distribution and the degree of sharing of sharks in northern Australia.

- FRDC project (2002/064): Northern Australia Sharks and Rays – The sustainability of target and bycatch species, Phase 2. One of the objectives is ‘to determine the appropriate management scale for the target species of northern Australian shark fisheries, by examining the degree to which stocks are shared across northern Australia and with Indonesia’ (FRDC R&D Funding Application, 2002). Section 1.1.1 provides further information.
- The feasibility of a new industry based shark tagging program in the NT is currently being examined for the monitoring of movement and harvest rates of the principal target species.
- The sustainability of Australian sharks and rays (DEH). This project provides a collation of historical and biological data on northern chondrichthyans and a risk assessment of northern chondrichthyan species. Reporting for this project is currently underway.

Grey mackerel

Cameron and Begg (2002) discovered that the stock in the Arafura and Gulf of Carpentaria are genetically separate to the Queensland coast. However, Cameron and Begg (2002) also noted, that “the absence of genetic differences detected between samples from each of these areas should not necessarily be considered as evidence of composite, single stocks of grey mackerel in the Arafura Sea/Gulf of Carpentaria or Queensland east coast area.” They noted that this could be due to the type of analyses used which may not detect finer stock structures.

A new research proposal has recently been supported by the Northern Territory Fisheries Research and Development Trust Fund Advisory Committee (see section 1.1.1). This project proposes to gain an understanding of the status and research

needs of the grey mackerel stock in NT waters. This will collaborate with a similar study in Queensland and is part of a phased approach to establish what further research is appropriate.

Research into the stock structure of the northern Australia populations of grey mackerel has been recommended by an FRDC review into mackerel research and research needs in northern Australia. A proposal for such a study has been supported by the 2003 Northern Australia Fisheries Management Workshop and will be submitted in the coming FRDC funding round.

Factoring distribution and spatial structure into management responses.

Distribution and spatial structure is incorporated into stock assessments and subsequent management responses are based on these assessments. Until spatial information becomes more refined, the principal target species (*C.tilstoni*, *C.sorrah* and *S. semifasciatus*) are considered shared stocks across Commonwealth and the northern state jurisdictions and are assessed and managed accordingly.

The following examples illustrate the factoring of spatial information into management responses:

- Under the Offshore Constitutional Settlement (OCS) there are Memorandums of Understanding (MOU) between the relevant governments too complementary manage the shared resources of the shark fishery. Management of the shark fishery includes the incorporation of the objectives of the Commonwealth, State and Territory Acts. For example, the NTFJA has the role of “keeping constantly under consideration the condition of the fishery, formulating policies and plans for the good management of the fishery, and for the purposes of the management of the fishery exercising the powers conferred on it by the Northern Territory Fisheries Act and co-operating and consulting with the other authorities including other Joint Authorities within the meaning of the Commonwealth Act, in matters of common concern” (Clarke 1996).
- A number of joint workshops have been held on stock assessments of northern shark species and the management of the fishery linked under MOU arrangements between the Commonwealth, States and Territory.
- Annual NAFMW between Commonwealth, WA, QLD and NT to discuss future management and research direction of shared fisheries, including the shark fishery.
- Complementary management arrangements agreed between the NT and QLD for the shark fishery within the central Gulf of Carpentaria (GoC) region. Agreed policies include the linking of shark fishing concessions issued by the NT and QLD agencies for the central GoC region to prohibit any increase in fishing effort and to ensure complementary management arrangements.
- Cooperative research between the Commonwealth, WA and QLD fisheries agencies (eg. Shark Phase 2 – see section 1.1.1). The research will include a risk assessment in line with the NPOA-Shark priority for a national approach to risk assessment for chondrichthyans.
- Drafting of the Operational Plan for northern Australia builds on the NPOA-shark. The Operational Plan allows jurisdictions to implement the strategic directions

of the NPOA - Shark. In particular the document identifies the mechanisms to undertake complementary management and research required for ecologically sustainable management of species in the northern shark fisheries.

1.1.4 There are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

Commercial fishing is the main source of removals of the target and byproduct species. Commercial removals of the same species from different fisheries are also taken into account in stock assessments (e.g. shark taken by the barramundi fishery). Reliable estimates of these removals are factored into stock assessments of target and byproduct species.

Reliable estimates are provided from commercial fisher logbook returns while observer monitoring provides bycatch estimates. This information allows for accurate estimations of stock removals by the licensed Australian vessels and contributes towards fish stock assessments and sustainable catch rates.

All commercial fish processor/traders are licensed by the Fisheries Group and are required to complete compulsory log sheets identifying the quantity and source of the product. This information can then be compared with reported landings from commercial fishers. The Fisheries Group undertakes an annual review of logbook data to ensure the data collected provides an appropriate level of information for stock assessment.

Catch and effort data has been collected from commercial (domestic) fisher logbook returns since 1983 (Figure 4). Prior to this time Taiwanese gillnet fleet catches in the area between Australia and Papua New Guinea averaged about 25 000t annual live weight of mainly shark, tuna and mackerel. With the declaration of the AFZ a quota of 7000t processed weight (10 000t live weight) a year was allocated to 30 gillnetters between November 1979 to October 1982 under a bilateral agreement. Between February 1990 and September 1991 a joint venture allowed eight Taiwanese longliners to fish in the AFZ, where they caught approximately 1700t of shark.

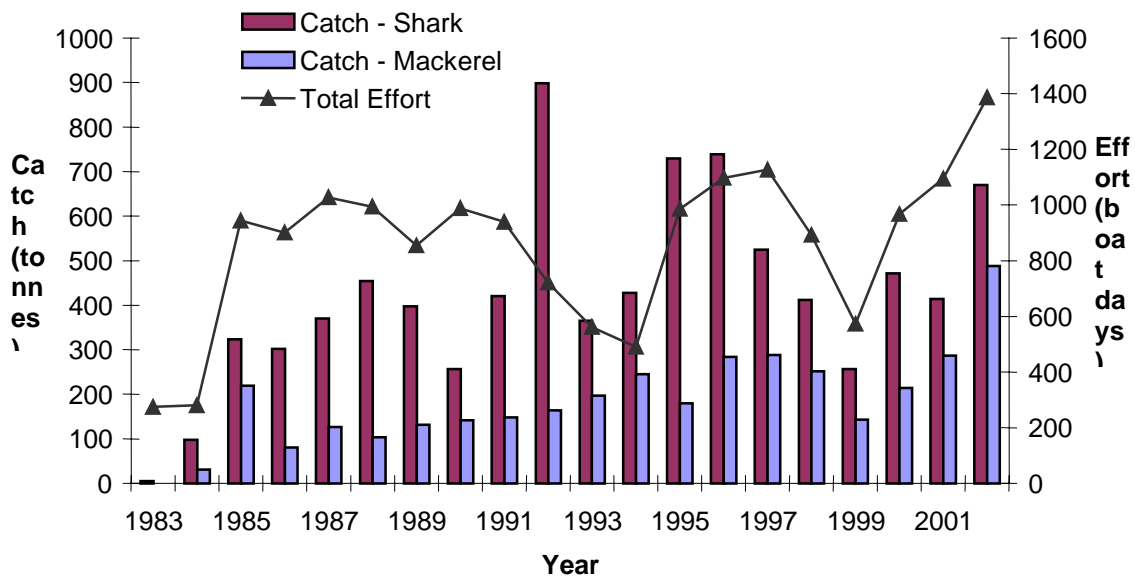


FIGURE 4. Catch and effort in the NT commercial shark fishery, 1983 – 2002 (Shark Fishery Status Report, 2002).

Fishing Tour Operators

Fishing Tour Operators (FTO's) also provide logbook returns on shark species and grey mackerel species landed (Appendix 4). However, these species are not targeted by FTO's and as a consequence catches are relatively low. Furthermore most catches of these species are released alive (Table 1). This data is included in stock assessments.

Table 1. Number of shark and grey mackerel caught by FTO's in 2002.

Species	Number caught	Number released	Number retained	% released
shark (general)	5404	4425	979	82%
grey mackerel*	830	499	331	60%

- grey mackerel figures may include a few spotted mackerel catches.

Recreational

Estimates of removals by the recreational fishery are provided by recreational fishing surveys. The first of these surveys was, conducted between November 1994 and February 1996 and targeted recreational fishers, Fishcount 95 (Coleman 1998). The survey was designed, among other things, to collect information on recreational fisher participation and their catch and effort. Recreational groups were found not to target sharks and grey mackerel. These species were caught while targeting other species (e.g. Spanish mackerel). In 1995, over 80,000 individual sharks were caught, with 82% being released, giving a harvest of 14,400.

Recently the more comprehensive National Recreational and Indigenous Fishing Survey was completed. Between May 2000 and April 2001 7942 individual sharks and rays were caught by recreational fishers.

Indigenous Fishing

Results from the NRIF survey suggest that sharks and rays are one of the more important groups of fish caught by indigenous people in the Northern Territory. In 2000, over 12,000 sharks and rays were harvested, comprising just over 3% of the total finfish harvest. The species of sharks and rays caught and harvested were not identified.

Discarded Catch

A review of the incidental capture of sharks, including finning, in other fisheries targeting non-shark species concluded in 2002. A limit on the incidental catch of shark was agreed for barramundi and the coastal line fishery. A prohibition on the possession of sharks and shark product was also agreed for the Timor Reef, demersal, finfish trawl and Spanish mackerel fishery. Details of catch limits on shark as byproduct in these fisheries is described in section 1.1.7.

The Fisheries Group is unaware of any other circumstances where fishers would choose or be required to discard target or byproduct species in the NT Shark fishery. Furthermore, there does not appear to be any incentive for fishers to discard target or byproduct species (no quota on species, holding facilities are adequate, market accepts all species landed). As a result there has been no reported at sea discarding of these species (whole). However, due to recent concerns over the practice of shark finning and discarding of the remaining carcass the Fisheries Group in consultation with the Shark Fishery Association has now amended as a condition of the licence to prevent the practice of shark finning. The marketing and sale of shark fin is allowed providing commercial use is made of the remaining carcass or compliance officers can match shark product to the agreed ratios of shark (see section 1.1.7). This management arrangement aims to prevent the practice of shark finning and discarding of the remaining shark carcass. It also satisfies international and national recommendations for the sustainability of shark fishery resources. Further details of the new amendments are described in section 1.1.7.

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

The joint NT-CSIRO Pelagic Fish Stock Assessment program of the mid-1990s estimated that, in waters adjacent to the Northern Territory, the maximum sustainable yield (MSY) for *C. tilstoni* and *C. sorrah* is 3,400 t annually. This estimated yield consists of 1,900 tonnes in the Arafura and Gulf of Carpentaria zones and 1,500 tonnes in the NT zone.

CSIRO tagging studies (Stevens et al 1990) suggest that *C. tilstoni* and *C. sorrah* form a single large stock throughout northern Australia. However, movement rates both inshore and offshore are relatively restricted, indicating slow exchange rates (1-10 percent/year) between the northern Australia / Arafura area where most Taiwanese gillnetting took place, versus the Gulf of Carpentaria and Bonaparte Gulf where foreign fishing was either low or totally excluded. This suggests that heavy fishing pressure by Taiwanese vessels offshore was unlikely to have an impact on inshore populations fished by Australian vessels (Stevens et al 1990).

Walters and Buckworth (1997), in an assessment utilizing both Taiwanese and domestic fishery records up to 1995, concluded the following:

Combining potential yields over the heavily fished Arafura Sea and Gulf of Carpentaria stock components results in a combined potential yield estimate for WA, the NT, and Queensland of at least 2000 t/yr with an optimum annual exploitation rate on the gillnet vulnerable component of the stock of 6-7 percent per year. This suggests that while there may be a large population of sharks, only a small amount can be sustainably harvested each year. The optimum annual exploitation rate is determined from annual mortality, growth, selectivity, and pup production rate data. The question remains as to how large a stock the optimum annual rate should be applied to in calculations of the total annual catch.

CPUE statistics corrected for shark targeting (square root variation in CPUE with stock size) suggest that the Taiwanese fishery of the 1970s and 80s reduced the northern Australia / Arafura component of the stock by about 60-70 percent. The Gulf of Carpentaria (GoC) stock component may not have declined by more than 30 percent during the period when the northern Australia/Arafura component was being depleted. There was probably "hyperdepletion" in the overall CPUE statistics due to a substantial part of the stock in the GoC not being fished by the Taiwanese due to closures imposed by the Commonwealth.

Age-structure modeling indicates that the overall stock (northern Australia/Arafura plus GoC components) should have been increasing at a rate of between 5 percent and 10 percent per year since the mid-1980s when Taiwanese catches were greatly reduced, in spite of more recent domestic catches. However, CPUE data from the NT gillnet fishery does not show such a rise in catch levels. This suggests unreported catches of about 1500t/yr from the stock. This may be due to foreign fishing activity in the Arafura Sea, combined with unreported domestic catches.

It is also possible that declines in domestic CPUE have been due to slow depletion of an inshore, resident component of the overall stock, without there being a major impact of recent fishing on the stock as a whole (i.e., overall stock may be recovering, but inshore density being reduced by domestic fishing in spite of overall increase).

The tagging work undertaken by CSIRO is not totally inconsistent with this hypothesis, when data is corrected for bias in apparent movement patterns due to higher offshore fishing efforts during the period when the study was conducted. However, if there is a distinctive inshore stock component being fished by NT and Queensland fishers, this stock component has a much lower sustainable yield than we would estimate for the stock as a whole based on the offshore Taiwanese catches.

For this assessment we have had to rely almost entirely on highly suspicious CPUE statistics from Taiwanese fishers, the validity of which is questionable for stock management purposes. It is not known whether the observed fishing strategy and changes in catch rates are linked to the availability of sharks or the targets of other pelagic fish in other regions. There are various reasons to suspect that the observed CPUE trends are not proportional to changes in the actual stock size.

There is now an additional seven years of data available since Walters and Buckworth (1997) undertook their assessment and, although there has been strong variation (particularly the strong peaks of 1995 and 1996), there has been little long-term change in the catch rate trend for black tip sharks. In contrast, there has been a very strong and persistent increasing trend in the catch rate of grey mackerel,

suggesting that this species has been increasingly targeted. The diversion of effort to target grey mackerel is supported by the observation in Figure 3 that catch rate variation in the sharks and grey mackerel are in counterpoint – years in which catch rates of grey mackerel peaked, shark catch rates declines and vice versa. It has not as yet been feasible to resolve logbook information into the target groups, but the inference from these observations is that catch rate trends presented for sharks are likely to be conservative – they may not be sensitive to increasing trends in shark abundance. Slight declines may reflect increased reliance by operators on the highly valued grey mackerel, rather than a decrease in shark abundance.

There is no assessment in place for grey mackerel and this component of the fishery has been growing in value since the early 90's. To address this factor, further assessments using CPUE as a measure of abundance will allocate effort amongst targets. As indicated in the Walters and Buckworth (1997) stock assessment, tagging and reference fishing are to be investigated as a means of monitoring fish mortality and abundance.

Given the statements above the reliability for stock assessment of the major target species (*C. tilstoni* and *C.sorrah*) must be considered low. Subsequently, precautionary management arrangements (see section 1.1.7) and reference / trigger points (see section 1.1.6) have been implemented to ensure the sustainability of these species.

Grey mackerel estimates while not available will be addressed in the recently funded proposed research project (see section 1.1.1). Byproduct and bycatch estimates will become available once target species yield estimates (including grey mackerel) become more refined. In the interim precautionary reference points and triggers have been implemented to ensure the sustainability of these species (see section 1.1.6).

1.1.6 There are reference points (target and/or limit), that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.

The shark fishery is managed in accordance with the management objectives, performance indicators, trigger points and management actions listed in Table 2. If a trigger point is reached the Director will respond by directing a SharkMAC to convene to review the management arrangements of the fishery. Alternatively, the Director can request the Minister to declare emergency changes (immediately) under the provisions of the *Fisheries Act*, (Division 1, subsection 29). The same emergency provisions apply for the target species, byproduct and bycatch species listed below.

The strategic management arrangements of the shark fishery are continually reviewed and assessed at the NAFMW and in compiling the annual status report. An appropriate management response if a reference point were reached would be made in consultation with stakeholder groups in the interests of ensuring the ecological sustainability of the fishery.

The Fisheries Group are committed to formulating guidelines for a review of the fisheries management arrangements once reference points and triggers are reached, by December 2004.

Table 2. Management Objectives, Performance Indicators, Trigger points and Management Actions used in the demersal fishery

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

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

Details from the fishery including catch (relative abundance) and effort are gathered from statutory logbook data and observer records. This information is reviewed in compiling the annual status report and through regular stock assessments (see section 1.1.2). Observer records provide information on all landed species, including byproduct, bycatch and interaction with threatened species.

The current management strategies are appropriate to detect any changes in fishing effort and relative abundance and composition of catch (outlined below). Trigger points and agreed management responses provide the means to respond and control the level of take in the shark fishery.

In the event of a triggered response, the Director, through a consultative process, can call for a review of the fishery and undertake appropriate action, if required, to ensure the ecological sustainability of the fishery. See section 1.1.6 for trigger values for the shark fishery.

Input and output controls to control the level of take in the fishery are described below and listed in Division 5 of the Fisheries Regulations.

Limited entry / licence reduction

Entry to the shark fishery is limited to those operators who, in the past, have satisfied commercial catch criteria in demonstrating a reliance on the fishery. A commercial fishery licensing reduction program commenced in 1995 to both reduce capacity available in the fishery with the aim of ensuring sustainability and an adequate level of profitability for the remaining operators.

Pre-existing access concessions were recognised with the passage of an Offshore Constitutional Settlement (OCS) in 1995. At that time, existing fishers were issued a “restricted licence” for the zone or zones in which they were authorised to operate. The three management zones previously implemented under a Commonwealth development plan were continued. New entrants must acquire and surrender three “restricted” shark fishery licences for the issuance of an “unrestricted” fishery licence. Alternatively, any new entrant may acquire an “unrestricted” licence, that is, a pre-existing licence issued on the surrender of three (restricted) licences.

Area restrictions

A number of special interest areas have been declared throughout Northern Territory waters, in which fishing activity is restricted. While not specifically declared to afford protection for sharks, fishing restrictions apply which limit the capture of sharks.

Complementary arrangements (Licence linking)

Policies have been agreed to effectively “link” shark fishing concessions issued by NT and Qld Agencies for the central GoC region to prohibit any increase in the number of fishing vessels and to ensure complementary management arrangements.

Byproduct / bycatch limits of shark in non target fisheries

The Fisheries Group is currently determining shark bycatch / byproduct levels for all fisheries in which sharks are landed as an incidental part of the catch. The following agreed bycatch / byproduct limits of shark in commercial fisheries are based on historical landings:

Timor Reef fishery – nil

Demersal fishery – nil

Spanish mackerel fishery – nil

Finfish trawl – nil

Barramundi fishery – 500 kg of converted whole shark weight on board a vessel

Coastal line fishery – 500 kg of converted whole shark weight on board a vessel

Gear restrictions

Commercial operators may use a maximum of 2,500 m of pelagic gillnet constructed of twine not less than 0.9 mm in diameter with a mesh size between 150 mm and 250 mm. Pelagic longline may be used in all regions (restrictions apply to the Coastal zone) of the shark fishery, or demersal longline in the Arafura or Gulf of Carpentaria (GoC) region, provided the total length of all lines used does not exceed 20 nm at any time.

Vessel regulations

The holder of a shark fishery licence may operate a vessel under that licence if that vessel operated in the fishery prior to 1995 or if he or she has the written approval of the joint authority to use the vessel

Catch restrictions (see section 1.1.8)

Prevention of shark finning

It is now a condition of the shark fishery licence that shark product on board a vessel must conform to the following percentage ratios.

- a). 'Fresh or frozen fin weight to be no more than eight (8) percent of trunk weight on board a vessel'
- b). 'Fresh or frozen fin weight to be no more than sixteen (16) percent of fillet weight on board a vessel'
- c). 'Dried fin weight to be no more than three (3) percent of trunk weight on board a vessel'
- d). 'Dried fin weight to be no more than six (6) percent of fillet weight on board a vessel'
- e). 'This licence condition is to be reviewed by December 2004.'

These ratios effectively prevent the practice of shark finning (i.e. the take of shark fin without retaining the remaining carcass). Over the next 12 months the Fisheries Group working with industry will refine the ratios as needed to ensure protection and sustainability of shark species.

Compliance

The PMFEU effectively monitors and enforces compliance through the inspection of arrival and departure of the NT Shark fishery operators through the ports of Darwin and Nhulunbuy. Offshore surveillance of fishing activities is undertaken periodically or on a “as needed ” basis. The principal management arrangements can be monitored in port. This includes verification of catch returns against processor returns (i.e. requirement for all operators to specify where they are selling their product). The PMFEU has the power, if necessary, to investigate the records of wholesalers and licensees.

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

The Shark Fishery is a multi-species fishery whereby any species, apart from barramundi, threadfin salmon and mudcrab can be kept and sold as part of the catch. Spanish mackerel can only be harvested in accordance with the following conditions;

- (1) 30 trunks of Spanish mackerel or 30 Spanish mackerel retained as whole fish; and
- (2) for each tonne of grey mackerel taken by the licensee during the voyage – not more than an additional 10 trunks of Spanish mackerel or an additional 10 Spanish mackerel retained as whole fish.

The management measures for Spanish mackerel together with those for the species above are designed to identify these species as principal target species in other managed fisheries.

Black tip shark (*C.tilstoni* and *C.sorrah*) and grey mackerel comprise the main portion of commercial species caught in the shark fishery. Although fishers target all species of shark, these shark species are considered the principal target species. Byproduct species only comprise 17% of the commercial catch (2002 logbook data).

The main by-product species in the shark fishery are outlined in Appendix 5. Information is collected for by-product species through observer monitoring and the compulsory shark fishery logbook system.

Fisheries Research observers monitor the composition of catch in addition to an annual review of all species landed, including byproduct and bycatch species. If the proportion of byproduct should increase to 35% of the overall catch in the shark fishery there will be a review of management arrangements of the fishery under provisions of the *Fisheries Act*.

The Fisheries Group believes that the precautionary management arrangements (see section 1.1.7) and current and proposed research (Shark Phase 1 and 2) provide the necessary tools to assess the status and ensure the sustainability of byproduct species in the shark fishery.

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

The management measures outlined in section 1.1.7, aim to ensure that the shark fishery is managed in accordance with the National Strategy for ESD and the objectives of the *Fisheries Act*. Provisions under the *Fisheries Act* allow the Director to take appropriate action for the protection of the fishery by ensuring aggregate landings are below sustainable yield estimates. In addition the Minister has the capacity to close the fishery.

The conservative management response measures outlined in section 1.1.6 provide the means to ensure the fishery is maintained at ecologically sustainable stock levels. The information provided in sections 1.1.1-1.1.8 indicates that there are collection, assessment and management response systems in place to identify risk and uncertainty to stocks of target and byproduct species.

Management responses are appropriate to ensure overall landings remain within sustainable yield estimates for blacktip sharks. Appropriate trigger mechanisms are in place to prompt a review should overall landings approach or reach sustainable yield estimates. Where yield estimates are not known (e.g. grey mackerel) changes in overall landings are monitored (by onboard monitoring) with significant variations prompting a review of management arrangements for protection of the species concerned (section 1.1.6 provides details of trigger values for the fishery).

As outlined in section 1.1.8, byproduct in the shark fishery is relatively low. Such low numbers landed together with conservative trigger values (sections 1.1.6) ensure minimal risk to the sustainability of byproduct stocks in the shark fishery.

OBJECTIVE 2. WHERE THE FISHED STOCK(S) ARE BELOW A DEFINED REFERENCE POINT, THE FISHERY WILL BE MANAGED TO PROMOTE RECOVERY TO ECOLOGICALLY VIABLE STOCK LEVELS WITHIN NOMINATED TIMEFRAMES.

1.2.1 A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock.

and

1.2.2 If the stock is estimated as being at or below the biological and/or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a 'whole of fishery' effort or quota reduction are implemented.

Although stock assessments for the shark fishery are not considered reliable, they do not indicate that the stocks have been overfished in the past or have been below any biological bottom line. Current precautionary management arrangements (see section 1.1.16 –1.1.7) are aimed to ensure that stocks are maintained at ecologically sustainable levels.

Based on all available advice, the fishery is unlikely to be operating at or below the biological or effort bottom line, (see section 1.1.6). However, sections 28 and 29 of the *Fisheries Act* provide for a management response, including emergency measures, if required.

PRINCIPLE 2

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.

OBJECTIVE 1. THE FISHERY IS CONDUCTED IN A MANNER THAT DOES NOT THREATEN BYCATCH SPECIES.

Onboard monitoring data indicates that bycatch species comprise less than 2% of the total catch (FRDC Project Phase 1 and 2). The majority of the bycatch species (80.5%) are pelagic (Trevally sp. and *Scromberomorus queenslandicus*), crustaceans (*portunus pelagicus*) and rays (mostly *Mobula eregoodootenke*) which are released alive (FRDC Project Phase 1 and 2 Observer data). Onboard monitoring will continue to be undertaken annually to provide detailed data, suitable for assessing the shark fishery with regard to composition and abundance of bycatch species.

The shark fishery management arrangements, particularly the licence reduction scheme (3:1), gear restrictions (no bottom set nets, net length limits, no unattended nets) minimise the risk to bycatch species. The regulation prohibiting the use of bottom set nets to avoid bycatch species (nets must be set 2m off the seabed) has the added protective benefit to bycatch species by effectively preventing fishers from operating in shallow water. These evolving management arrangements between the Fisheries Group and stakeholders ensure that the fishery is conducted in a manner that does not threaten bycatch species.

The minimal bycatch and the negligible risk involved from the impacts of shark fishery operators demonstrate that the activities of the shark fishery are unlikely to threaten any bycatch species, including threatened and protected species. Therefore, the shark fishery is meeting the objectives of 1 and 2 of Principle 2.

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

Information from fishers and observer data gathered under the Shark Phase 1 and 2 project suggests that the composition and abundance of bycatch species is very low (<2%) (Figure 5).

Due to the low levels of bycatch, it is appropriate that bycatch, and the diversity of bycatch species continues to be monitored by onboard observers and not added to commercial fisher logbooks. The Fisheries Group has recently employed a temporary technician to continue annual observer monitoring in the shark fishery.

A rise in the bycatch to 10% of the total catch composition in successive calendar years will trigger a review of management arrangements to ensure protection of bycatch species.

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

Almost all shark species are kept as catch by operators in the shark fishery (i.e. < 2% bycatch). Although considered low, the Fisheries Group will undertake a risk assessment of bycatch vulnerability caught in the fishery by December 2005. This risk assessment will complement the risk assessment undertaken as part of the FRDC Shark Phase 2 (see section 1.1.1).

2.1.3 Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.

The level of bycatch in the shark fishery is low and measures are already in place to minimise the interaction with bycatch species. These include mesh size restrictions, net attendance rules, and the regulation to ensure the net remains 2 metres off the seabed. The net off the seabed regulation was specifically designed to reduce net interaction with turtles and other threatened species.

Annual observer monitoring together with logbook returns provides the means to determine the impact of fishing activities on bycatch species. If there is a significant change (recorded by observer data) in catch composition and bycatch levels are threatened, legislation under sections 28 and 29 of the *Fisheries Act* allows for a review in the management arrangements of the fishery. In addition a risk assessment of the vulnerability of bycatch species caught in the fishery will be undertaken before December 2005.

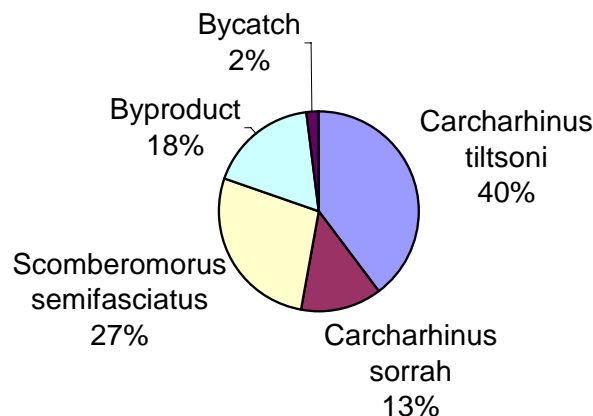


Figure 5. Relative catch composition of the shark fishery (observer data).

2.1.4 An indicator group of bycatch species is monitored.

Monitoring of an indicator group of bycatch species is not appropriate in this fishery because the level of bycatch (<2%) is considered to pose no immediate threat to stocks of bycatch species. Furthermore, sufficient knowledge on individual bycatch species suitable as indicator species is not available.

The present levels of bycatch monitoring by Fisheries observers is considered sufficient until such time as bycatch increases to 10% of the total catch. These management measures are considered more effective than the monitoring of an indicator group of bycatch species. However, if the risk assessment of bycatch vulnerability (due before December 2005) reveals the need for an indicator species, management measures will be altered accordingly.

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

Not applicable.

A risk assessment on bycatch species vulnerability to be undertaken prior to December 2005 will provide the information to determine if an indicator group of bycatch species is appropriate for this fishery.

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

The current management measures and consideration to the results of the bycatch vulnerability risk assessment (December 2005), provide the means to ensure the management response achieves the objectives of bycatch sustainability.

OBJECTIVE 2. THE FISHERY IS CONDUCTED IN A MANNER THAT AVOIDS MORTALITY OF, OR INJURIES TO, ENDANGERED, THREATENED OR PROTECTED SPECIES AND AVOIDS OR MINIMISES IMPACTS ON THREATENED ECOLOGICAL COMMUNITIES.

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

Observer programs are in place to gather reliable data on the shark fishery operator's interaction with endangered, threatened or protected species.

Shark Phase 2 also includes a study of the biology, distribution and catch rate of members of the sawfish species group. The freshwater sawfish (*Pristis microdon*) is currently listed as having a high conservation status (threatened – *EPBC Act 1999*).

There are a number of species listed as protected in Commonwealth waters under the *EPBC Act* and in NT waters under *the Territory Parks and Wildlife Conservation Act*. Recently, the instructions on completing daily logbooks were amended to include information on reporting requirements for interaction with threatened species under the *EPBC Act*. A leaflet on "Interaction with protected species" and a threatened species list relevant to NT waters was also distributed with each updated logbook sheet. The logbook amendments and leaflet are to remind fishers of their legal obligation to report interactions with endangered, threatened or protected species to the relevant government agency.

There are no threatened ecological communities in the area of the shark fishery.

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

The shark fishery rarely encounters any threatened species. There is no recorded interaction with endangered or protected species.

The following are threatened or endangered species which possibly occur in the vicinity of the shark fishery.

Critically endangered species

Speartooth shark (*Glyphis sp. A*)

Endangered species

Northern River shark (*Glyphis sp. C*)

Loggerhead turtle (*Caretta caretta*)

Olive Ridley turtle (*Lepidochelys olivacea*)

Dugongs are listed in the Conservation of International Trade in Endangered Species (CITES).

Threatened

Green turtle (*Chelonia mydas*)

Hawksbill turtle (*Eretmochelys imbricata*)

Leatherback turtle (*Dermochelys coriacea*)

Flatback turtle (*Natator depressus*)

The death of one hawksbill turtle in the shark fishery has been recorded. The Fisheries Group considers the death to be a rare occurrence and that this fishery will have a negligible effect on the population of turtles. On the rare occasions that turtles are caught they are generally released alive.

Sawfishes and all other shark species in northern Australia are undergoing a formal risk assessment through the collaborative Shark Phase 2 project. Shark specialist working groups for the IUCN and DEH as a priority action have identified a recovery plan for freshwater sawfishes (*Pristis microdon*) and sharks (*Glyphis sp.*). However, the species of sawfish listed as critically endangered or endangered above and *Pristis microdon* do not currently interact with the shark fishery. No catches of these species have been recorded (logbook or observer data) during normal activities of the shark fishery.

The results of the bycatch vulnerability risk assessment to be completed by December 2005, will provide information on the impact of the fishery on bycatch species including endangered, threatened or protected species.

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

There are no ecological communities listed as threatened under the *EPBC Act* in the area of the shark fishery.

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

The interaction and level of capture of endangered, threatened or protected species in the shark fishery is low and existing management measures introduced by the Fisheries Group minimise interaction of these species with nets. These measures include restrictions (net set not less than 2 metres from the seabed) in relation to the seabed where nets can be set. This measure is to primarily reduce the number of turtles being captured, but also assists in allowing most bottom feeding species (Dugongs) to avoid the nets thus reducing bycatch.

In conjunction with net placement regulations, there are area closures, which minimise interaction.

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

Not applicable.

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

Given the low levels of interaction of this fishery with protected species and the current management arrangements it is unlikely that any unacceptable impacts on threatened species will result from the shark fishery. However, as observer data and results from the risk assessment on the vulnerability of bycatch species become available, the suitability of the current performance measures may need to be reviewed. If the current performance measures are inappropriate, or the level of interaction increases, appropriate alterations to fishing operations will be taken.

In particular, management arrangements such as the licence reduction scheme (3 for 1), area closures (no netting within 2 NM of shore) and specifically gear restrictions (see section 2.2.4) greatly reduce the interaction and mortality of protected species. The industry Code of Conduct, due to be completed by November 2004, will enhance protection of these species. In addition, a Strategic plan, first proposed by industry 4 years ago will be finalised by September 2004, with a full Environmental Management System (EMS) due to be completed by February 2005. These industry initiatives will further set objectives and measures to ensure protection of these species.

OBJECTIVE 3. THE FISHERY IS CONDUCTED, IN A MANNER THAT MINIMISES THE IMPACT OF FISHING OPERATIONS ON THE ECOSYSTEM GENERALLY.

The limited entry and subsequent low levels of participants and passive fishing methods in the shark fishery minimises the likelihood of impact of fishing activities on the ecosystem generally. Precautionary management arrangements and regular review and assessment will ensure continued minimal impact on the ecosystem. In this respect the shark fishery is meeting the performance requirements in objective 3 of Principle 2.

2.3.1 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the fisheries impact on the ecosystem and environment generally.

The fishing methods (pelagic net and line) are essentially passive fishing methods that are highly species selective and are likely to have little effect on the ecosystem and environment generally. There is no interaction with the substrate other than anchors to vessels and longlines. Shark nets are regulated to ensure they remain set at minimum of 2 metres off the seafloor. This restricts fishing operations to deeper water outside the more vulnerable shallow estuarine environment.

A fishery with only 19 operators using low impacting methods of fishing is highly unlikely to impact on the ecosystem and the environment. Therefore a risk assessment to determine any impact on the ecosystem or the environment at this time is not justified. As such, research information regarding impacts on the ecosystem generally is not available to the extent where all aspects of 2.3.2 could be analysed and evaluated. This situation is not unique. The amount of information available on these aspects in any of the world's fisheries is scant.

An appropriate level of information is collected on levels of catch and effort of target and byproduct species, fishing method, and bycatch. This information provides the basis for understanding the impact on the ecosystem and the environment, generally.

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

1. Impacts on ecological communities

Benthic communities

The methods of fishing (virtually no contact with seabed other than anchors) ensure the impact on the substrate and benthic communities is likely to be low. Therefore information collected and risk analysis is not considered necessary.

Ecologically related, associated or dependent species

The shark fishery is likely to have little impact on ecologically related, associated or dependent species. The fishery targets high order predator species with highly selective fishing gear types and methods, and catches low amounts of bycatch (<2%) relative to other fisheries.

Water column communities

Water column communities have not been assessed as part of the research effort. The number of operators and level of effort is unlikely to cause significant impact on these communities.

2. Impacts on food chains

Structure and productivity flows

The effect of removing the upper level predators in a deep-water fish community is not well understood and research specifically designed to address this question is yet to be undertaken.

3. Impacts on the physical environment

Physical habitat

The fishing methods used in the shark fishery are unlikely to affect the seabed. In most cases there is no contact with the seabed. Nets must be set 2 metres above the seabed. They are set freely from bow of the vessel unanchored. Such minimal contact with the seabed ensures negligible impact to the physical environment.

Water quality

The shark fishery has a small number of commercial vessels that use no chemicals in their operation other than diesel fuel. The vast area, tidal movement and wave action, in addition to the small number of vessels in the fleet, reduce the likelihood of any significant impact on water quality.

2.3.3 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

The low number of vessels operating in the shark fishery fleet, the method of fishing, and the extent of fishing area is considered to limit the potential of significant impact on the ecosystems found on the shark fishing grounds. Should a threat or significant impact be detected through logbook or observer data, there are provisions under section 29 of the *Fisheries Act* which enable the Minister to take appropriate remedial actions.

2.3.4 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

Not applicable. See 2.3.3 above.

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

Not applicable. See 2.3.3 above.

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APPENDICIES –

APPENDIX 1 – EXCERPT FROM THE 2002 NTFJA ANNUAL REPORT.

Section 62 of the *Fisheries Management Act 1991* together with Section 66 of the *Northern Territory Fisheries Act 1988* provides for the function of the NTFJA, viz.:

“keeping constantly under consideration the condition of the fishery, formulating policies and plans for the good management of the fishery, and for the purposes of the management of the fishery exercising the powers conferred on it by the Northern Territory Fisheries Act and co-operating and consulting with the other authorities including other Joint Authorities within the meaning of the Commonwealth Act, in matters of common concern.”

The Commonwealth Act also provides that in undertaking these functions, the Joint Authority must pursue the objectives of –

- (a) implementing cost-effective fisheries management; and
- (b) ensuring that the exploitation of fisheries resources and the carrying on any related activities are conducted in an manner consistent with the principles of ecological sustainable development, in particular the need to have regard to the impact of fishing activities on non-target species and the marine environment; and
- (c) maximise economic efficiency in the exploitation of fisheries resources; and
- (d) ensuring accountability of the fishing industry and to the community generally in its management of fisheries resources.

APPENDIX 4 FTO LOGBOOK SHEET

IN CONFIDENCE **FISHING TOUR OPERATOR - DAILY LOG** 

DATE I.C. No# GRID No# FISHED FROM Reef Shoals

SPECIFIC AREA FISHED (name of reef, bay, river etc.)

PERSON DETAILS (all anglers, including yourself)

PERSON NO.	1	2	3	4	5	6
ORIGIN <small>Reef State (Aust) Cairns (O'ceania)</small>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
FISHING SKILL <small>Expert Average Beginner</small>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

TARGETING AND HOURS FISHED

B - Barramundi	G - Game Fishing	R - Reef/Bottom Fishing	C - Crabbing	O - Other
Methods (✓ any) Trotting <input type="checkbox"/> Casting <input type="checkbox"/> Bait <input type="checkbox"/>	Methods (✓ any) Trotting <input type="checkbox"/> Casting <input type="checkbox"/> Bait <input type="checkbox"/>	Methods (✓ any) Casting <input type="checkbox"/> Bait <input type="checkbox"/>	Methods (✓ any) Pots / Dribbles <input type="checkbox"/> Other <input type="checkbox"/>	Methods (please write in eg. beach area, cast net etc.) <input type="text"/>
(calculation space) <input type="text"/>	(calculation space) <input type="text"/>	(calculation space) <input type="text"/>	(calculation space) <input type="text"/>	(calculation space) <input type="text"/>
Total Line Hours <input type="text"/>	Total Line Hours <input type="text"/>	Total Line Hours <input type="text"/>	Total Pot Hours <input type="text"/>	Total Hours <input type="text"/>

CATCH DETAILS (or tick here if NIL CATCH)

Species	Target Fished	No. Caught Kept/Rel.	Species	Target Fished	No. Caught Kept/Rel.	Species	Target Fished	No. Caught Kept/Rel.	Other Species (please write in)	Target Fished	No. Caught Kept/Rel.
Barramundi	<input type="checkbox"/>	<input type="checkbox"/>	Mangrove jack	<input type="checkbox"/>	<input type="checkbox"/>	Sooty grunter	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Timon	<input type="checkbox"/>	<input type="checkbox"/>	Mullus	<input type="checkbox"/>	<input type="checkbox"/>	Snapper (Golden)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Calfish (blacktail)	<input type="checkbox"/>	<input type="checkbox"/>	Mullet	<input type="checkbox"/>	<input type="checkbox"/>	Snapper (White-T)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Cobra	<input type="checkbox"/>	<input type="checkbox"/>	Mud crab	<input type="checkbox"/>	<input type="checkbox"/>	Snapper (Thick)	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Cod (all types)	<input type="checkbox"/>	<input type="checkbox"/>	Queenfish	<input type="checkbox"/>	<input type="checkbox"/>	Stripy	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Coral trout	<input type="checkbox"/>	<input type="checkbox"/>	Empere (Red)	<input type="checkbox"/>	<input type="checkbox"/>	Sweetie	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Levein fish	<input type="checkbox"/>	<input type="checkbox"/>	Subwas (Blue)	<input type="checkbox"/>	<input type="checkbox"/>	Tarpon	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Jobfish	<input type="checkbox"/>	<input type="checkbox"/>	Tomalia adonis	<input type="checkbox"/>	<input type="checkbox"/>	Trevally	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Sparan mackerel	<input type="checkbox"/>	<input type="checkbox"/>	Siripoga	<input type="checkbox"/>	<input type="checkbox"/>	Tuna	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
Mackerel (Other)	<input type="checkbox"/>	<input type="checkbox"/>	Snak - All	<input type="checkbox"/>	<input type="checkbox"/>	Tusk / Parrotfish	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>

Comments/Notes

Guides Name:

I, _____ certify that the information provided here is true and complete. Signed

(print name)

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APPENDIX 5 PERCENTAGE OF SPECIES CAUGHT FROM THE NT SHARK FISHERY, FISHERIES OBSERVER RECORDS.

Species	Common name	No. caught	%	Species value
<i>Carcharhinus tilstoni</i>	Australian black-tip	2678	39.75%	target
<i>Scomberomorus semifasciatus</i>	Grey mackerel	1850	27.46%	target
<i>Carcharhinus sorrah</i>	Spot-tail shark	879	13.05%	target
<i>Eusphyra blochii</i>	Winghead shark	217	3.22%	byproduct
<i>Scomberomorus commerson</i>	Spanish mackerel	178	2.64%	byproduct
<i>Sphyrna lewini</i>	Scalloped hammerhead	101	1.50%	byproduct
<i>Rhizoprionodon acutus</i>	Milk shark	91	1.35%	byproduct
<i>Apolectus niger</i>	Pomfret	75	1.11%	byproduct
<i>Carcharhinus fitzroyensis</i>	Creek whaler	72	1.07%	byproduct
<i>Eleutheronema tetradactylum</i>	Blue salmon	66	0.98%	byproduct
<i>Portunus pelagicus</i>	Sand crab	62	0.92%	bycatch
<i>Sphyrna mokarran</i>	Great hammerhead	59	0.88%	byproduct
<i>Carcharhinus amboinensis</i>	Pigeye shark	54	0.80%	byproduct
<i>Thunnus tonggol</i>	Longtail tuna	38	0.56%	byproduct
<i>Anoxypristis cuspidata</i>	Narrow sawfish	35	0.52%	byproduct
<i>Carcharhinus macloiti</i>	Hardnose shark	28	0.42%	byproduct
<i>Lutjanus johnii</i>	Golden snapper	24	0.36%	byproduct
<i>Carangidae</i>	Trevall sp.	22	0.33%	bycatch
<i>Carcharhinus brevipinna</i>	Spinner shark	19	0.28%	byproduct
<i>Euthynnus affinis</i>	Mac tuna	19	0.28%	byproduct
<i>Lutjanus erythropterus</i>	Red snapper	16	0.24%	byproduct
<i>Rhizoprionodon taylori</i>	Australian sharpnose shark	16	0.24%	byproduct
<i>Scomberoides commersonianus</i>	Queenfish	16	0.24%	byproduct
<i>Carcharhinus dussumieri</i>	White cheek shark	12	0.18%	byproduct
Scad		12	0.18%	byproduct
<i>Scomberomorus queenslandicus</i>	Queensland mackerel	12	0.18%	bycatch
<i>Mobula eregoodootenke</i>	Pygmy devilray	11	0.16%	bycatch
<i>Carcharhinus amblyrhynchos</i>	Grey reef shark	9	0.13%	byproduct
<i>Hemipristis elongata</i>	Fossil shark	9	0.13%	byproduct
<i>Rachycentron canadus</i>	Cobia	9	0.13%	byproduct
<i>Parastromateus niger</i>	Black Pomfret	6	0.09%	bycatch
<i>Chirocentrus dorab</i>	Wolf herring	5	0.07%	bycatch
<i>Istiophorous platypterus</i>	Sailfish	5	0.07%	byproduct
<i>Scomberomorus munroi</i>	Spotted mackerel	4	0.06%	byproduct
<i>Katsuwonis pelamis</i>	Skipjack tuna	3	0.04%	byproduct
<i>Makaira indica</i>	Black marlin	3	0.04%	byproduct
<i>Rhynchobatus djiddensis</i>	White spotted shovelnose ray	3	0.04%	bycatch
<i>Carcharhinus amblyrhynchoides</i>	Graceful shark	2	0.03%	byproduct
<i>Galeocerdo cuvier</i>	Tiger shark	2	0.03%	byproduct
<i>Protonibea diacanthus</i>	Black jewfish	2	0.03%	byproduct
hawksbill turtle*		2	0.03%	bycatch
<i>Aetobatus narinari</i>	Spotted eagle ray	1	0.01%	bycatch
<i>Carcharhinus melanopterus</i>	Black-tip reef shark	1	0.01%	byproduct
<i>Echeneis naucrates</i>	Slender suckerfish	1	0.01%	bycatch
<i>Lates Calcarifer</i>	Barramundi	1	0.01%	bycatch
<i>Megalops cyprinoides</i>	Tarpon	1	0.01%	bycatch
<i>Pseudocaranx dentex</i>	Giant trevally	1	0.01%	bycatch
<i>Pastinachus sephen</i>	Cowtail ray	1	0.01%	bycatch
<i>Stegastoma fasciatum</i>	Leopard shark	1	0.01%	bycatch
Trevally sp.		1	0.01%	bycatch

barracouda sp.		1	0.01%	bycatch
greenback turtle		1	0.01%	bycatch
		6737	100.00%	