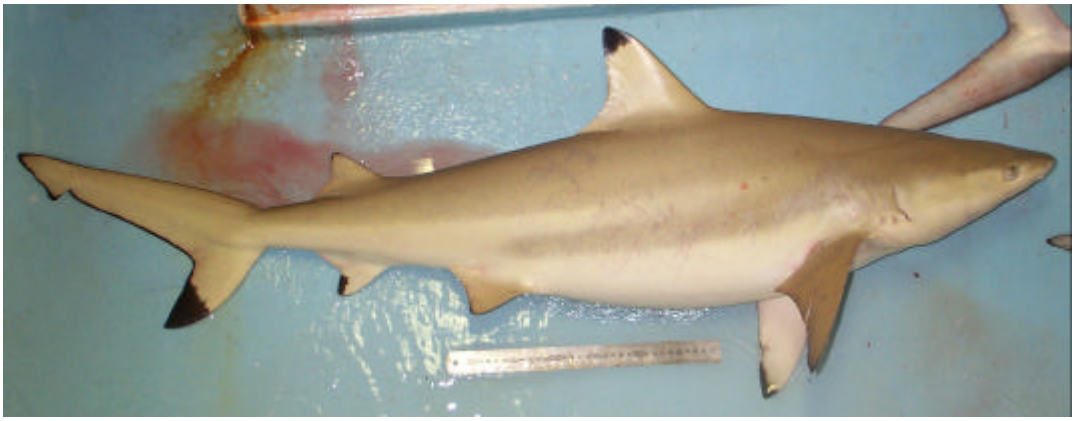
Northern Australian sharks and rays: the sustainability of target and bycatch fisheries, Phase I

FRDC Project 2001/077

by C. Rose, Dr N. Gribble and J. Stapley



Contributing Authors: R. Buckworth and R. Lenanton

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Fish for the future

Northern Australian sharks and rays: the sustainability of target and bycatch fisheries, Phase I.

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Dr Neil Gribble: Principal Investigator
Cassandra Rose and Jason Stapley: Project Biologists

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Manager, DPI Publications
Department of Primary Industries
GPO Box 46
Brisbane Qld 4001

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PRINCIPAL INVESTIGATOR: Dr N. Gribble
ADDRESS: Queensland Department of Primary Industries
Northern Fisheries Centre
PO Box 5396
CAIRNS
Qld 4870

OBJECTIVES:

1. Workshop stakeholder and management issues and concerns in WA, NT and Qld for inclusion into the planning process for the full-scale FRDC project ' Northern Australian sharks and rays: the sustainability of target and bycatch fisheries' (FRDC 2002/064).
2. Workshop new Shark Identification manual (Dr John Stevens, FRDC 00/105) with shark fishers in WA, NT and Qld to improve the quality of data recorded in commercial logbooks.
3. Carry out pilot fishery observer programs in WA, NT and Qld shark fisheries to (1) establish co-operation with fishers and jointly establish appropriate observer protocols, (2) determine shark catch composition, and (3) determine conversion ratios for shark fin to whole animal.

NON-TECHNICAL SUMMARY:

OUTCOMES ACHIEVED

The workshops and pilot observer program contributed significantly to the FRDC proposal for Phase II. The proposal was based soundly on stakeholder consultation and input, with co-operation from industry assured.

This study also contributed to improved stock assessment data for principal target species of the northern shark fisheries:

- Fishers were instructed at the workshops in the use of a new Field Guide which will improve the accuracy of the commercial logbook data;
- The pilot observer program provided data on the catch composition of the target shark fisheries shark catch; and
- The calculation of shark fin to body ratios for the principal target species will allow managers to more accurately estimate the total weight of shark caught from logbook returns.

International, national and regional concern for the sustainability of sharks and rays is increasing. Sharks and rays are more susceptible to fishing pressure than bony fishes due to their slow growth, late age at maturity and low fecundity. Northern Australia has one of the most diverse shark and ray faunas in the world and there is a need for research to improve the management of northern shark fisheries. In particular, better information is needed on the shark catch composition of both target and bycatch shark fisheries.

This study was Phase I of a larger project on the 'Northern sharks and rays: the sustainability of target and bycatch fisheries, Phase II '. As such, this was essentially a pilot study for Phase II.

This project met all of its objectives and ran informal workshops in Qld and NT and pilot observer programs in Qld, NT and WA. In WA, communication between managers and the small number of fishers (6) is already well established and consequently it was not necessary to hold a workshop. At the Qld and NT workshops there were hands-on sessions to explain how the new shark Identification Field Guide works. At each session there were a dozen specimens of different sharks and rays brought in by local shark fishers that Dr Stevens used to instruct the fishers on how to use the Guide. The fishers were positive about the new Field Guide as it could improve the accuracy of their shark identifications and it could provide consistent use of common names recorded in logbooks across northern Australia. This will greatly improve the quality of logbook data and catch composition information for the northern shark fisheries.

The workshops also provided a forum for free flowing discussions between fishers and managers on a range of issues, potential solutions and future directions of the northern shark fisheries. The major issues raised and discussed were:

- Expansion of shark fishing effort;
- Inadequate shark catch composition information on target and bycatch fisheries;
- The need for improvement in recording of shark species in commercial logbooks;
- Bycatch;
- Shark finning;
- Mercury in shark flesh;
- Recreational fisher and community perceptions of shark fishing; and
- Uncertainty over status of some of the principal species taken by the target shark fisheries.

Proceedings from the two workshops were compiled and distributed to all workshop participants. These proceedings included transcripts of the workshop presentations and summaries of all the issues and outcomes discussed during the workshops.

Shark fishers co-operated well with the pilot observer program that ran in Qld, NT and WA. Observers collected data on the catch composition of the shark and bycatch on 15 trips aboard commercial target shark vessels across the three States/Territory. A total of 6776 individuals from 68 species were identified, with sharks accounting for nearly half of all the species caught. Two species of shark dominated the catch in each of the States/Territory, that is, *Carcharhinus tilstoni* and *C. sorrah*. Hammerheads

were the other dominant species in Qld and NT (*Sphyrna lewini* and *Eusphyra blochii* respectively) and *C. plumbeus* was also dominant in WA. These findings were consistent with previous studies of northern sharks, though in this pilot program more shark species were recorded than have been previously reported for the northern shark fisheries.

Bycatch was greatest in NT (around half of the total catch) where the shark fishers also target mackerel, while in Qld the bycatch accounted for around 15 % of the catch and in WA where demersal longlines are used (rather than gillnets as in Qld and NT) the bycatch accounted for around 3% of the catch. The term bycatch refers to all non-targeted catch including byproduct (non-targeted catch that is retained and sold), discards and other interactions with gear (Anon 2000).

Conversion ratios for wet and dry shark fins to whole, trunk and fillet weight were calculated for the major species of sharks taken in the northern shark fisheries. A mean ratio of wet fin to whole weight of 1.52 % was calculated for the twelve species commonly taken in this study. This is similar to the 2.0% ratio applied in the review of shark finning in Australian fisheries (Rose and McLoughlin 2001). This pilot study found considerable variation in the ratios for fin to whole shark, both within and among shark species. The conversion ratios appear to be influenced by a number of factors, that are:

- Species, size and body shape of the shark;
- The moisture content of the fins which may vary with species and size of shark;
- The type of cut used to remove the fins from the shark;
- The types of commercially valuable fins retained from different species of shark; and
- The manner in which the shark is processed (eg, whole, trunked or filleted).

The conversion ratios calculated in this study were for the principal species of shark taken by gillnets in coastal waters of northern Australian. Care should be taken in extrapolating the use of the ratio from this study to other species of shark taken by different gear in other fisheries. Such sharks may be different species with different average sizes and body shapes to those observed in this study and this may result in different mean conversion ratios.

This study provided information on the concerns of fishers and managers about the northern shark fisheries, catch composition of target and bycatch species and some fin to whole shark conversion ratios. All of these are significant as stand-alone results and were also used in the formulation of the full-scale Phase II FRDC Project 2002/064. The results will also be included in the Strategic Assessment of the northern shark fisheries that is to be submitted to Environment Australia for assessment of the sustainability of these fisheries.

KEYWORDS: Sharks and rays, sustainability, bycatch

ACKNOWLEDGEMENTS

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We wish to sincerely thank all fishers who took time out of fishing to attend the workshops. Their input into the discussions was invaluable and greatly appreciated.

We also wish to thank all speakers at the workshops for their contribution and time. From the Queensland workshop we thank Geoff MacPherson from Queensland Fisheries Service (QFS) for enlightening fishers on the background to the project, covering the historic shark catch and describing the use of acoustic devices to reduce bycatch in gill nets. Thanks to Shane Hansford from QFS for presenting the management situation and issues of Qld sharks and thanks to John Stevens from CSIRO for introducing the new field guide to sharks and rays and running a hands-on session with shark specimens. Thanks also to Mitch Trezise, the shark fisher who kindly provided a variety of shark and ray specimens for the shark identification session.

From the Darwin workshop we wish to thank Rik Buckworth from NTDBIRD for presenting the background to the project, an overview of research on northern sharks, sustainability/risk assessment to determine shark species vulnerable to fishing and the use of acoustic devices to reduce bycatch in gill nets. Thanks to Ray Clarke from NTDBIRD for covering the management situation and issues of NT sharks and thanks to John Stevens from CSIRO for introducing the new field guide to sharks and rays and running a hands-on session with shark specimens. Thanks also to Bill Mounsey the shark fisher who kindly provided a variety of shark and ray specimens for the shark identification session.

Thanks to the observers Jason Stapley from QFS, Nick Spanswick from NTDBIRD and FWA research staff for their observer work. Thanks also to Stuart Hyland for contribution of data from the Coastal Fisheries Resource Monitoring Project. Special thanks to those skippers and fishing vessels that participated in the pilot shark observer programs by allowing the observers to come onboard and collect data on the catch species composition, lengths and weights of shark and shark products. Without their co-operation the collection of such invaluable data would not have been possible.

BACKGROUND

International, national and regional concerns for the sustainability of elasmobranchs (sharks and rays) is increasing. Northern Australia has one of the most diverse shark and ray faunas in the world and their management and conservation status is in the international spotlight. Sharks and rays are more susceptible to fishing pressure than bony fishes, due to their slow growth, late age at maturity and low fecundity.

In 1993 the IUCN Shark Specialist Group requested TRAFFIC Oceania review the trade in sharks and rays globally due to the lack of information available for assessing the conservation status of populations. One of the recommendations of this review (Sant and Hayes 1996) is that management of northern Australians shark fisheries be improved through more research into the catch and biology of the species involved. In 1994 CITES passed a resolution calling for international fishing organisations to provide information on shark fisheries and trade for further discussion. In 1997 the FAO Committee of Fisheries instigated a technical working group on sharks and rays which produced guidelines for the implementation of an International Plan of Action for the conservation and management of sharks (IPOA-Sharks 1999, Walker 2000). In accordance with the requirements of the IPOA-Sharks, Australia has begun preparing its National Plan of Action for the conservation and management of sharks (Shark Advisory Group 2001). One of the major issues identified on a national and international level is the under reporting of shark and ray catches, mainly in the form of bycatch.

Sharks have been fished commercially in northern Australia since the early 1970's. Following the Offshore Constitutional Settlement agreement the take of sharks and rays is managed as three separate Commonwealth-State/Territory Joint Authorities across northern Australia (Queensland Joint Authority Shark Fishery, Northern Territory Joint Authority Shark Fishery and West Australian Joint Authority Shark Fishery). Queensland (Qld) and Western Australia (WA) also have State managed fisheries which target sharks, the Qld developmental inshore shark fishery within the Gulf of Carpentaria (N9 licences) and the WA North Coast Shark Fishery. The fishing gear used varies, but includes longlines, droplines and gillnets. The catch of these fisheries tends to be dominated by a few Carcharhinid sharks, but they also catch numerous other less common species.

The current shark and ray catch across northern Australia taken by target fisheries (~900t pa) is low by international standards but the total bycatch (eg gillnet and trawl) is unknown. Additionally, interest by fishers is increasing due to the high value of some shark products such as fins. The new Environment Protection and Biodiversity Conservation Act 1999 requires that if fisheries wish to maintain a licence to export product they must produce a Strategic Assessment to demonstrate that they are ecologically sustainable. Catch composition information is required as an essential part of this Strategic Assessment. As such there is a pressing need for improved shark and ray catch composition data from both the target and bycatch fisheries of northern Australia. Without this information sustainable shark fishing levels cannot be adequately assessed.

The lack of adequate data on the northern shark fisheries was raised in 1997 at a FRDC funded Stock Assessment Workshop in Darwin, Northern Territory (NT). In response, a Northern Australian Fisheries Management (NAFM) workshop in 1998 identified research and management of shark fisheries as a priority and agreed that CSIRO should co-ordinate collaborative research to address the main issues. Environment Australia (Natural Heritage Trust) funded a CSIRO desk top study to collate all available information on northern sharks and rays, that is, biology, distribution and fisheries information. The Bureau of Resource Sciences and NTDBIRD collated the available historic shark catch data which also links in with the ACIAR project on shark fisheries in South-east Indonesia. The 1999 and 2000 NAFM workshops again raised shark research and management as a priority and confirmed support for this project on the sustainability of northern sharks and rays.

The current study is Phase 1 of the larger "Northern Australian sharks and rays: the sustainability of target and bycatch fisheries" project which will integrate the catch information from the different fisheries with available biological and ecological knowledge of the species to examine the sustainability of catches of northern sharks and rays.

This project builds on previous research in the CSIRO Northern Pelagic program which provided information on the biology, diet and population structure of the main target species of the northern shark fisheries and some of the other species caught (Stevens and Church 1984, Stevens and Wiley 1986, Lyle 1987, Lavery and Shaklee 1989, Stevens and Lyle 1989, Stevens and McLoughlin 1991). This project also extends the work of FRDC 96/257 (Ecological Sustainability of Prawn Trawl Bycatch, Stobutzki et al. 2000) where sharks and rays were highlighted as a potentially vulnerable group.

Workshops were held in Qld and NT to ensure that fishers and management could input their respective issues and concerns into the planning stage of the full project. In WA, communication between fishers and managers is already well established. Consequently their issues and concerns were already known and it was not necessary to hold a workshop in WA.

The workshops also provided an opportunity to improve the fishers' shark identification skills with a hands-on identification session run by Dr John Stevens, CSIRO, using shark and ray specimens and the new Field Guide to sharks and rays (FRDC 00/105). In WA, the Shark Research Section of FWA have developed a Field Guide specific to Western Australian species and fishers have already been instructed in species identification. The use of these field guides by the fishers is essential to improving the quality of data that is recorded in commercial logbooks. The workshops were also necessary to establish the co-operation of commercial fishers in a fishery observer program.

Pilot shark fishery observer programs were conducted in Qld, NT and WA. These provided species composition data on the commercial shark catch and conversion ratios of shark fins to whole animals. The catch composition data is critical to even the simplest of stock assessments.

The outcomes of the workshops and pilot studies are significant as stand-alone results but will be used primarily in the formulation of the full project planned for 2002-2005.
For the remainder of this report the term sharks will be used to refer to sharks and rays and the term bycatch to refer to all non-targeted catch including byproduct (non-targeted catch that is retained and sold), discards and other interactions with gear. This definition of bycatch is that applied in the Commonwealth Bycatch Policy (Anon 2000).

NEED

The need for research to improve the management of northern sharks fisheries is clearly recognised at State/Territory, national and international (TRAFFIC Oceania, FAO) levels. A number of relevant Australian forums have identified the main issues and prioritised the necessity for shark research to address the current lack of data required for shark management. The sustainability of shark species is also a priority issue with stakeholders.

The 1998, 1999 and 2000 Northern Australia Fisheries Management Workshops identified shark research as high priority. The 2000 Northern Shark Stock Assessment Review Workshop identified the lack of species identification in the catch of NT and Qld and the lack of uniformity in logbook reporting of shark catch as major concerns. In 2001 the national Shark Advisory Group identified a number of significant issues pertaining to the conservation and management of sharks. These included:

- A general lack of species identification and quantification of shark taken in some target and non-target shark fisheries;
- A lack of consistent data collection and validation programs across some fisheries and jurisdictions;
- The need for a minimum standard level of data collection and shark reporting across shark fisheries and jurisdictions;
- Shark finning (this activity is currently banned in the Commonwealth tuna fisheries, WA, New South Wales, Victoria and Tasmania, with Qld in the process of implementing a shark finning ban).

This project directly addresses the Research and Development Priorities of QFIRAC (1.2 Develop and improve the quality of catch/effort data collection systems, 1.3 Undertake stock assessments of fisheries resources, 2.2 Quantify the unintentional effects of fishing on fish stocks) and those of FRDC (Natural resource sustainability: effect of fishing activities on fish and their ecosystems).

This study focussed on workshopping the issues with stakeholders in each State/Territory and running short pilot observer programs in Qld, NT and WA to test methods and gain critical preliminary data on the shark catch. It is the first stage (Phase 1) of a more comprehensive project.

OBJECTIVES

1. Workshop stakeholder and management issues and concerns in Qld, NT and WA for inclusion into the planning process for the full-scale FRDC proposal " Northern Australian sharks and rays: the sustainability of target and bycatch fisheries" (FRDC 2002/064).

   A workshop was not held in WA as a close working relationship is already established between managers, researchers and fishers. A more detailed explanation is provided in Part A, Methods.

2. Workshop the new Shark Identification Field Guide (Dr John Stevens, FRDC 00/105) with shark fishers in Qld, NT and WA to improve the quality of data recorded in commercial logbooks.

   In WA, the Shark Research Section (FWA) have developed a Field Guide specific to Western Australian species and fishers have already been instructed in species identification using Sharks and Rays of Australia (Last and Stevens 1994).

3. Carry out pilot fishery observer programs in WA, NT and Qld shark fisheries to (1) establish co-operation with fishers and jointly establish appropriate observer protocols, (2) determine shark catch composition, and (3) determine conversion ratios for shark fin to whole animal.

PART A: NORTHERN SHARK FISHERIES WORKSHOPS

METHODS

Shark fisheries workshops were held in Qld and NT. A workshop was not held in WA for a number of reasons, that is:

- Stakeholders have already been canvassed regarding management issues in WA northern shark fisheries;
- The terms of reference of the WA Demersal Gillnet and Demersal Longline Fishery have been changed to include a member from the northern shark fishery, ensuring continued fishery input into management advice to the Minister for Fisheries;
- The Department of Fisheries, WA has already had considerable assistance from northern shark fishers in all aspects of its research; and
- Given the close working relationship between the Shark Research Section (FWA) and industry, fishers are kept fully updated on research issues.

The one day workshops involved local shark fishers, fishery managers and shark scientists from each State/Territory. The workshops were advertised by the placement

of flyers in relevant industry journals, industry peak bodies, local newspapers and fishermens co-operatives. Fishers were also directly contacted through personal networks.

The number of project staff at the workshops were kept to a minimum to control costs. In Qld, where shark fishers are based in various ports along the coastline, their travel and accommodation costs involved in attending the Cairns workshop were covered by allocated monies from the project funds.

The Cairns workshop was held on 7th November, 2001 at the Cairns Cruising Yacht Squadron and the number of participants was 39. There were 30 shark fishers, one of whom is also a seafood processor, a fisheries manager and 8 scientists from government that included 3 speakers and 2 observers from the observer program in the Gulf of Carpentaria.

The Darwin workshop was held on 20th November, 2001 at the Fisheries Research Laboratory, NTBIRD. The number of participants was 13. There were 7 dedicated shark fishers (one of whom is also a seafood processor), a representative from the Northern Territory Seafood Council, a fisheries manager and 4 scientists from government that included 3 speakers, one of whom is the observer from the pilot shark observer program in the Northern Territory.

The aim was to keep the workshops reasonably informal, with a number of presentations by scientists and managers to stimulate discussion within the workshop groups. The workshops were divided into morning and afternoon sessions. In the morning sessions there were the presentations, followed by hands-on shark identification sessions with shark specimens and then open discussions in the afternoon.

There were a number of presentations at both the Qld and NT workshops that covered:

- Management of Qld and NT shark fisheries;
- The historic shark catches across northern Australia;
- An overview of research on northern sharks;
- The use of sustainability/risk analysis to determine shark species vulnerable to fishing pressure;
- Acoustic devices to reduce bycatch; and
- Improvements to shark identification using a new field Guide developed for fishers.

In WA management issues and concerns were derived from stakeholder submissions in relation to the 1998 management paper (Department of Fisheries, Western Australia 1998); the subsequent industry meeting held at FWA on 4 February 1998; minutes of the WA Demersal Gillnet and Demersal Longline Management Advisory Committee; extensive discussions with stakeholder; preliminary research data and personal observations by FWA research staff.

At the hands-on shark identification sessions of the Qld and NT workshops there were about a dozen specimens of different sharks that had been brought in by local shark

fishers. These specimens were used by Dr John Stevens as he instructed the fishers on how to identify a shark using the new Shark Identification Field Guide (FRDC 00/105).

In WA, the Shark Research Section (FWA) have developed a Field Guide specific to Western Australian species and fishers have already been instructed in species identification using Sharks and Rays of Australia (Last and Stevens 1994).

DISCUSSION OF RESULTS

Proceedings from each of the Qld and NT workshops were compiled and distributed to all participants of the workshops. These proceedings include transcripts of all the presentations followed by summaries of the issues and outcomes that arose from discussions among the participants during the workshop. The full proceedings from each of the workshops are in Appendix 2 (Cairns) and Appendix 3 (Darwin).

The workshops were extremely successful in meeting objective one of providing a forum for open discussions between fishers and managers about their respective issues and concerns for the shark fisheries. The small and informal nature of the workshops encouraged free flowing discussions among the managers and fishers with the result that a range of issues, potential solutions and future directions were raised and discussed extensively.

The hands-on sessions were also very successful in meeting objective two of improving the quality of data that could be recorded in commercial logbooks. The fishers were positive about using the Field Guide as it could provide consistent use of common names in their logbooks and improve the accuracy of their identifications, particularly of some of the less commonly caught species. Fishers with years of experience recognised many of the species of sharks in the Field Guide. They commented that they would just have to learn the common name applied to those species in the Guide, so correct and consistent recording of shark species in their logbooks would not be difficult. Other fishers with less experience learned how to use the Guide to successfully identify the shark specimens. The design and trials of a logbook that will allow fishers to record their shark catch more accurately will be undertaken in Phase II of Northern Sharks and Rays: the sustainability of target and bycatch fisheries.

In WA, FWA research staff have liaised closely with northern shark fishers and species identification by the skippers and crews of the shark fishing vessels is now considered to be very good.

The discussion below is a summary of the main issues and outcomes that arose from the workshops in Qld and NT and from the WA stakeholder submissions and industry meetings.

Issues

The Qld and NT workshops highlighted a number of issues of concern to the fishers, researchers and management. In Qld the main issues were:

- Expansion of effort, increased use of net reel boats, new entrants coming into the fishery;
- Lack of catch composition information on both target and bycatch fisheries;
- Bycatch;
- Shark finning; and
- Mercury

In the NT where the shark fishery is much smaller, some of the same issues as those of Qld were raised while there were also other concerns discussed. The issues and concerns raised in the NT were:

- Potential for increased fishing effort;
- Inadequate catch composition information on both target and bycatch fisheries;
- Bycatch;
- Shark Finning;
- Recreational fishers and community perceptions of shark fishing; and
- Uncertainty over status of NT shark stocks.

In WA the issues identified were:

- Expansion of effort leading to over-exploitation of target stocks;
- Bycatch;
- Shark finning;
- Uncertainty over Joint Authority Northern Shark Fishery (JANSF) regulations; and
- Impacts of northern fisheries on shared key shark stocks.

In Qld, the main issue raised by fishers and managers alike, was concern with an expansion of effort in the shark fishery that is increasing pressure on the shark stocks. In the NT, where there has been a restructuring of the shark fishery to reduce pressure on shark stocks, this issue was not so pressing although some fishers did express concern that there was still a potential for excess effort on the shark stocks. In WA, some were concerned about the potential for effort increase and although there is no pressing need to reduce current access, it is considered unwise to increase the number of operators.

Another major issue in both Qld and the NT is the lack of adequate information and validated data on catch composition in both target and bycatch fisheries. In WA there is some target shark fisheries catch composition information, though more information on the target and bycatch fisheries is needed. The use of a number of different common names for the same species has in the past complicated the analyses of logbook data. The Qld commercial logbook does not record shark species, while those of NT and WA record the principal shark species retained.

In Qld, NT and WA the issues of bycatch in gill nets and shark finning were highlighted and identified as complex. There were also concerns over mercury in some shark products in Qld, while in the NT there were a number of issues with

recreational fishers, perceptions of shark fishing among the general community and concerns over the uncertain status of shark stocks. In WA there were concerns associated with uncertainty over gear and access regulations in the JANSF and potential fisheries effects on shared key stocks.

Each of these issues are discussed more fully below.

Expansion of effort, increased use of reel boats, new entrants coming into the fishery in Qld, potential for increased fishing effort in the NT and WA.

Queensland

This was the major concern expressed by all fishers in Qld. There are around 1200 N1 net licences on the east coast, though currently only a very small number actually catch shark full-time. However, each one of these net licences has the right to take shark. As such it is difficult to define an east coast "shark fishing fleet". There were discussions over the need for some sort of cap on the number of people catching shark. The shark fishers are very concerned that the fishery cannot support much more effort targeted on sharks. They are concerned that with the East Coast Trawl buy back scheme, more prawn trawlers will move into shark fishing and that as other fisheries such as the Reef/Line Fishery are examined more closely, some fishers may leave that fishery and start targeting shark.

Possible management interventions to address this issue and reduce the increasing pressure on shark stocks could be by a number of mechanisms: regulation amendments, amendments to permit conditions or imposing new licence conditions.

There were discussions on the issue of how to define a shark fisher. Some fish all year for shark only and use net reels, others fish for shark, barramundi, mackerel and use hand haul nets. All consider themselves shark fishers and any management changes need to be fair. Logbooks, that are a fisher's history, may be a fair method to define dedicated shark fishers.

There was concern by fishers about the lack of time to gather sufficient data (that is, accurate catch composition) required to complete a sustainability/risk analysis on all species of northern shark caught by October 2002. There is some information already available and by placing observers in the East Coast shark fishery that information can be verified and refined and used for a sustainability/risk assessment.

Northern Territory

Some fishers in the NT raised concerns that if all 11-12 licenced shark boats in NT waters used the maximum amount of net allowed that there would be too much net in the water for the shark stocks. There has been a restructuring of the dedicated shark fishery to address the issue of increasing effort via a three for one licence reduction program. However, further discussion between the shark fishing industry and government may be needed on the amount of potential net in the water.

Western Australia

Some fishers were concerned that there may be an expansion of effort. There are currently 4 full-time shark fishing vessels operating in the WANCSF and 2 operating in the JANSF. Given what is currently known about shark stocks in the northern shark fisheries, it is considered that there is currently no need to reduce access. However based on a precautionary approach to the management of the fishery, it would be unwise to increase the number of operators. As such, access will remain for those fishers who have a history in the fisheries.
The Department of Fisheries, WA have expressed concern about the potential activation of latent endorsements, particularly in the Western Australia North Coast Shark Fishery (WANCSF).

Inadequate catch composition information on both target and bycatch fisheries in Qld and the NT

Queensland

For the Qld East Coast shark stocks, there is a lack of catch composition information. The logbooks currently used by shark fishers in Qld do not record shark species, only weights of shark, fillets and trunks. Species catch information is needed to complete a sustainability/risk assessment of the northern shark fisheries. The new *Environment Protection and Biodiversity Act 1999* requires that fisheries must be shown to be ecologically sustainable to maintain a licence to export product. Additionally, improved species identification not only benefits management of the fishery, it should also improve marketing of shark product.

With the co-operation of shark fishers, researchers can place observers on board to collect species catch composition data and to verify logbook entries. The current commercial logbook system also needs to be improved. It will have to be a compromise between all the information that researchers would like for stock assessment and what can reasonably be expected of a fisher to record in the time available. The design and trial of an improved commercial logbook system will be undertaken in Phase II of this FRDC Northern sharks and rays project.

Fishers raised the issue that some in their fishery may not correctly record species if they do not realise its importance, simply do not care or are trying to falsify their catch history in anticipation of management changes. This would result in misleading logbook information. The use of observers could reduce some of these problems so that when data from the logbooks is entered it will be easier to detect if some logbook entries appear erroneous. There is also the possibility of using processor return validation, where the processor also records the catch information. This would provide a cross check for logbook entries that appear erroneous, although correct identification of processed shark products such as trunks and fillets may be difficult.

In the Gulf of Carpentaria net and crab fishery a separate logbook was introduced that has room for the recording of more accurate species identification and other information. It was used voluntarily by a number of fishers and now all fishers in that fishery have requested that it be used permanently. Over time with observer verification and this more thorough logbook system, the accuracy of species recorded by fishers should increase. A similar logbook could be developed and trialed on the East Coast in Phase II of this project.

An issue raised was that there are times in the fishing operations when it is just not possible to identify every shark that is caught, due to the need to process the shark quickly. In such cases the fishers could quickly identify to family or group level, for example, hammerheads or milksharks. Information is still recorded and as fishers become more familiar with the correct names used for different sharks, the accuracy of species recorded in the logbooks will increase.

Fishers questioned how additional information that may affect the susceptibility of species could be included in the Strategic Assessment of the Qld northern shark fishery. It was agreed that information such as moon phases, water temperatures etc is too much to be included in the logbooks. However, the observer program that has been running in the Qld shark fishery in the Gulf of Carpentaria provided an avenue for discussion between shark fishers and observers that allows such information to be recorded.

One other issue discussed was the use of a wide variety of common names for the same animal, which could create problems in analysing logbook catch composition data. In 1994 a survey identified that commercial fishers recognised 135 species of shark while the fishery was landing about 18 species (Lightowler 1994). A new shark and ray field Guide for fishers has been produced which should alleviate these problems if all shark fishers use the Guide and so record the same common name for each species of shark.

Northern Territory

There is a lack of species identification for all species of shark caught in NT waters. The species discarded in the shark fishery have not been identified and the composition of the shark bycatch in other fisheries is unknown. To assess the sustainability of the NT shark fishery all species caught must be determined.

In the NT shark fishery the commercial logbook system is more detailed than that of Qld and there is good information on the principal species taken. However there is a need to improve the data on the discarded species and the observer program can address this by collecting such information.

Another issue raised was the use of a wide variety of common names for the same animal, which could create problems in analysing logbook catch composition data. Similarly to Qld, it was recognised that use of the new shark and ray field Guide by all fishers and observers should alleviate these problems.

There is an issue in the NT with the current lack of validated logbook data on the NT shark catch in both the target and bycatch fisheries. Data is required on all species caught, that is both target and bycatch species, for ecological assessment of the fisheries. This FRDC project has a pilot observer program for the shark fishery that can verify the accuracy of the catch composition information recorded in the logbooks and collect data on the bycatch composition. The observer program may be expanded in the next, larger proposed phase of this project where the information on bycatch in other fisheries will also be addressed. The observer data will also enable the

government to make firm statements about the catch composition of sharks in NT waters.

Western Australia

There is some information on the catch composition of Western Australian northern shark fisheries. However, it has been acknowledged that more catch composition data is needed. A preliminary logbook program began in 1998 in WANCSF and since August 2000 logbooks have been completed by all vessels in the fishery. Operators have also voluntarily provided their vessels' daily catch records from 1999-2000, which has been stored electronically. There has been a research trip to identify the catch composition and a FRDC funded biology and stock assessment project for the primary species caught *Carcharhinus plumbeus* is underway (FRDC 2000/134). This FRDC project will incorporate analyses of the electronic logbook data. In the JANSF fishing effort began to decline dramatically in 1998 and the two operators currently targeting shark are fishing infrequently and taking very small amounts of shark. As a result, logbooks have not been introduced into the JANSF.

Department of Fisheries, WA research staff have so far accompanied 3 of the 4 full-time shark fishing vessels which operate in the WANCSF. During these observer trips, fishers were instructed in species identification using Last and Stevens (1994). Species identification and catch reporting by the skippers and crews of the shark fishing vessels is now considered to be very good. Crew from the 4th vessel have worked with researchers on other vessels and their identification and reporting is considered to be adequate.

To ensure ongoing improvement in species identification and catch reporting, a WA-specific field identification guide has been developed and is awaiting final approval for publication and should ready for distribution to fishers within the next 3 months.

Bycatch

Queensland

Recently in the Gulf of Carpentaria N9 shark fishery the catch of a number of dolphins and a turtle was reported. This resulted in a review of the fishery which provided a number of recommendations, one of which was that a Bycatch Action Plan be produced for the Qld Gulf Net Fishery.

There were concerns by Qld East Coast shark fishers that even though their shark fishing methods may be different from those in the Gulf and that there may not be the same level of interaction with bycatch, that their fishery will be perceived to have these same bycatch issues as in the Gulf. The east coast shark fishers need information on bycatch to verify anecdotal evidence such as: no dolphins are caught in the east coast shark gillnets. The fishers recognise that it is good to be proactive and install acoustic alarms on the nets to reduce dolphin bycatch, even if they feel there is no problem with bycatch, but they are concerned about the cost.

Another suggested solution to the bycatch issue was that industry and researchers work together to produce a code of conduct that would have procedures in place to deal with such issues as bycatch. For such a code of conduct the fishers had concerns about the use of the term bycatch when they consider they are fishing a multispecies net fishery. For example, what part of their catch do they record as target and what as bycatch in their logbooks in situations when their nets haul in shark along with other fish such as mackerel. The fishers were not intentionally targeting mackerel; however, mackerel are a target net fishery species, though in this situation they were technically taken as bycatch.

The unrecorded bycatch of shark taken in other fisheries is the other part of this issue. The amount of shark bycatch taken across the northern shark fisheries (Qld, NT and WA) is unknown. Environment Australia requires some accurate information on the bycatch of marine mammals in the shark fisheries. The best manner to obtain this information may be to document it through the Management Advisory Committee process and the observer program rather than rely on commercial logbook data. A lot of community groups perceive that gill nets kill marine mammals and industry and government recognise that the shark fishery needs to document what is actually caught so that statements based on fact can be made.

Northern Territory

For most fisheries in the NT the bycatch of shark taken in other fisheries is unknown and unrecorded. The information on bycatch of the shark fisheries is also limited. An observer program in the shark fishery could collect information on bycatch and address part of the issue. However there is still a need to determine the bycatch of shark in other fisheries.

The bycatch of shark in other fisheries may impact on the status of shark stocks caught in the shark fishery. There has been a restructuring of the NT dedicated shark fishery in the form of a three for one licence reduction program. Government and industry do not want to see the benefits of this eroded by the bycatch of shark in other NT fisheries. Currently in the majority of fisheries there are no limits on shark bycatch. To address this issue the government has asked all other NT fisheries to consider what is an appropriate shark bycatch limit for their fishery as a precursor to further discussions between the fisheries and the government on this matter.

With regard to the bycatch of the shark fishery, there is a perception among the general community of the NT that gill nets kill marine mammals. Similarly to Qld, industry and government recognise that the shark fishery needs to document what is actually caught so that statements can be made based on fact. In addition to the collection of this bycatch information through the observer program, the benefits of a proactive approach such as using acoustic alarms on the nets to reduce bycatch was recognised by the NT shark fishers. They were concerned about the cost and effectiveness of the acoustic devices, though they did acknowledge that the cost of the devices could be viewed as insurance and a precautionary measure to guard the fishery against misconceptions about the fishery among the general community.

Again similarly to Qld, a proactive solution suggested for the bycatch issue in the NT was that industry and government work together to produce a code of practice that

would have procedures in place to deal with such issues as bycatch. The Northern Territory Seafood Council is currently applying for funding to assemble a code of practice for the shark fishery and other NT fisheries.

Western Australia

There is a lack of information on the catch composition of sharks taken in other fisheries in WA. In some non-target fisheries such as the Pilbara fish trawl and mackerel fisheries, shark is considered an integral part of the catch. The Pilbara fish trawl fishery has been identified as the fishery with the largest bycatch of shark on the north coast of WA. The Department of Fisheries, WA have recently begun a bycatch observer program in this Pilbara fishery that should provide a better understanding of the shark bycatch composition. The FWA Shark Research Section now has very serious concerns about the potential impact of the take of dusky, *Carcharhinus obscurus*, and sandbar sharks, *C. plumbeus*, by non target-shark sectors, such as the Commonwealth tuna and billfish fisheries. Specifically, given the results of demographic analysis of the dusky shark in WA (FRDC project no. 96/130) and apparent recent declines in their catch rates, there is some suggestion that the breeding stock may have been compromised by a currently unquantified source of exploitation (McAuley, 2002). Additionally, preliminary research data from FRDC project 2000/134 indicates that the offshore distribution of sandbar sharks and, therefore, their susceptibility to pelagic longline gear may be greater than previously believed (R. McAuley, pers. comm.).

There is recognition of the need to minimise the bycatch of the target shark fishery, that is, scalefish, particularly tuna and tuna-like species, billfish, demersal scalefish and spanish mackerel. There have been considerable industry and management discussions about the gear used in the northern shark fisheries. In the WANCSF fishers are restricted to using droplines (single hook sharklines) and demersal longlines, with no gillnets permitted. In the adjacent JANSF, droplines, longlines and gillnets are permitted. There have been deliberations on the phasing out of gillnets. A fisher commented that gillnetting within the JANSF rarely resulted in the capture of turtles or marine mammals and there are concerns that a shift to increased use of demersal longlines would lead to an increase in the take of demersal scalefish and spanish mackerel. Others were concerned about the possible impact on spanish mackerel stocks if gillnetting is permitted within 12nm.

Shark Finning

Queensland

Queensland will introduce a ban on shark finning: that is, the practice of removing only the fins and discarding the carcass at sea. In 1992, the Qld shark fishing industry recognised the need for some kind of documentation to establish the weight of fins to flesh products. Currently the conversion ratio referred to in Qld is 5 %, that is, wet fin weight is 5 % of whole weight.

Fishers raised concerns about the manner in which the shark finning ban may be worded. They stressed the need to be able to remove the fins at sea as they process

shark on board. There was also a great deal of concern over the way in which conversion ratios from fin weight to shark flesh product weight will be calculated. This conversion ratio depends on a number of factors:

- The species and size of shark;
- The manner in which the shark fin is cut from the body (how much excess meat is left on the fin affects its weight); and
- The manner in which the shark is processed (fin weight conversions to fillet, trunk or whole weight may vary).

There was also concern that the introduction of a shark finning ban may create difficulties in the marketing of large shark carcasses that have been brought ashore to enable the sale of the fins. There is an overseas market for large shark, though Australians must compete with other countries that can supply a lot of large shark and the price received is low. This market may not be large enough to take all Australian large shark landed when the finning ban is in place. This may create problems in selling or disposing of large shark carcasses.

Northern Territory

Managers are concerned over information that one or two shark fishers were targeting large sharks just for their fins and discarding the carcasses. The NT government opposes this practice. Industry and managers were also concerned that people outside the shark fishery were targeting large shark for their fins and that the shark fishery would bear the consequences from the general community.

Fishers were also concerned about the finning of sharks by recreational fishers and in other fisheries as there is anecdotal evidence that it does occur. Currently, recreational fishers can be in possession of up to thirty sets of fins. However it is illegal for these to be sold. Fisheries compliance officers have not reported any recreational fishers with large numbers of fins in their possession. Only the dedicated shark fishery records fins so there is no information on the extent of finning in other fisheries.

There were discussions over the shark finning ban to be introduced in Qld and the same concerns expressed over the manner in which conversion ratios from fin weight to body weight will be calculated.

Western Australia

There are concerns regarding the northern fisheries targeting shark specifically for their fins, finning in other WA fisheries and finning by foreign boats operating in WA waters. Shark finning regulations were introduced in WA in October 2000 that apply to all fishers who take shark (target and non-target). It requires that **all** the body parts of the shark (except the head and guts) be retained till the shark is landed.

Since the shark finning regulations were enacted, there has been some discussion regarding an allowance for the possession of damaged sharks, which may not have complete sets of fins. Additionally there are concerns over the dumping of unsaleable

carcasses once they have been landed. The enforceability of the shark finning ban has also been questioned by fishers.

Mercury

In recent sampling conducted by the Australian Quarantine Inspection Service for the National Residue Survey (2001), analyses of East Coast shark product indicated common occurrences of shark mercury content in excess of four times the accepted mercury level. To deal with mercury concerns fishers need to take care in sending shark to market that may have unacceptable levels of mercury. The most appropriate way for industry to approach this problem may be to conduct its own risk assessment on the implications to the fishery of not addressing the mercury issue.

There was no issue of mercury in shark samples raised at the Northern Territory workshop or in WA discussions.
The following two issues were raised only at the Northern Territory workshop.

Recreational fishers and community perceptions of shark fishing

Northern Territory shark fishers are concerned with the amount of shark taken by recreational fishers. Based on the available information from Fishcount Surveys, the overall take of shark by recreational fishers is relatively low. However, this indicated only shark retained. A national survey of recreational and indigenous fishers is underway that will improve the information on the recreational shark take in NT waters.

Concerns were expressed by the shark fishers that recreational fishers and some small operators are targeting large shark for their fins, which could affect large shark stocks. The shark fishers commented that over the last 2-3 years recreational fishers have realised the value of fin, as buyers have been actively seeking shark fin and offering cash. They are concerned by the fact that shark are included in the general possession limit of 30 fish and that with so many recreational fishers active in NT that this could put pressure on large shark stocks.

Managers have raised concerns with the recreational sector over some recreational fishers' practice of clubbing sharks to death before they throw them back. The recreational sector agree it is a mind set that needs to be changed and recreational fishers need to be encouraged to release the sharks alive.

Recreational fishers have been travelling more widely in the NT which has increased the level of contact between recreational and shark fishers. To address this and avoid potential conflicts, the recreational sector and the general community need to be informed about shark fishing operations and issues facing the industry. Industry and government need to work together to determine how this can be done. One solution is for industry and government to co-operatively develop a strategic plan for the shark fishery. The government recognises that a formal process is required for dealing with resource access issues between recreational fishers and shark fishers. A strategic plan

could address concerns over resource allocation, develop codes of practice for other issues, provide industry with direction, and allow the general community to be informed of shark fishing issues and that they are being addressed.

A general concern raised by both fishers and management is the need to educate the public about shark fishing. The correct information needs to be taught in schools, provided to conservation groups, the media and other members of the public.

Uncertainty over status of Northern Territory shark stocks

Shark stock assessments of the NT shark fishery have concluded that there is uncertainty over the status of NT shark stocks. The difficulty in northern waters is that there are a lot of different shark species caught across the target and bycatch fisheries. Logbook data does not provide sufficient information to allow a thorough assessment of the stocks. An alternative approach to assess sustainability is the development of a sustainability/ risk analysis, which is already underway. This provides a method to determine those species of shark that are vulnerable to fishing pressure. Management attention can then be directed towards the species and fisheries of greatest concern. It also addresses Environment Australia's requirements for assessment of ecological sustainability of the shark fishery.

Fishers were concerned about the lack of knowledge of offshore shark stocks that they do not fish, as it is difficult to determine the status of stocks and sustainability of the fishery if you are only fishing part of it. There was a lot of information gathered on sharks in the offshore waters when the Taiwanese were operating 15 years ago, but since then there have been virtually no surveys. Fishers suggested a research program with appropriate gear such as bottom set nets be undertaken to survey these stocks. Managers agreed that information from a survey of offshore stocks would be valuable; however, as bottom set nets have been outlawed in NT waters to avoid the capture of turtles, the risks of conducting a survey at this time with gear that may interact with turtles may outweigh the benefits.

Two further issues were discussed in WA, as follows.

Uncertainty over JANSF regulations.

The legislative and management issues in the JANSF pertain to uncertainty over the status of State regulations since they were superseded by the Offshore Constitutional Settlement (OCS) in 1995. Section 25(6) of the WA Fish Resources Management Act (FRMA) states that if a fishery becomes a Joint Authority Fishery, any subsidiary legislation (FRM Regulations, instruments and notices) applying in that area (prior to the declaration) would cease to apply (subject to section 28). At the time that the area between Koolan Island and the NT border was declared a JA fishery (3 Feb 1995), Notices 602, 476 apparently cease to apply to the JANSF area. FWA is currently considering the need for new management arrangements for this fishery.

Fisheries effects on straddling stocks

Management and research scientists have expressed concern over the effects of the northern fisheries on shared straddling stocks, in particular *Carcharhinus plumbeus*

and *C. obscurus*. The concentration of fishing effort targeted at *C. plumbeus* in the Pilbara has been raised as an issue.

Outcomes

The main outcome of the two workshops was that they helped improve the fishers shark identification skills. The Qld and NT workshops and the industry meetings in WA also provided forums for industry, researchers and government to communicate and discuss issues of the northern shark fisheries. The need for a shark fishery observer program was recognised at both workshops and in WA as was the need to address bycatch issues. There was also recognition by fishers at both workshops of the need to be proactive in dealing with such issues as bycatch. Outcomes on other issues varied slightly between Qld, NT and WA. The outcomes are presented below.

The major outcomes were:

- The hands-on session improved the fishers shark identification skills and the new sharks and rays field Guide for fishers was seen as a solution to the issue of a variety of common names being used for the same animal. The WA-specific field identification guide will ensure accurate recording of the shark catch composition;

- Co-operation of fishers with the Qld East Coast observer program was established with fishers volunteering to have observers on board in the first part of 2002. In the NT where the observer program has commenced, fishers gained an increased awareness of the benefits of the NT shark fishery observer program and in WA the fishers have co-operated extremely well with the observer program as observers have been aboard 3 of the 4 dedicated shark fishing vessels in the WANCSF;

- Recognition by fishers of the need to be proactive in dealing with such issues as bycatch; and

- Communication between government, researchers and industry was reinforced in Qld. In the NT there were constructive discussions between industry and government on shark fishing issues and there was also recognition of a need for industry and government to improve communication with the NT general community. In WA liaison among government, researchers and fishers is well established.

In Queensland other outcomes were:

- A Working Group of fishers was formed to maintain a communication link between government, researchers and industry;
- A number of fishers volunteered to take part in Phase II of this project in the development and trial of a logbook system that will improve catch composition data and;
- Communication and contact between fishers themselves was set up;
- Details of scientific information discussed at the workshop were requested by the fishers and subsequently mailed to all attendants.

? Future developments and outcomes of the FRDC Research Program will be forwarded to all attendants at the appropriate times.

In the Northern Territory the workshop also provided the opportunity to: calculate some accurate fin to body weight conversion ratios; receive industry advice on the methods used for fin cuts and drying of fins; and provide hands-on training to the fishery observer on the staging of sexual maturity in male and female sharks.

In WA other specific outcomes were:

? Whilst existing management arrangements will remain in place pending the results of stock assessment of the key target species (sandbar shark, *Carcharhinus plumbeus*), FWA will shortly inform stakeholders that it is the Department's intention to contain effort in the State's northern shark fisheries.

? Existing gear definitions should be amended to recognise some currently used 'dropline' gear types, as longlines.

? The terms of reference of the WA Demersal Gillnet and Demersal Longline Management Advisory Committee have been changed to include a member from the northern shark fisheries. This will allow for the ongoing transfer of management and research information to and from the fisheries.

? The need to minimise the take of spanish mackerel. Support was given for a continued closure to the use of pelagic gillnets inside 12 nm.

Communication and extension strategies

Queensland, NT and WA

Issues, needs and concerns of fishers and government were discussed openly at both workshops and in WA there is well established communication between fishers and government. Fishers realise they must take part in the management of the shark fisheries, that is, communicate with government and co-operate to develop appropriate strategies for addressing issues such as:

? The increasing fishing pressure on shark stocks;
? Bycatch;
? Shark finning; and
? In the NT, potential conflicts with recreational fishers and misconceptions that the general community may have about shark fishing.

Industry must be proactive in management, this means the involvement and participation of industry with government at all stages of planning and development for research and management.

Industry and management recognise the need to collaborate and develop extension strategies to inform and educate other stakeholders and the general community about shark fishing and the steps that are currently being taken to address issues such as

resource allocation and environmental concerns. This would help to alleviate potential conflicts and to address general misconceptions about the shark fisheries.

Observer program

Queensland, NT and WA

With respect to improving species identification data, fishers in Qld, NT and WA willingly agreed to co-operate with the shark fisheries observer program. Co-operation was most difficult to establish in Qld where the shark fishery is comparatively new and the fishers have not previously been involved with government and researchers to the same extent as in WA and NT. The East Coast shark fishery is located in the Great Barrier Reef Marine Park which has raised issues between fishers, government and conservation groups. Consequently, some fishers are reticent to become involved with any government departments. A number of Qld fishers volunteered to have observers on board in the first part of 2002, while in the NT and WA the observer program has already commenced. The fishers recognise the long term benefits of this to their shark fisheries as the observer program can be used to verify commercial catch composition information, collect information on the species of shark discarded and also provide fishery independent data required for assessment of ecological sustainability.

The hands-on sessions with the shark specimens improved the fishers shark identification skills. Similar hands-on sessions have been conducted at sea by observers in WA. The new sharks and rays field Guide for fishers and the WA-specific field guide were well accepted as solutions to the issue of a variety of common names being used for the same animal. Other possible outcomes discussed at the Qld workshop were the need to improve the current commercial logbook and the possibility of using processor return validation to check erroneous logbook entries.

At the NT workshop, Dr Stevens explained the staging of sexual maturity using the shark specimens. There are five stages used to describe female shark sexual maturity, that is (see Appendix 4, Figure 1 for parts referred to in the staging):

Stage 1. Immature. Oviducts and uteri thread-like. Nidamental gland not visible, or present only as slight swelling. Uteri not distinguishable from oviducts. Ovary distinguishable from epigonal organ, or very small with minute ova.

Stage 2. Mature resting. Mature resting. Nidamental gland visible as heart-shaped structure. Uteri clearly distinguishable from oviducts. Ovary well formed, ova of about 5 mm in diameter with clear yolk.

Stage 3. Pre-ovulatory. Uteri expanded, thick walled and vascular. Ovary with large, yellow yolked eggs ready for ovulation.

Stage 4. Pregnant. Uteri expanded and containing eggs or embryos.

Stage 5. Spent. Uteri very expanded, thin walled and flaccid. May contain remnants off egg membrane or placental scars. Ovary usually with numerous pale or greeny coloured corpora lutea and mostly with small ova.

Male sexual maturity is assessed by measurement of the claspers, recording whether they are uncalcified or calcified and plotting relative clasper length against body length. This plot typically produces an S-shaped curve (Stevens and McLoughlin 1991).

Bycatch

Queensland and NT

The complexity of the bycatch issue was highlighted at both workshops. Fishers realised that they need to address this issue and be proactive in developing procedures to deal with bycatch. Most fishers were willing to consider trialing acoustic alarms on their nets as the need becomes more pressing and affordable alarms become available on the market. The co-operation with the observer program will also provide independent data on bycatch interactions. Industry and government could work together to develop codes of conduct to address bycatch issues.

Western Australia

The bycatch implications of different gear types used in the target shark fisheries were discussed at the industry meeting and in subsequent forums. Industry broadly supported the concept of gear specific licencing arrangements based on the method to which each operator historically had access, at least until such time more is known about the bycatch issues of each gear type. In order to safeguard spanish mackerel, support was expressed for a continued closure to the use of pelagic gillnets inside 12nm and the introduction of a possession limit for spanish mackerel.

Shark finning

Queensland, NT and WA

Acceptance of the observer program by fishers helps address the issue of calculation of conversion ratios for fin weight to body weight of the shark. Observers and fishers can now co-operate to collect this data and ensure that it is used to calculate accurate fin conversion ratios.

At the WA 1998 industry meeting, it was suggested that an industry code of practice be developed and implemented based on the fin/trunk ratio of 4:1 (that is, 4 fins to 1 trunk) until more information is available. At-sea shark finning legislation was enacted in WA in October 2000.

In NT, the workshop also provided an opportunity to calculate some accurate fin to body weight conversion ratios. A seafood processor present demonstrated the cut used by commercial operators to remove the fins from the shark specimens brought in for the hands-on identification session. He also gave advice on the commercial procedure used for drying the fins in a mechanical dryer.

Following are the other outcomes of the Qld workshop.

Working Group

A Working Group of eight volunteer fishers was formed to provide this communication link between industry and government that will allow continued co-operation and involvement of industry in management.

Development of an improved Logbook

To increase fishers participation in correct species identification, some fishers also volunteered to take part in developing and trialing a logbook system that would have space for recording more accurate species identification and other relevant information. This will be undertaken in Phase II of this FRDC project.

Fishers Communication

This was the first time that shark fishers on the east coast have met as a group and the fishers took the positive step of setting up a network of communication among themselves. The fishers requested that all their contact details be forwarded to each other to increase their ability to contact one another and begin to form a shark fishers group.

All of these issues and outcomes that arose out of the two workshops and from WA will be taken into account in the development of the three year study of the sustainability of northern sharks and rays, Phase II of this project. They will also be included in the Strategic Assessments of the Qld, NT and WA shark fisheries which is to be submitted to Environment Australia for assessment of the sustainability of the Qld, NT and WA shark fisheries.

PART B: PILOT SHARK FISHERY OBSERVER PROGRAMS

METHODS

Pilot shark observer programs were conducted in Qld, NT and WA. The pilot observer work was used to establish co-operation with fishers and to develop appropriate and realistic data collection methodologies. Some of the data collected varied among the three States/Territory due to varying time constraints among observer trips.

Workplace health and safety issues were addressed by the observers in Qld and NT. On each observer trip in Qld and NT the observers had their own lifejacket, EPRB (Emergency Positioning Radio Beacon), GPS (Global Positioning System) and mobile satellite phone (unless there were reliable communications already present onboard).

At sea data collection

The data collection protocol was developed with the aim of collecting as much data as possible without undue interference in the commercial shark fishing operation. The primary aim was to collect the shark species catch composition. All sharks were identified. The bycatch was identified and counted, though when large numbers of sharks and/or bycatch were taken, the counts may not be 100% accurate as a few individuals may not have been counted due to time constraints in the recording of the data as shark identification and measurements were the main priority. Measurements of the sharks were taken as time permitted, that is, sex, lengths (total and/or fork length), weights (whole and/or processed shark-either trunks or fillets). When there was time other data were collected on the WA and NT observer trips such as sexual maturity, number of pups and stomach contents, vertebrae and genetic samples taken.

As each fish came aboard it was passed to the observer who identified, measured and weighed it, then it was handed to the processor who trunked (or filleted) the fish, then it was returned to the observer to take the final processed weight. Measurements were taken to the nearest centimetre using a 150 centimetre flat measuring board. Fish over 150 cm were measured on deck with a 3 metre flexible tape. Weights were taken to the nearest 250 grams using a 60 kilogram spring balance. Trunk weights were from trunks with the belly flap removed. When stomachs were collected, stomachs from individuals of the same species were collected in bags and labelled accordingly (many individuals have empty stomachs as they discard their stomach contents during capture). On the NT observer trips, water temperature, salinity and turbidity were measured using a Horiba U10 multiprobe water analyser before each shot. On one NT observer vessel water temperature was taken through the hull transducer before each shot.

Queensland

In Qld four observer trips were conducted in coastal waters over the period February-March 2002. The first three trips were of 2-11 days duration on vessels ranging in length from 6 to 18 metres. Two trips were out of Cardwell in depths from 4-33 m and the third trip was from Margaret Bay to Cape York in depths of 20-30m (Appendix 5, Figure 1). All vessels used net reels and fished with bottom set monofilament, 6.5 inch mesh nets. On the Cardwell trips 600m of net was deployed and on the other trip 1200m was set. On all vessels the net was set during both day and night and set duration was usually 2-3 hours. Bait was not used by these east coast shark fishers.

Shark catch composition data on a 4th vessel were collected in March 2002 as part of Coastal Fisheries Resource Monitoring Project. This vessel fished off Cairns (Appendix 5, Figure 1) in 25 m with 1200 m of bottom set monofilament, 6.5 inch mesh nets. The sharks were identified and counted, but no measurements were recorded. On this trip there was very little bycatch and it was not identified or counted.

Northern Territory

In the Northern Territory there were three observer trips over the period November 2001-April 2002. Each trip was of 6-10 days duration on vessels ranging in length from 14.6 to 24 metres. The three vessels fished in different areas of the NT with the first trip in Anson and Fog Bay in depths of 9-16 m, the second trip near Bathurst Island in 8-35 m and the third trip further east near Elcho Island in 16-28m (Appendix 5, Figure 1). The vessels fished in coastal waters. All vessels used net reels to set near surface monofilament mesh nets of 1500-1600 m length and of 6.5 inch mesh. Two vessels had drops of 50 mesh, a third used 100 mesh drop. On all vessels the net was set and hauled twice a night, with the first set around sunset and the second set a few hours before dawn. The headrope of the net is buoyed by floats. Plastic bait pouches were sometimes clipped to the mesh every 150 m or so. The bait was usually mackerel heads or tuna frames from the previous shot.

In addition, approximately 160 individual sharks from 12 species were obtained through collaboration with the Northern Territory National Parks and Wildlife Habitat mapping program. These sharks were used to measure fin to whole weight ratios and trunk and fillet to whole weight ratios. The sharks were caught in Bynoe Harbour and Point Jenny, Fog Bay (Appendix 5, Figure 1). Trammel nets were used, each 30 m long and with a 3m drop, one had 7 inch mesh, 2 inch inner panel the other 4 inch mesh and 1 inch inner panel. Length, whole weight and total wet and dry fin weights for each shark were recorded. Sexual maturity was also recorded.

Western Australia

In WA there were eight observer trips over the period August 2000-March 2002 (WA data collected prior to the current project were also included in this report). Trip length varied considerably from 2-19 days and were dispersed over a large area of coastal waters in north-western Australia across a range of depths (Appendix 5, Figure 1). Trips 1, 6, 7 and 8 fished in similar locations south of Port Hedland in depths of 9-157 m, trips 2 and 3 were further north near Port Hedland and fished in 20-40 m, trip 5 was in the vicinity of Broome in 15-90 m and trip 4 south of Carnarvon in 35-50 m (Appendix 5, Figure1). The trips were on 3 of the 4 vessels operating full time in WANCSF. All vessels were 20-21 m in length and fished with demersal longlines with numbers of hooks deployed per set ranging from 170-620. Soak times varied from 5 to 22 hours but were generally around 12-17 hours. The bait was usually mullet.

Fin to body weight ratios

Weighing the shark bodies became difficult in rough seas as the spring balance became inaccurate. Electronic scales for weighing the fins were inaccurate even in mild seas. Consequently to collect accurate fin weights on future observer trips a more appropriate protocol would be: individually bag, label and freeze (to prevent any weight loss) a range of fins from all the species at sea; bring them ashore; weigh the wet fins accurately in the laboratory using electronic scales; oven dry; reweigh the dry fins; and return the fins to the fisher. If the trips are long and the fins cannot be stored frozen on board the vessel there may be a reduction in fin weight due to moisture loss. To avoid this potential error another method could be to freeze whole sharks (a subsample of the sharks caught) and bring them ashore to the lab where they can be

thawed and fin to body weight ratios calculated. The trunks and fins can then be returned to the fisher.

Shark fin ratios were calculated in the laboratory. In Qld specimens of the two major species caught, *C. tilstoni* and *C. sorrah* were brought ashore frozen. The 10 specimens of *C. tilstoni* and 8 of *C. sorrah* were processed in the same way as done aboard commercial vessels. Measurements were taken of: total and fork length; whole weight, trunk weight (with belly flap off) and fillet weight; and wet and dry weights of the dorsal, individual pectoral and caudal fins from each shark. All fin cuts were the half-moon cut, as done commercially.

In the NT, the dozen sharks and ray specimens brought in by a commercial shark fisher for the hands-on identification session and the 160 sharks from the NT National Parks and Wildlife Service were weighed and the fins removed and weighed. A fin processor was present at the hands-on session which ensured that the fins were cut-off the shark body in same way as done commercially.

All fins were dried in Qld and NT according to the same process used by a commercial fin processor, that is, oven dried with maximum air flow at 44°C overnight.

Mean shark fin conversion ratios were calculated for each species that had data for more than five individuals. Regression analysis was used to examine the relationship between body size and fin weight for three species where there was data for more than 20 individuals.

Other body ratios

Conversion ratios were calculated for trunk weight to whole weight and for trunk weight to fillet weight for a few species that had data for more than 5 individuals. Trunk weight was defined as headed and gutted with fins removed and belly flap removed. Total length to fork length was expressed where both measurements had been taken.

Length and other data

Length data was examined for apparent size differences among location and gear type. Differences in size of some of the principal species of shark among Queensland, Northern Territory and Western Australia were examined by calculation of mean fork lengths for species with fork length data for more than five individuals across all observer trips in each of the three States/Territory.

Differences in size within each of these States/Territory was examined by calculation of mean fork lengths for species with more than five individuals per trip and location. In Queensland there was only one trip on which fork length data was taken, in the Northern Territory there were two trips in two diferent locations where fork length was measured and in Western Australia where fork length was measured on all trips, the trips were grouped by location.

No statistical analyses were been done as the pilot data is preliminary and the sample sizes are insufficient to run statistical analyses to determine the relationships between size of sharks and location and gear type.

The male to female sex ration was calculated for species with more than five individuals sexed per trip.

RESULTS

Catch composition

During the observer program in Qld, NT and WA, 6776 individuals of 68 species and 9 different families were caught. Nearly half of the species caught (47 %) were sharks. Of the 34 species of sharks identified, 13 were caught across all three jurisdictions, that is, *C. tilstoni*, *C. sorrah*, *C. brevipinna*, *C. dussumieri*, *C. fitzroyensis*, *C. macloti*, *C. melanopterus*, *R. acutus*, *R. taylori*, *G. cuvier*, *S. lewini*, *S. mokarran* and *R. djiddensis*. Similar numbers of shark species were caught in WA and NT (26 and 25 respectively) and 20 shark species were caught in Qld (Appendix 5, Table 1). The numbers of individuals recorded by the observer program were highest in NT (3622), followed by WA (2619) and Qld (535) (Tables 1-3). The comparatively low numbers of shark caught in Queensland may be have been due to the relatively new nature of the Qld east coast shark fishery in comparison to the fisheries in NT and WA and/or the timing of the Qld observer trips. They were in Feb-March which may have been unfavourable months for shark catches.

For each of the States/Territory, the observed shark catch was dominated by three species of sharks, though the dominance varied. *Carcharhinus tilstoni* and *C. sorrah* were among the three most abundant species in all States/Territory. In Qld together they accounted for 40% of the shark catch, in NT 62 % and in WA 35 % of the shark catch. *Carcharhinus tilstoni* was the most abundant shark species in Qld and NT, while *C. sorrah* was more abundant than *C. tilstoni* in WA. The other dominant species were hammerheads in Qld and NT (*S. lewini* and *E. blochii* respectively) and *C. plumbeus* in WA (Tables 1-3).

Bycatch accounted for around half of the total catch in NT at 53.7 %, around 15% of the catch in Qld and was minimal in WA at 2.8% of the total catch (where demersal longlines, rather than gillnets were used). *Scomberomorus semifasciatus* was the most abundant bycatch species in NT (42 % of total catch) and in Qld (4.7 % of total catch) (Tables 1-3).

Table 1: Queensland catch composition (%) for all species caught across all 4 observer trips. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch.

Shark species	% $comp^n$ total	% $comp^n$ sharks	Other species	% $comp^n$ total
C. tilstoni	27.3	32.0	*S. semifasciatus*	4.7
S. lewini	15.3	18.0	*Arius sp.*	3.9
C. sorrah	6.5	7.7	*S. commersonianus*	1.5
C. dussumieri	6.4	7.5	*E. tetradactylum*	1.5

R. acutus	5.8	6.8	*D. labiosum*	0.9
C. amblyrhynchos	5.6	6.6	*C. gymnostethus*	0.6
C. amboinensis	4.1	4.8	*Caranx sp. (juv)*	0.4
C. brevipinna	2.6	3.1	*C. talamparoides*	0.2
C. fitzroyensis	2.4	2.9	*G. speciosus*	0.2
S. mokarran	2.4	2.9	*Echeneidae sp.*	0.2
C. macloti	1.9	2.2	*Hydrophiidae sp.*	0.2
C. melanopterus	1.1	1.3	*L. surinamensis*	0.2
R. taylori	1.1	1.3	*R. canadus*	0.2
R. neglecta	0.9	1.1	*R. brachysoma*	0.2
T. obesus	0.4	0.4		
A. narinari	0.4	0.4		
R. djiddensis	0.4	0.4		
H. elongatus	0.2	0.2		
G. cuvier	0.2	0.2		
C. falciformis	0.2	0.2		
Total no. sharks	456		Total no. other individuals	79
Total no. all individuals	535			
% catch composition	85.2			14.8

Table 2: Northern Territory catch composition (%) for all species caught across all 3 observer trips. Catch composition is expressed as a percent of total catch and also for the shark s as % of the total shark catch.

Shark species	**% comp^{n} total**	**% comp^{n} sharks**	**Other species**	**% comp^{n} total**
C. tilstoni	17.1	37.4	*S. semifasciatus*	42.0
C. sorrah	11.5	25.2	*S. commerson*	3.3
E. blochii	4.8	10.5	*A. niger*	2.1
S. lewini	2.4	5.2	*E. tetradactylum*	1.6
R. acutus	2.2	4.9	*P. pelagicus*	1.5
C. amboinensis	1.7	3.6	*L. johni*	0.6
C. fitzroyensis	1.5	3.4	*S. munroi*	0.5
S. mokarran	1.0	2.3	*S. commersonianus*	0.4
A. cuspidata	0.9	2.0	*S. leptulepis*	0.4
C. macloti	0.8	1.7	*R. canadus*	0.2
C. brevipinna	0.5	1.1	*Carangidae sp.*	0.2
R. taylori	0.4	0.9	*T. tonggol*	0.1
C. dussumeri	0.3	0.7	*C. dorab*	0.1
H. elongatus	0.1	0.3	*I. platypterus*	0.1
R. djiddensis	0.1	0.2	*E. affinis*	0.1
C. amblyrhynchoides	0.1	0.1	*C. para*	0.1
C. amblyrhynchos	<0.1	0.1	*P. daicanthus*	0.1
A. narinari	<0.1	0.1	*E. imbricata*	0.1
G. cuvier	<0.1	0.1	F. Carangidae	0.1
C. melanopterus	<0.1	0.1	*L. calcarifer*	<0.1
N. acutidens	<0.1	0.1	*M. cyprinoides*	<0.1
P. sephen	<0.1	0.1	*S. putamiae*	<0.1
M. eregoodootenke	<0.1	0.1		
S. fasciatum	<0.1	0.1		
Total no. shark	1654		Total no. other individuals	1944
Tot. no. all individuals	3622			
% Catch composition	46.3			53.7

Table 3: Western Australia catch composition (%) for all species caught across all 8 observer trips. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch.

Sharks species	% comp^{n} total	% comp^{n} sharks	Other species	% comp^{n} total
C. plumbeus	27.9	29.4	*R. canadus*	0.5
C. sorrah	19.7	20.7	F. Istiophoridae	0.4
C. tilstoni/limbatus	13.1	13.7	F. Sphyraenidae	0.3
R. acutus	8.6	9.1	*Arius sp.*	0.3
G. cuvier	6.6	6.9	F. Scombridae	0.3
N. acutidens	3.6	3.8	*L. scleratus*	0.2
C. amboinensis	2.9	3.0	Other scalefish	0.2
C. amblyrhynchos	2.1	2.2	F. Serranidae	0.2
S. mokarran	2.1	2.2	F. Carangidae	0.1
S. lewini	1.4	1.5	*E. suillus*	0.1
L. macrorhinus	1.1	1.1	*P. multidens*	0.1
C. albimarginata	1.1	1.1	*L. sebae*	0.1
C. obscurus	0.7	0.8	*Opistognathus sp.*	<0.1
F. Rhinobatidae/Rhynchobatidae	0.6	0.7	*P. auratus*	<0.1
N. ferrugineus	0.6	0.7	*Scomberoides sp.*	<0.1
R. taylori	0.6	0.6	*E. multinotatus*	<0.1
E. blochii	0.5	0.5		
C. macloti	0.4	0.5		
S. fasciatum	0.3	0.3		
R. djiddensis	0.2	0.2		
C. dussumeiri	0.2	0.2		
C. brevipinna	0.2	0.2		
F. Dasyatidae	0.2	0.2		
T. obesus	0.1	0.2		
C. fitzroyensis	0.1	0.1		
C. altimus	<0.1	<0.1		
S. zygaena	<0.1	<0.1		
C. melanopterus	<0.1	<0.1		
Total no. sharks	2568		Total no. others	76
Total no. all individuals	2619			
% Catch composition	95.2			2.8

The shark catch composition for the individual observer trips in each State/Territory are presented in the Appendix 5, Tables 2-4.

Queensland catch composition

A total of 20 species of sharks were caught over four trips with the catch composition varying considerably among the trips. Only 3 species were caught on all trips, that is, *C. sorrah*, *C. tilstoni* and *S. mokarran* (Appendix 5, Tables 2a-d). Sharks represented between 67 and 91% of the total catch. The numbers of species and individuals were low for the first trip where only 34 individuals from 6 species of shark were caught, with 118, 103 and 203 individuals caught on the other three trips. The first trip was short, only 2-3 nights, with short 2 hour shots as the vessel kept the sharks brined in ice, rather than freezing the product and storing it in the hold. This limited the duration of sets and the trip and may account for the low numbers of sharks caught.

The catch composition was dominated by *C. sorrah, C. amboinensis* and *C. fitzroyensis* on the first trip, *C. tilstoni, S. lewini* and *C. amboinensis* on the 2nd trip, *C. amblyrhynchos, C. tilstoni* and *C. sorrah* on the 3rd trip and *C. tilstoni, S. lewini* and *R. acutus* on the 4th trip (Appendix 5, Tables 2a-d). The variation in catch composition may be related to the differences in areas and depths fished. The first two trips around Cardwell fished in shallower waters than the other two trips which were also both further north.

Fourteen bycatch species were caught over the three trips. The bycatch was dominated by catfish and grey mackerel on the first two trips. On the 3rd trip only 10 individual bycatch fish were caught, with sweetlip accounting for half of these fish.

Northern Territory catch composition

In the NT, 25 species of sharks were caught over three trips with 10 of these species caught on all trips, that is, *C. tilstoni, C. sorrah, E. blochii, S. lewini, A. cuspidata, R. acutus, C. amboinensis, C. fitzroyensis, C. macloti, C. dussumieri* (Appendix 5, Tables 3a-c).

The total catch composition varied among the three trips (Appendix 5, Tables 3a-c). For the first two trips, sharks comprised 88.7 % and 66.8 % of the total catch respectively, while for the third trip they were only 28.6 % of the total catch due to very high numbers of grey mackerel captured.

On the first two trips 14 species of sharks were caught and 662 and 298 individuals respectively, while on the third trip there were 18 species and 694 individuals. On the second trip the weather was unfavourable which restricted the number of shots set and accounted for the lesser numbers of shark caught. *Carcharhinus tilstoni* and *C. sorrah* were among the three most abundant species caught on all trips. *Carcharhinus tilstoni* dominated the shark catch on two of the trips, at (37% and 46%) and *E. blochii* was the most abundant species on the second trip at 28% of the shark catch.

Twenty-five bycatch species were caught over the three trips. Bycatch was dominated by mackerel, blue threadfin salmon and pomfret.

Western Australia catch composition

In WA, 26 shark species and 2 shark families were recorded as caught over the eight observer trips (Appendix 5, Tables 4a-h). The most abundant sharks on all trips were *C. plumbeus, C. sorrah, G. cuvier, R. acutus, C. obscurus* and *C. tilstoni/limbatus*, although the dominance of each of these varied among trips. The first four species were taken on every trip, with the exception of Trip 7 where *C. plumbeus* was not caught, however this was also the trip with the lowest effort (Appendix 5, Table 4g). *Carcharhinus plumbeus* was the most abundant shark on six of the trips, accounting for between 32-64 % of the shark catch. The variations in shark catch composition may be a result of variations in depths and locations fished, though the data set is too small to detect any relationship between differences in catch composition and these factors.

The scalefish bycatch was extremely low, with no scalefish caught on 5 of the trips and representing between 2 and 6 % of the total catch on the other trips. This low bycatch is a reflection of the selectivity of demersal longlines.

Fin to body weight ratios

Wet and dry fin weights to whole weight ratios varied among shark species and also within species (Tables 4 and 5). The mean (±se) ratios for all individuals pooled across all of the twelve species from Tables 4 and 5 were (n-number of individuals):

- wet fin/whole weight 1.52% ± 0.03, n = 186, range of values 0.94-3.09 %
- dry fin/whole weight 0.67% ± 0.01, n = 178, range of values 0.39-1.39 %
- dry fin/wet fin weight 44.0% ± 0.45, n = 178, range of values 29.8-67.9 %

For each of these conversion ratios there is range of values for the ratio, particularly for wet fin to whole weight. There were also variations in the amount of moisture in the fin (expressed as dry fin/wet fin weight). The hammerheads *E. blochii* and *S. mokarran* had higher fin to body weight ratios than the whaler species (Table 4).

The wet and dry fin to whole weight ratios measured in Qld for *C. tilstoni* and *C. sorrah* were both higher than those from NT (Tables 4 and 5). There were smaller sharks of both species included in the NT data analysis which may account for the lesser fin to body weight ratios. There were also differences in the moisture content of the fins between those dried in Qld and NT. However the variations in moisture do not account for the differences in the fin to whole weight ratios as the moisture contents were not consistently higher as were the fin to whole weight ratios. *Carcharhinus tilstoni* had a higher dry fin to wet fin ratio in Qld than NT (more moisture, heavier fin), but in *C. sorrah* it was slightly lower in Qld than NT (less moisture, lighter fin).

Table 4: Northern Territory wet and dry fin weights to whole weights and dry fin/wet fin weight (mean ±se) expressed as a percent for 12 species of shark. The whole weight range for the individuals of each species is indicated. n - number of individuals.

Species	n	wet fin/ whole weight (%)	Dry fin/ whole weight (%)	Dry fin/wet fin (%)	Weight range (kg)
C. tilstoni	40	1.50 ±0.03	0.63 ±0.02	42.4 ±1.0	1.0-9.3
C. sorrah	20	1.23 ±0.04	0.55 ±0.02	44.2 ±1.6	2.0-7.2
C amboinensis	6	1.68 ±0.10	0.73 ±0.05	43.4 ±1.0	2.1-11.2
C. fitzroyensis	14	1.71 ±0.07	0.68 ±0.04	39.5 ±0.7	2.3-9.0
C. dussumieri	18	1.35 ±0.06	0.61 ±0.03	46.0 ±1.7	1.5-2.4
C. melanopterus	34	1.50 ±0.04	0.68 ±0.02	45.6 ±0.9	1.1-13.5
C. amblyrhynchoides	13	1.47 ±0.06	0.59 ±0.01	41.3 ±1.9	1.1-6.8
C. cautus	1	1.06	0.51	47.5	4.5
R. acutus	1	1.92	1.04	54.0	1.8
E. blochii	9	2.16 ±0.17	0.98 ±0.07	45.8 ±1.2	3.2-10.5
S. mokarran	3	2.21 ±0.04	0.99 ±0.03	44.9 ±2.0	5.8-22.2
A .cuspisdata[1]	8	1.41 ±0.06	No data	No data	2.2-3.3
A. cuspidata	1	2.18	0.98	44.9	4.1

1. A. cuspidata (n= 8) were from the NPWS sampling, the A. cuspidata (n=1) was from the hands-on session at the Darwin workshop.

Table 5: Queensland wet and dry fin weights (mean ± se) expressed as a percent of whole weight, trunk weight and fillet weight. Total mean (±se) are for all 18 individuals. n - number of individuals. The weight ranges were: *C. tilstoni* 5.5-15.4 kg and *C sorrah* 3.8-7.5 kg.

Species	n	WET FINS (%)			DRY FINS (%)			Dry fin/ Wet fin (%)
		Wet fin/ Whole w	Wet fin/ Trunk w	Wet fin/ Fillet w.	Dry fin/ Whole w	Dry fin/ Trunk w	Dry fin/ Fillet w.	
C. tilstoni	10	1.64 ±0.06	2.98 ±0.12	4.84 ±0.21	0.79 ±0.04	1.45 ±0.08	2.36 ±0.15	48.6 ±1.9
C. sorrah	8	1.32 ?0.04	2.36 ±0.11	3.77 ±0.12	0.56 ±0.01	0.99 ±0.03	1.59 ±0.05	42.2 ±0.7
Total for all individuals	18	1.50 ±0.05	2.70± 0.11	4.37 ±0.18	0.69 ±0.03	1.25 ±0.07	2.02 ±0.12	45.8 ±1.3

The wet and dry fin to trunk weight and fillet weight ratios indicate the recovery rates for the fins to the different shark flesh products. For example, *C. tilstoni* dry fins are 2.36 % of the fillet weight (Table 5).

The size of the shark appears to have an affect on the fin to body weight ratio (Figures 1-3). As the size of the shark increases the fin to body weight ratio varies. The linear regressions of wet fin to body weight for 3 species, *C. sorrah*, *C. tilstoni* and *C. melanopterus* were all highly significant. For *C. tilstoni* and *C. sorrah* as the body size increased, the fins were proportionally heavier. For example, for *C. tilstoni* a 2 kg shark had wet fins of 30 g (wet fin/whole weight of 1.50%) and a 6 kg shark had wet fins of 95 g (wet fin/whole weight 1.58%). However, the proportional increase was higher for *C. sorrah* than *C. tilstoni* as indicated by the regression equation. For *C. melanopterus* the larger the body, the fins were proportionally lighter, for example a 4 kg shark had wet fins of 60 g (wet fin/whole weight 1.42 %), a 12 kg shark had fins of 155 g (wet fin/whole weight 1.29 %). For the three species analysed the fin weight varied proportionally with size, though not in a consistent manner between species. As such, the relationship between fin weight and body weight is complex.

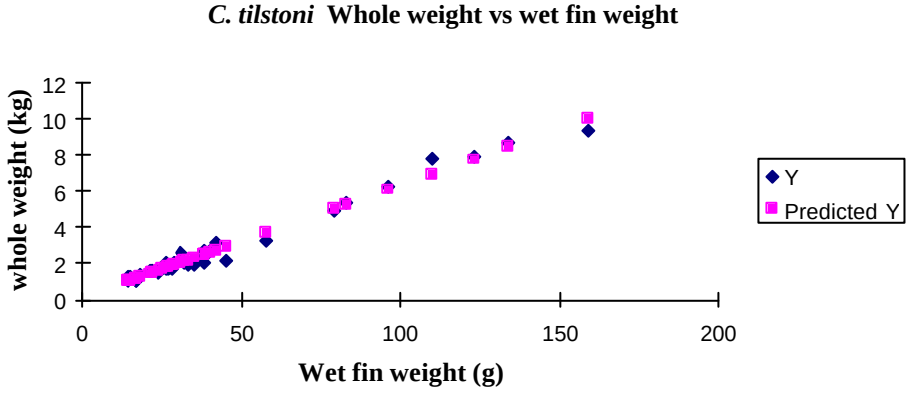

Figure 1: Regression of whole weight to wet fin weight for *C. tilstoni*. n= 40, y= 0.0617x + 0.1623, R^2 = 0.98

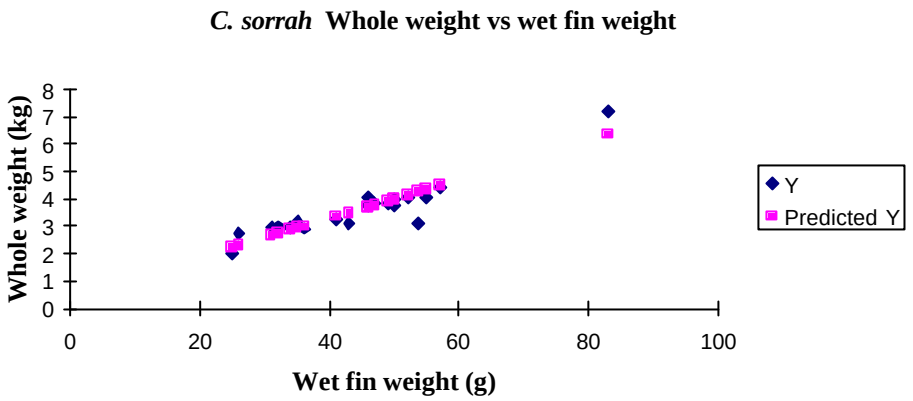

Figure 2: Regressi on of whole weight to wet fin weight for *C. sorrah*. N= 20, y=0.0714x + 0.4341, R^2 = 0.85

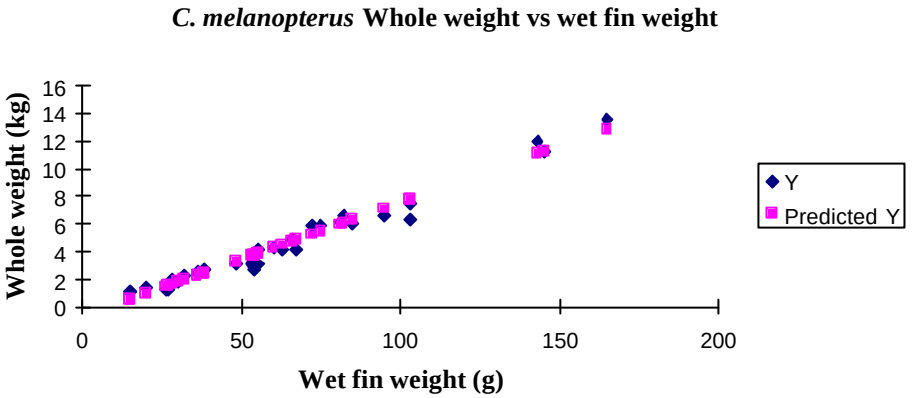

Figure 3: Regression of whole weight to wet fin weight for *C. melanopterus*. n= 33, y=0.0817x – 0.6476, R^2 = 0.85.

Weights of different fin types

Each of the types of fins, that is, dorsal, pectoral and caudal have proportionally different weights. The proportional contribution of each of the fin types to the total fin weight was similar for the two sharks examined, *C. tilstoni* and *C. sorrah*. The pectoral fins were the heaviest, accounting for between 54-55 % of the total fin weight. The dorsals accounted for around 23-27 % of the total fin weight and the caudals 20-22% (Appendix 5, Table 5).

The pectoral fins from each individual *C. tilstoni* and *C. sorrah* were weighed and dried separately. The two pectorals from each shark varied in weight by between 0.9-20 % (Appendix 5, Table 6). This is most likely a reflection of small differences in the amount of meat left on each fin after it is cut off the shark. A very small difference in the angle of the fin cut, particularly on the smaller fins can cause a difference in the resultant fin weight.

Other body ratios

The ratios for trunk weight to whole weight for *C. tilstoni* and *C. sorrah* that were measured at sea and in the laboratory in Qld and NT were around 53-63 % for *C. tilstoni* and 56-61 % for *C. sorrah* (Appendix 5, Table 7). For the fillet weight to trunk weight ratio there were more marked differences in the ratios measured in NT and Qld. Ranging from 37-61 % for *C. tilstoni* and 40-63 % for *C. sorrah* (Appendix 5, Table 7). This may be due to different fillet cuts in NT and Qld. There were trunk weight to whole weight ratios calculated for another nine species of shark which ranged from 49-68 %.

These ratios can be used to calculate recovery rates for whole shark to the various flesh products. For example for *C. tilstoni* (ratios from Queensland laboratory weights, Appendix 5, Table 7):

Trunk weight is 55 % of whole weight.
Fillet weight is 61 % of trunk weight.
Fillet weight is 0.55 x 0.61= 0.34, ie fillet weight is 34% of whole weight.

The ratio of fork length to total length was fairly consistent for eleven species of shark, taken variously in Qld, NT and WA (Appendix 5, Table 8). The ratio was around 76-89%. Regression of fork to total length was not done as this was a pilot study and for each species, the numbers of individuals which had both measurements taken were relatively small.

Other results

Lengths

Mean lengths of shark species measured in Qld, NT and WA are presented in Appendix 5, Tables 9-11. Among the three States/Territory sharks of the species examined were generally larger in WA than in Qld and NT (Table 6). The gear used in Qld and NT is monofilament mesh nets whereas in WA demersal longlines are used (Table 6). However as this is preliminary data it is not possible to determine the relationship between shark size, location and gear type.

Table 6: Fork lengths (cm, mean ± se) of sharks caught in Queensland, Northern Territory and Western Australia and method of shark fishing. n-no. individuals

Species	Queensland		Northern Territory		Western Australia	
	n	mean	n	mean	n	mean
C. tilstoni	29	98.2 ± 3.0	80	75.7 ± 1.7	336	115.1 ± 1.5
C. sorrah	16	79.5 ± 1.1	67	74.8 ± 1.4	484	76.8 ± 0.5
C. amblyrhynchos	30	105.6 ± 3.4			47	116.7 ± 2.3
C. macloti			13	65.2 ± 3.3	11	62.6 ± 1.0
C. amboinensis			24	75.0 ± 4.8	74	175.9 ± 2.8
E. blochii			82	85.8 ± 1.8	9	99.4 ± 3.3
R. acutus			8	46.4 ± 4.2	206	67.5 ± 0.4
R. taylori			15	40.7 ± 1.0	14	45.4 ± 1.0
S. lewini			12	96.8 ± 5.2	33	136.6 ± 7.8

Method	Bottom set monofilament mesh net 6.5 inch mesh 1200 m length Set day and night Set duration of 2-3 hrs Depth: 20-30 m Bait- none	Near surface set monofilament mesh net 6.5 inch mesh 1500-1600 m length Set at night-dusk to dawn Set twice per night Depth: 9-28 m Bait: sometimes mackerel heads or tuna frames	Demersal longline No. hooks/set: 170-620 Soak time: 5-22 hrs, mostly 12-17 hrs Depth: 9-157 m Bait: mullet

Slightly larger *C. tilstoni* were caught in Qld (98 cm) and WA (115 cm) than NT (76 cm). *Carcharhinus sorrah* caught across the three States/Territory were of similar size (75-80 cm).

For other species that had been measured both in NT and WA: *C. amboinensis* mean fork lengths in WA were more than twice that of NT; *E. blochii*, *R. acutus, R. taylori* and *S. lewini* caught in WA were all slightly larger than those of NT; and *C. macloti* was of similar size in both areas (Table 6).

Within the Northern Territory slightly larger *C. tilstoni* were observed in the deeper waters of Bathurst Island (trip 3) than in Anson and Fog Bay (trip 2) and *C. sorrah* were of similar size in both locations (Appendix 5, Table 12). Within WA, *C. tilstoni* observed were larger south of Port Hedland than those taken around Broome. *Carcharhinus sorrah, C. amblyrhynchos, C. amboinensis, R. acutus, S. lewini, C. plumbeus* and *Galeocerdo cuvier* were all of similar size in the locations observed from south of Port Hedland to north of Broome (Appendix 5, Table 12).

Where appropriate, this pilot data will be included in the full analyses of data from Phase II.

Sex ratios

On all WA observer trips and for some species on some of the NT trips the sex of the individual sharks were recorded. The percentage of females of each species caught varied widely among trips for both NT and WA and ranged from 13-100 % (Appendix 5, Tables 13and 14).

Number of pups

Over the three trips in the NT, 2 and 7 pups were recorded from two individual *A. cuspidata*, and from six individual *C. sorrah*, 2,2,3,4,5,6 pups were recorded.

DISCUSSION

The pilot fishery observer program was very successful in meeting objective three, as: co-operation with fishers and observer data collection protocols were both established; the shark catch composition across northern Australia was identified and conversion ratios for shark fin to whole animal were calculated for the major target shark species caught.

In Qld, NT and WA the fishers co-operated with the observer program by allowing observers on board. Nearly all target shark fishers in NT and WA recognised the

advantages of the observer program and were very willing to be involved. In Qld, the co-operation was established with most, but not all target shark fishers. More difficulties were encountered as the target shark fishery in Qld is relatively new and has not been previously managed. As such the fishers had not been involved with government and researchers to the same extent as in NT and WA. The east coast shark fishery is located in the world's largest marine park, GBRMPA, which has raised issues between fishers, government and conservation groups. As a result some fishers were reticent to become involved with any 'government' bodies. In addition, many east coast fishers only target shark for a short time during the fishing season and as this was a pilot observer program of limited duration, the numbers of vessels both actively targeting shark and willing to have an observer on board were limited.

The pilot observer program provided an opportunity for the observers to determine what data could be consistently collected without undue interference in the fishing operations. On fishing trips where the catch was low to average, the observer had more time available to take a range of measurements of each shark, such as total and fork length, whole weight and processed weight, and collect other data such as sexual maturity and stomach contents. However on very busy trips when the catch was higher, just to identify the sharks and bycatch and take basic measurements of the sharks took all of the observers time. On extremely busy trips, priority was given to shark identification and measurements and it was not possible to identify and count every bycatch species, particularly those that are discarded directly from the net. This information can be used to refine a standard minimum data collection protocol among the States/Territory in Phase II of this FRDC project.

Catch composition

The catch composition of northern sharks caught while observers were onboard was consistently dominated by *C. tilstoni* and *C. sorrah*. However, the extent of their dominance varied among the three States/Territory. This is consistent with previous studies of northern sharks (Lyle 1987) that found these species accounted for 79-97 % of the catch in NT and Qld and 30-45 % of the catch in WA. The dominance observed in this study was not as high as these figures, particularly in Qld, though this may be a result of a smaller data set as this was a pilot rather than a large scale study.

The observed catches were also dominated by hammerheads in Qld and NT and *C. plumbeus* in WA which agrees with other studies of the shark catch in these States/Territory (Anon 1994, Clarke 2001, Simpfendorfer et al 1999, McAuley et al 2002). The relatively high abundance of *S. lewini* in the Qld catch has not previously been reported (Williams 1997, 2002), but there is limited information on the Qld target shark catch composition with which to compare the observer data. Many of the other shark and bycatch species caught have all previously been reported from the northern Australian shark fisheries (Lyle 1987, Clarke 2001, Simpfendorfer et al 1999, Williams 1997, 2002, McAuley et al 2002). However, this observer study recorded more shark species for NT and Qld than generally reported. In NT the Northern Pelagic Fish Stock Research Programme of 1984-1985 reported 20 species of shark, while in this study 25 species were recorded (Lyle 1987). In Qld there have been no major detailed observer studies of the target shark fisheries species catch composition and the less abundant species of shark have generally been recorded as "shark unspecified".

Bycatch was greatest in NT where the shark fishers also target mackerel which accounted for 42 % of the total catch. In Queensland the bycatch only accounted for 15 % of the total catch, while in WA the use of demersal longlines greatly reduced bycatch, as it was not recorded on all observer trips and when it was, only represented around 3 % of the total catch.

The catch composition varied among the trips in each State/Territory. Previous studies of northern sharks have found that catch composition can be affected by location, depth and gear type (that is, gillnets vs longlines) (Lyle 1987). For example in the 1984-1985 study, *C. tilstoni* were more abundant across Qld and NT than WA and *R. acutus* more abundant in WA (Lyle 1987). The same trend for these species was apparent in the catch composition data from this study.

Depth has been found to influence the capture of some shark species, for example in the 1984-1985 study, *C. sorrah* were less abundant at depths less than 20 m, while *C. amblrhynchoides* and *R. acutus* were more abundant in shallower waters (Lyle 1987). In this pilot observer study the depths ranges fished were not distinctively different enough to examine these trends and determine the influence of depth on catch composition. Gear type was reported to affect catch composition of the dominant species in 1984-1985, *C. tilstoni* was the most abundant species taken by gillnet, while *C. sorrah* dominated the longline catches (Lyle 1987). This change in dominance with gear type was also evident in this study when Qld and NT were compared to WA.

As such, some of the previously reported trends in catch composition with location and gear type were observed in this pilot observer program. However, as it was a pilot study it was not fully representative of the target shark fisheries and conclusive relationships cannot be determined. Further data will be collected in Phase II of this project to more closely examine these trends.

Fin to body ratios

The fin to body conversion ratios derived from the observer program were generally within the range of those reported in Rose and McLoughlin (2001). The mean ratios of fin to whole weight (1.52 and 0.67 % for wet and dry fin respectively) were slightly less than the 2 % and 0.8 % applied in Rose and McLoughlin (2001), though the range of values observed was consistent with those reviewed in the literature by Rose and McLoughlin (2001). These observed wet fin to whole body weight ratios and those applied in Rose and Mcloughlin (2001) are all less than the ratio currently referred to in Qld of 5% wet fin to whole weight. This relatively large difference between the observed ratios and that currently referred to in Qld warrants further attention and will be investigated in Phase II of this northern shark project on an opportunistic basis.

The mean wet and dry fin to trunk ratios observed in this study of 2.70 and 1.25 % respectively, were somewhat smaller than those estimates for the same ratios derived in Rose and Mcloughlin (2001) of 5% and 2% respectively. The ratio applied in the USA Shark Management Plan for wet fin to carcass weight is 5% (Anon 1993). The reason for the differences between the ratios observed in this study and those of Rose and McLoughlin (2001) and Anon (1993) are not clear. These latter studies referred to

a 'carcass' as a shark that had been headed and gutted, generally with fins attached. In this study a 'trunk' referred to a shark that had been headed and gutted and the fins removed, which should tend to make the conversion ratios higher for fin to trunk than for fin to carcass. These discrepancies highlight the need for carcass and trunk to be clearly defined when comparing fin to body ratios and for more data to be gathered to calculate more accurate ratios for fin to processed weight for the range of species caught by target shark fishers in northern Australia.

The size of the shark also appears to affect the fin to body weight ratio. For *C .tilstoni* and *C. sorrah* measured, the larger the shark, the larger the proportional weight of the fins but for *C. melanopterus* (the other species analysed as there were adequate numbers of individuals) the larger the body, the smaller the proportional fin weight. As such, the relationship between fin weight and body weight appears to be complex and is an area that warrants further investigation.

There was also variation evident in the fin to body ratio among species, particularly for wet fin to whole weight. This variation in fin weight among species was raised by fishers at the workshops, one of whom commented that, for example the dorsal fins are much thicker on *C. limbatus* than *C. sorrah*. This pilot study data also indicated that the hammerheads had higher fin to body weight ratios than the whaler and sawfish species. This suggests that for different groups of sharks, ie, with distinctively different body shapes, the proportion of body weight accounted for by the fins may vary.

This study highlighted three additional factors that may affect the calculation of the fin to body conversion ratios: fin moisture content; the fin cut; and types of fins retained.

The moisture content of fins from different species was also shown to vary markedly. In this study it varied from 30-68 % which compares well to the variation of 20-60 % reported in Rose and McLoughlin (2001). This moisture content has been reported to vary with species of shark and the size of the fin (some smaller fins appear to have a higher moisture content) (Rose and McLoughlin 2001). These variations in moisture content would affect the weight of fins and the calculation of a conversion ratio for fin to whole weight.

It was evident from the comparison of individual pectoral fins in this study that even slight differences in the fin cut, especially for small fins, may affect the resultant fin weights and consequently fin to body conversion ratios. Usually a half moon cut is used to remove the fin and this cut leaves little meat on the fin. However even if there is a slight difference in the angle of the cut and a small amount of meat is left, this can cause marked differences in the final dried fin weight. The need to consider that the type of fin cut can affect the weight of the fin was also raised by fishers at the workshops.

The various types of fins on the shark, that is, dorsals, pectorals and caudals have markedly different proportional weights. Not all sharks have the same types of saleable fins, for example, as commented by fishers at the workshops, sawfish have a valuable whole caudal fin (unlike other sharks), but no valuable pectorals (unlike other sharks), so two dorsals and a whole caudal are retained. For some other species

two dorsals, two pectorals and only the lower lobe of the caudal are valuable, on some other sharks the anal fins are also saleable. So there is some variation in the types of fins that are kept from different species. This would result in different total fin to body weight ratios.

Caution needs to be exercised in applying a fin to body weight ratio. This pilot study indicated that the ratio may vary according to:

- Species of shark;
- Size of the shark;
- Body shape of shark;
- Moisture content of the fins;
- Type of cut used to remove fin from shark;
- Types of fins retained from different species of shark; and
- Manner in which shark is processed.

The mean ratios calculated in this pilot study are for those species of shark taken by gillnets in coastal waters. Care needs to be taken in extrapolating these results to sharks taken in other fisheries by other gear. For example the tuna longline fisheries catch pelagic shark species in oceanic waters, which may have different body shapes and therefore different fin to body weight proportions. For instances, the blue shark which is the dominant species of shark taken as bycatch by the tuna longline vessels (Rose and McLoughlin 2001) has a slim body and large pectorals.

Other body ratios

The ratios for trunk and fillet weight to whole weight were calculated to provide indicative ratios of recovery rates of processed shark product from whole weight. The trunk to whole weight conversion ratios were fairly consistent for *C. tilstoni* (53-63 %) and for *C. sorrah* (56-61 %). The range of this ratio for another nine species of shark was 49-68 % that suggests the recovery ratios among species are quite variable. Ratios of fillet to trunk weight also exhibited variation among species which may be due to slightly different processing methods by different fishers. These findings suggest that these variations in conversion ratios among species may need to be considered in the calculation of processed shark back to whole weights.

Lengths and sex ratios

The lengths of shark species observed in this study were very similar to those previously reported in the 1984-1985 study on northern sharks (Lyle 1987). That project found that on average larger *C. tilstoni* were caught by longline compared to gillnets, though this size selectivity did not occur with *C. sorrah*. This same pattern was evident in this study with larger *C. tilstoni* sharks caught in WA and similar size *C. sorrah* caught across all three States/Territory. However it cannot be conclusively stated that these observed sizes were related to gear type as this is a pilot study and more extensive and representative data will be collected in Phase II of this project.

Additional sex ratio data that were collected by this pilot study may be useful for analyses when included with the Phase II data. The data set is too small to examine any trends. There were very large variations in the percentage of females caught

among trips. Many sharks species have seasonal reproductivity which likely affects the sex ratio caught at different locations and times of the year. Large variations in proportions of the sexes caught have been previously reported and as such large sample sizes are required to detect any differences in sex ratios in relation to other factors (Stevens and Wiley 1986).

BENEFITS

The commercial shark fishing sectors in Qld, NT and WA will benefit directly from this project in a number of ways, that is:

- It provided an opportunity for the fishers to voice their needs, issues and concerns about their fishery both for managers to take into consideration for future management decisions regarding the shark fisheries and for planning of the full-scale research project into sustainability of northern sharks and rays;

- There will be an improvement in the quality of the commercial logbook information as a result of the extension and instruction in the use of the shark Field Guide. Fishers can now record the shark species caught accurately and with consistent use of common names. This improvement in logbook data will provide long term benefits in terms of the sustainability of the fisheries by allowing for more accurate stock assessments and sustainability analyses of the species caught;

- The participation of fishers in the observer program provided data on the target and bycatch species caught which will be included in the Strategic Assessments of the fisheries. This Assessment is required under the Environment Protection and Biodiversity Conservation Act 1999 as the fisheries must demonstrate that they are ecologically sustainable in order to maintain a licence to export the shark product. As shark fins, cartilage and other shark products are exported, the collection of validated catch composition data contributes vital information necessary to ensure the fishers can maintain the ability to export high value shark products;

- The observer program allowed for the calculation of fin weight to body weight ratios. With the implementation of shark finning bans in Qld and WA (already in place) there will most likely be a requirement for fins retained on board to be in ratio to the shark landed. The ratio applied will affect the fishers income directly and as such, this project (and the full-scale Phase II project) will benefit the fishers by ensuring the calculation of realistic and accurate ratios;

- In Qld it was the first time that shark fishers on the East Coast have met as a group. This was beneficial to them as they used the opportunity to set up a network of communication among themselves, and so began to form a shark fishers group. This will be highly beneficial in the long term for communications between fishers and management in discussions of the future management of Qld shark fisheries; and

- The workshops increased the fishers awareness of some issues that may arise in their fishery, such as bycatch and they realised the need to become proactive in

developing procedures to deal with the issues, for example trialing acoustic warning devices on their nets. A proactive stance by those directly involved will be beneficial to the commercial fishery.

In addition, the project was beneficial to Environment Australia as the issues and outcomes that arose from the workshops and the data collected by the pilot fishery observer program will be included with that gained from Phase II of this FRDC project in the Strategic Assessment of the northern shark fisheries which is to be submitted to Environment Australia.

The project was also beneficial to Australian Fisheries Management Authority as it provided data that can be used to improve management of the northern shark fisheries. It addressed some of the major issues identified by Shark Advisory Group (2001) for the Australian National Plan of Action for the Conservation and Management of Shark, that is, the identification of shark catch composition, validation of logbook information and improvements to the reporting of shark catches in logbooks. A further beneficiary was the Bureau of Rural Sciences as it provided validation to some of the estimated fin to body weight ratios used in the shark finning review (Rose and McLoughlin 2001).

As identified in the flow of benefits in the original application for project funding, the commercial shark fishing sectors in Qld, NT and WA were the main beneficiaries of the project. Environment Australia and AFMA also benefited as stated in the original application and an additional beneficiary was the Bureau of Rural Sciences.

FURTHER DEVELOPMENT

Further research directions have been detailed in the Northern Australian sharks and rays: the sustainability of target and bycatch fisheries, Phase II project proposal, FRDC No. 2002/064. This Phase II will extend and add to the results of Phase I and include other fisheries where shark is taken as bycatch.

PLANNED OUTCOMES

A major output of the workshops was that they provided the opportunity for stakeholders to voice their needs, issues and expectations from the full-scale research project (Phase II) and it provided local knowledge and suggestions for appropriate methods. This contributed significantly to the planned outcome for the FRDC proposal for Phase II as the proposal was able to be based soundly on stakeholder consultation and input, with co-operation from industry assured.

An output of the workshops, the extension and instruction in the use of shark identification guides contributed well to the planned outcome for improved stock assessment data for primary target species of northern shark fisheries. This output will lead to better identification of species caught through the correct use of standardised shark identification guides. This will provide managers with an improved estimate of the sustainable exploitation levels on which to base management decisions. As this is collaborative across the States/Territory it will assist managers in ensuring management is complementary across their jurisdictions.

The workshops also provided the opportunity for fishers to become involved in the research project through the pilot observer program. This program contributed significantly to the planned outcome of a preliminary description of the catch composition of sharks in northern Australian shark fisheries. The program also extended the results of the historic shark-data compilation project by providing extra data. This data will provide industry, managers and all stakeholders with a greater understanding of the take of these fisheries. This data is also the basic information required for any stock assessment, which is one of the basic requirements for schedule 4 certification, under the *Environment Protection and Biodiversity Conservation Act 1999*.

Another major output of the pilot observer program was the provision of conversion ratios for shark fin to shark flesh products. This contributed greatly to the planned outcome of the calculation of these conversion ratios for the major target shark species caught in Qld, NT and WA. This information will allow managers to more accurately estimate the total weight of shark caught from logbook returns and landed product, whether it is meat or fins.

The observer programs also allowed for the testing of appropriate methodologies to collect standardised data in each State/Territory with feedback from the fishers of possible improvements to the project. This further contributed to the planning of the full scale-research project by testing of methodologies with the involvement of fishers.

CONCLUSION

There were a number of outcomes of the workshops and pilot observer program which all addressed the objectives of the project. The workshops provided an opportunity for fishers and managers to communicate and discuss their issues and concerns for the shark fisheries for inclusion into the full-scale FRDC Phase II of this project. They also improved the shark fishers identification skills which will improve the quality of catch data recorded in commercial logbooks. The pilot observer program was very successful as it provided preliminary data on the target and bycatch species composition of the northern Australian commercial shark catch and it also provided some initial conversion ratios for shark fins to whole animal for the major species taken in the shark fisheries.

Besides improved communication between fishers and managers, establishment of the co-operation of fishers with the observer program and improved shark fishers identification skills, other outcomes of the workshops were:

- Recognition by fishers of the need to be proactive in dealing with issues such as bycatch and shark finning;

- In Qld a working group of shark fishers was formed and a number of fishers volunteered to take part in the development and trial of an improved logbook that will be undertaken in Phase II of this project;

- In the NT the sharks from the hands-on session were used to calculate fin to body weight ratios and a fisher and fin processor demonstrated the optimal fin cuts and fin drying protocol used in the industry; and

- In WA the shark fishers acknowledged the need to both minimise the bycatch of spanish mackerel and to give consideration to restricting the use of gillnets to waters outside 12nm.

The major outcomes of the pilot observer program were the catch composition data and fin to body weight conversion ratios. The target and bycatch species composition recorded were similar to that previously reported in the literature, with additional shark species recorded by the pilot observer program in Qld and NT.

A mean wet fin to whole body conversion ratio of 1.52 % was calculated from the observer program data. However, care should be taken in the use of this ratio as the data indicated that there is considerable variation in the ratio for fin weight to body weight both within and among the principal species taken by the northern Australian shark fishers. The conversion ratio appears to be influenced by a number of factors, that is: species, size and body shape of sharks; the moisture content of the fins which may vary with size and species; the type of cut used to remove fins from sharks; the types of fins retained from different species of sharks; and the manner in which sharks are processed. As the ratio is influenced by these range of factors, caution should also be exercised in use of this ratio for sharks taken in other fisheries by other gear as they may have different fin to body weight proportions to the species taken in coastal waters by gillnets.

These findings from the pilot observer program confirmed the comments of the fishers raised at the workshops. They had expressed concern over the potential application of a single fin to body weight ratio and had described the above factors as those that may affect fin to body weight ratios. This suggests that to verify the accuracy of the ratios calculated in this pilot study for the major shark species taken, further measurements of this ratio on a larger number of individuals may be needed. This is an area of research that will be studied in Phase II on an opportunistic basis.

Other outcomes of the pilot observer program were:

- The observers determined the type of data that could be consistently collected at sea without undue interference in the fishing operations, which can be used for development of the Phase II observer program; and

- Additional data was collected that could be later incorporated into Phase II of this study. This data included length and sex ratio measurements, and trunk and fillet weight to whole weight ratios which provided preliminary information on recovery rates of processed shark to whole weight.

The outcomes of the workshops and pilot observer program are significant as stand-alone preliminary results, but will be used primarily in the formulation of the full-scale Phase II part of this FRDC project on northern Australian sharks and rays. The outcomes and results will also be included with information collected in Phase II of this FRDC project in the Strategic Assessment of the northern shark fisheries which is

to be submitted to Environment Australia for assessment of the sustainability of these fisheries.

ACRONYMS

ACIAR	Australian Centre for International Agricultural Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CSIRO	Commonwealth Scientific and Industrial Research Organisation
FAO	United Nations Food and Agricultural Organisation
FRDC	Fisheries Research and Development Corporation
FWA	Government of Western Australia, Department of Fisheries
IPOA-Sharks	International Plan for the Conservation and Management of Sharks.
IUCN	International Union for the Conservation of Nature
JANSF	Joint Authority Northern Shark Fishery
NAFM	Northern Australian Fisheries Management
NT	Northern Territory
NTBIRD	Northern Territory Department of Business, Industry and Resource Development
QDPI	Queensland Department of Primary Industries
QFIRAC	Queensland Fishing Industry Research Advisory Council
Qld	Queensland
QFS	Queensland Fisheries Service
WA	Western Australia
WANCSF	Western Australian North Coast Shark Fishery

REFERENCES

Anon (1993) Fishery Management Plan for Sharks of the Atlantic Ocean. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, United States Department of Commerce. Washington DC.

Anon (1994) Northern Shark Status Report 1994. Northern Territory Department of Primary Industry and Fisheries.

Anon (2000) Commonwealth Policy on Fisheries Bycatch. http://www.affa.gov.au/ffid/bycatch/index.html

Clarke R (2001) Overview of issues in managing the Northern Territory shark catch. Fisheries Division. Department of Primary Industry and Fisheries. Fishery Report No 57.

Fisheries Western Australia (1998) Fisheries Management Paper 114-A Strategy for the Future Management of the Joint Authority Northern Shark Fishery.

IPOA-Sharks (1999) International Plan of Action for the Conservation and Management of Sharks. World wide web electronic publication. www.fao.org/fi/ipa/manage.asp

Last PR and Stevens JD (1994) Sharks and rays of Australia. CSIRO Division of Fisheries, CSIRO, Australia.

Lavery S and Shaklee JB (1989) Population genetics of two tropical sharks, *Carcharhinus tilstoni* and *C. sorrah* in northern Australia. *Australian Journal of Marine and Freshwater Research*. 40, 541-57.

Lightowler MA (1994) Survey of all the net fishers who reported shark catch. Queensland Fisheries Management Authority Survey. Contact author.

Lyle JM (1987) Northern Pelagic Fish Stock Research Programme: Summary of catch and effort data. Northern Territory Department of Primary Industry and Fisheries. Fishery Report No. 16.

McAuley R, Moran M, Simpfendorfer C, Lenanton R and Hall N (2002) Interim Status Report for the Southern and West Coast Demersal Gillnet and Demersal Longline Fisheries and Northern Shark Fisheries. West Australian Marine Research Laboratories.

Rose C and Mcloughlin K (2001) Review of Shark Finning in Australian Fisheries. Bureau of Rural Sciences, Australia.

Sant G and Hayes E (eds) (1996) The Oceania Region's Harvest, Trade and Management of Sharks and Other Cartilaginous Fish: An Overview. TRAFFIC Oceania.

Shark Advisory Group (2001) Australian Shark Assessment Report for the Australian National Plan of Action for the Conservation and Management of Sharks. Department of Agriculture, Fisheries and Forestry-Australia.

Simpfendorfer C, McAuley R, Chidlow J, Lenanton R, Hall N and Bastow T (1999) Biology and stock assessment of Western Australia's commercially important shark species. Fisheries Research and Development Corporation Project 96/130.

Stevens JD and Church AG (1984) Northern tagging project yields interesting results. *Australian Fish* 43(9), 6-10.

Stevens JD and Wiley PD (1986) Biology of Two Commercially Important Carcharhinid Sharks from Northern Australia. *Australian Journal of Marine and Freshwater Research*. 37, 671-88.

Stevens JD and Lyle JM (1989) Biology of Three Hammerhead Sharks *(Eusphyra blochii, Sphyrna mokarran* and *S. lewini*) from Northern Australia. *Australian Journal of Marine and Freshwater Research*. 40, 129-46.

Stevens JD and McLoughlin KJ (1991) Distribution, Size and Sex Composition, Reproductive Biology and Diet of Sharks from Northern Australia. *Australian Journal of Marine and Freshwater Research.* 42, 151-99.

Stobutzki I, Blaber S, Brewer D, Fry G, Heales D, Jones P, Miller M, Milton D, Salini J, Van der Velde T, Wang Y, Wassenberg T, Dredge M, Courtney T, Chilcott K and Eayrs S (2000) Ecological sustainability of bycatch and biodiversity in prawn trawl fisheries. Fisheries Research and Development Corporation, Project 96/257.

Walker T.I. (2000) Draft FAO Technical Guidelines for Implementation of the International Plan of Action for the Conservation and Management of Sharks.

Williams L (1997) Queensland's fisheries resources. Current conditions and recent trends 1988-1995. Department of Primary Industries. Queensland Information Series Q197007

Williams L (2002) Queensland's fisheries resources. Current conditions and recent trends 1988-2000. Department of Primary Industries. Information Series Q102012.

APPENDIX 1: STAFF

Dr Neil Gribble	Queensland Fisheries Service
Mr Geoff MacPherson	Queensland Fisheries Service
Mr Rod Garrett	Queensland Fisheries Service
Ms Cassandra Rose	Queensland Fisheries Service
Mr Jason Stapley	Queensland Fisheries Service
Dr John Stevens	CSIRO Division of Marine Research
Mr Rik Buckworth	Northern Territory Department of Business, Industry and Resource Development
Mr Nick Spanswick	Northern Territory Department of Business, Industry and Resource Development
Mr Ray Clarke	Northern Territory Department of Business, Industry and Resource Development
Mr Kevin McLoughlin	Bureau of Rural Sciences
Dr Steven Blaber	CSIRO Division of Marine Research
Dr Michael Moran	Department of Fisheries, Western Australia
Rod Lenanton	Department of Fisheries, Western Australia

Rory McAuley	Department of Fisheries, Western Australia
Mr Bob Pearson	Queensland Department of Primary Industries
Mr Shane Hansford	Queensland Fisheries Service

Northern Australian sharks and rays: the sustainability of target and bycatch fisheries, Phase I.

Proceedings from the Northern Shark Fisheries Workshop

Cairns, Australia, 7 November 2001

Edited by Cassandra Rose and Neil Gribble

EXECUTIVE SUMMARY

International, national and regional concerns for the sustainability of sharks and rays is increasing. Sharks and rays are more susceptible to fishing pressure than bony fishes, due to their slow growth, late age at maturity and low fecundity. One of the major issues identified on a global level is the under reporting of shark and ray catches, mainly in the form of bycatch. Management of shark fisheries can be improved through further research into the shark catch and biology, with the primary need for improved catch composition data from both the target and bycatch fisheries. Without this information sustainable fishing levels cannot be adequately assessed.

Sharks have been fished commercially in northern Australia since the early 1970's. The current shark and ray catch across northern Australia taken by target fisheries (~900t) is low by international standards while the catch taken as bycatch is unknown. The lack of adequate data on the northern shark fisheries was raised in 1997 and again at a Northern Shark Stock Assessment workshop in 2000. The new Environment Protection and Biodiversity Conservation Act 1999 requires that if fisheries wish to maintain a license to export product they must produce a Strategic Assessment to demonstrate that they are ecologically sustainable. Catch composition information is required as part of this Strategic Assessment. There is a lack of species identification in the catch of Northern Territory and Queensland and a lack of uniformity in reporting shark catch by the various logbooks programmes.

The current project that is funding the workshops in Queensland, Northern Territory and Western Australia will provide input into the process of developing a research programme that can address these issues. Phase I of this Fisheries Research and Development Corporation project will focus on improving the shark identification skills of fishers and workshopping any issues with fishers. Short pilot observer programmes are to be run as part of Phase 1, to test methods and gain preliminary information on the shark catch. Its outcomes will be used in the formulation of the full project proposal planned for 2002-2005.

The workshop attracted 39 participants who all contributed to the success of the workshop. There were 9 scientists from government that included 4 speakers and 2 observers from the observer programme in the Gulf of Carpentaria and 30 shark fishers, one of who is also a seafood processor.

There were a number of presentations that covered management of Qld shark fisheries, the historic shark catches across northern Australia, the use of susceptibility risk assessment to determine shark species vulnerable to fishing pressure, acoustic devices to reduce bycatch and improvements to shark identification using a new field Guide developed for fishers.

The workshop highlighted a number of issues that fishers and management have with the Qld shark fishery. The main issue identified by all is the expansion of effort, increased use of reel boats and new entrants coming into the fishery. There is also a lack of catch composition information on both target and bycatch fisheries, which is complicated by the use of a number of different common names for the same species. The issues of unknown bycatch in the East Coast shark fishery and shark finning were

identified as complex and need to be addressed. There were also concerns over mercury in some shark products.

The main outcome of the workshop was to open communication between shark fishers and government. Open discussions identified the issues and worked towards possible outcomes and a Working Group of fishers was formed to allow continuation of this contact and co-operation. The other major outcomes were:

- Fishers agreeing to participate in both the East Coast shark observer programme and in a trial of a research logbook in the fishery;
- Acceptance of the usefulness of the new field Guide to sharks and rays;
- For the first time contact between East Coast shark fishers themselves was established;
- Details of scientific information discussed at the workshop were later forwarded to the fishers at their request; and
- Future developments and outcomes of the FRDC Research Program will be forwarded to all attendants at the appropriate times.

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Workshop Information

- Held Wednesday 7th November, 2001 at the Cairns Cruising Yacht Squadron, Cairns, Australia.

- The number of participants was 39. There were 9 scientists from government that included 4 speakers and 2 observers from the observer programme in the Gulf of Carpentaria and 30 shark fishers, one of who is also a seafood processor.

Proceedings Structure

The intent of the workshop was to improve shark identification by fishers, through the use of a new shark identification Field Guide. The workshop also aimed to ensure fishers and management could discuss their respective issues and concerns for input into the planning stage of the full proposed Phase II of the FRDC project on the sustainability of northern sharks and rays. It also aimed to establish co-operation with fishers in the East Coast pilot shark observer programme. In the morning there were five presentations, followed by a hands on shark identification session and an open discussion in the afternoon.

Sponsoring Organisations

- Fisheries Research and Development Corporation

- Queensland Fisheries Service

- Agency for Food and Fibre Science- Fisheries and Aquaculture

Workshop Organising Committee

- Dr Neil Gribble (Queensland Fisheries Service)

- Ms Cassandra Rose (Queensland Fisheries Service)

- Mr Jason Stapley (Queensland Fisheries Service)

Workshop facilitator

Mr Geoff MacPherson (Queensland Fisheries Service)

Acronyms

AFFS	Agency for Food and Fibre Science
AFMA	Australian Fisheries Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EA	Environment Australia
FRDC	Fisheries Research and Development Corporation
FIDC	Fishing Industry Development Council
GoC	Gulf of Carpentaria
GBRMPA	Great Barrier Reef Marine Park Authority
MAC	Management Advisory Committee
NFC	Northern Fisheries Centre
NHT	Natural Heritage Trust
NPF	Northern Prawn Fishery
NPP	Northern Pelagic Shark Programme
NT	Northern Territory
QDPI	Queensland Department of Primary Industry
QFAB	Queensland Fisheries Advisory Board
QFMA	Queensland Fisheries Management Authority
QFJA	Queensland Fisheries Joint Authority
QFS	Queensland Fisheries Service
Qld	Queensland
QSCP	Queensland Shark Control Programme
TED	Turtle Exclusion Device
WA	Western Australia
ZAC	Zonal Advisory Committee

Abbreviations for speakers names used in the questions and answers during the presentations.

GM	Geoff MacPherson
SH	Shane Hansford
NG	Neil Gribble
JS	John Stevens
Fisher	Any of the shark fishers that attended the workshop.

ACKNOWLEGDMENTS

We wish to sincerely thank all fishers who took time out of fishing, some of who also travelled considerable distances to attend. Their input into the discussions was invaluable and greatly appreciated.

We also wish to thank all speakers for their contribution and time. Thanks to Geoff MacPherson and Neil Gribble from Queensland Fisheries Service (QFS) for enlightening fishers on the background to the project, covering the historic shark catch and describing the use of acoustic devices to reduce bycatch in gill nets. Thanks to Shane Hansford from QFS for presenting the management situation and issues of Qld sharks and thanks to John Stevens from CSIRO for introducing the new field guide to sharks and rays and running a hands on session with shark specimens. Thanks also to Mitch Trezise, the shark fisher who kindly provided a variety of shark and ray specimens for the shark identification session.

Funding for this workshop was provided by FRDC.

INTRODUCTION AND BACKGROUND

FRDC Northern Australian Sharks And Rays Workshop Agenda
Geoff Macpherson

Thank you for coming. This workshop is part of a FRDC (Fisheries Research and Development Corporation) project on the sustainability of northern sharks and rays. In the morning we will have a number of presentations covering historic development of shark fisheries across northern Australia, management, shark identification using a new field guide, and use of acoustic devices to reduce bycatch. The afternoon session will be an open discussion.

As Facilitator I'll provide a couple of objectives as to what needs to be achieved for a proposed three year FRDC shark project of northern sharks and rays taken in both target and bycatch fisheries, a project we will refer to as Phase II. Essentially we are asking for input from industry/operators. If you have particular concerns on any issues, any ideas, that may effect your or our involvement in future shark fisheries, we would like to hear about it.

History of Shark Fisheries In Queensland and Formulation of FRDC Collaborative Study
Geoff Macpherson

I would like to start on a very brief history on the development of shark fisheries in Queensland. In 1962 the Queensland Department of Primary Industries (QDPI) were concerned over the deaths of swimmers at popular swimming beaches over the summer in southern Queensland due to shark attack. Over a two year period the Government established the Queensland Shark Control Programme (QSCP) which has changed little till present day. Sharks were taken by a combination of large mesh gillnets and baited drumlins. The data from the catches was limited to recording the lengths of the sharks, sex and pups. Species identification was initially extremely poor with the exception of tiger, white and grey nurse sharks, but has improved greatly in recent years. Input data on species composition is based on CSIRO species codes. Any information in terms of shark fishing that comes from the QSCP in terms of take of sharks, population dynamics could be incorporated into any commercial shark fishery deliberations, however the species composition does not match likely commercial fishery species composition.

In 1980 FIRTA, the predecessor of FRDC, funded a developmental shark study in the southern Gulf of Carpentaria. I was asked to review the progress of the study on a Karumba based 45 foot trawler. The net setting operation was conducted from a duck-board over the stern from which floats were positioned on the net as it rolled out over the stern from a net reel. The net setting was not too bad, it was actually the net hauling that was the problem, because we had to back-up on the nets. The project did not succeed primarily due to logistical difficulties. There were project plans for gear development although the concepts did not appear in the Gulf fishery until nearly 15 years later.

QDPI commenced field work in the Gulf of Carpentaria in about 1981-1983. DPI suggested conducting shark assessment work alongside the barramundi survey work of Rod Garrett. We were unaware of the shark species composition in the inshore areas so up to 30 morphometric measurements were taken of every shark. It was not till about a year ago, for the Natural Heritage Trust (NHT) funded northern shark project run by Ilona Stobutzki (CSIRO), that all the sharks were finally identified.

Following this work, the next major study of northern sharks was the Northern Pelagic Shark Programme (NPP) driven by John Stevens (CSIRO). The NPP was a series of twelve 24 day shark cruises, known basically as the "Rachael cruises". The Program ran from West Australia around to Cairns. FRDC was the prime funding agency, CSIRO was the lead agency and Northern Territory, Queensland and West Australia provided about $ 50,000, to at least run one cruise in their own fishing area. What was determined then is about 90% of what we know now about northern sharks. It was a huge programme. We can always refine information, but it was a phenomenal baseline study of species composition, life history biology, movements and stock assessment. Bycatch of marine mammals was an issue then because it was occurring in the Taiwanese fishery at the time, as well as in the NPP catches.

In 1985 Queensland Fisheries Management Authority (QFMA) hosted a Queensland shark workshop in Cairns for two days. QFMA invited expertise from Northern Territory Fisheries who assisted with shark identification for fishermen, quality control of product and how to deal with issues such mercury and market acceptability.

Unfortunately things slowed down a little bit from 1985-1987. DPI staff submitted at least five applications to various funding agencies to work on Queensland northern shark. The main aims of the applications were to identify the species composition of the shark catch throughout Queensland and to conduct workshops to assist the commercial industry to understand the shark composition better so they could record more appropriate information in their logbooks. The current FRDC Phase I study on sharks will go a long way to redress the previous shortcomings.

In 1991-92 QFMA produced a shark fishery questionnaire/survey on the sharks caught in various Queensland fisheries. The questionnaire identified that industry recognised about 135 species of shark despite only about 18 species being present in the fisheries represented. There appeared to be an enormous variety of different common names in use for the same species of shark. A best example was the “hard-arse shark”-being also represented by additional forms such as “blue hard-arse” shark, “white hard-arse” shark, all of which were probably referring to the pigeye whaler (*Carcharhinus amboinensis).*

In 1992 industry recognised that finning would be an issue in the future. They wanted to maintain their shark fishery, but they also recognised that some kind of documentation was essential to establish the conversion ratio of the weight of fins to the weight of body. In this current FRDC programme on the sustainability of northern sharks and rays, species identification and fin to body weight conversion ratios are being assessed by DPI fisheries observers.

Around 1992, mercury was also recognised as an issue. A report of the time indicated that a significant proportion of retailed product was substantially in excess of the

accepted mercury consumption guidelines. In recent (2001) sampling conducted by Australian Quarantine Inspection Service for the National Residue Survey, analyses of East Coast shark product indicated common occurrences of shark mercury content in excess of four times the accepted mercury level. It may well be that the most appropriate way for industry to approach this problem is to conduct its own risk assessment about the implications to the fishery of not addressing the mercury issue.

In terms of bycatch, the existence of the gillnet fishery in the Gulf of Carpentaria was seen as a concern at the International Whaling Commission Scientific Committee meeting in Grenada in 1999. A proposal had been submitted to work on the numbers of dolphins in the former Taiwanese fishery area, including the Gulf of Carpentaria. The study did not proceed for a whole range of reasons. However the bycatch of marine mammals within the present shark fisheries will always be assessed relative to the massive mortality of dolphins in the former Taiwanese (and Australian) fishery, no matter how inappropriate this may be.

More recently there has been greater attention directed towards northern sharks and rays. The Northern Shark Stock Assessment Review workshop (Qld, NT, WA and the Commonwealth) held in Broome (2000) identified that there still is poor species recognition in the catch of NT and Qld commercial fisheries, whether it be the target fisheries or the bycatch fisheries. Shark finning and biodiversity issues were also raised.

The current FRDC project-sustainability of northern sharks and rays, Phase I is funding this workshop. There are three main objectives that this workshop could provide for the Phase II continuation of the project, including:

- This workshop is to discuss some management issues including bycatch reduction. Hopefully this workshop will provide an open forum for industry to discuss these issues;
- The workshop will take industry further down the track of correct species identification of the majority of the commercial catch, with the ultimate objective of more indicative stock assessments;
- There will also be discussions about the role and value of the fishery observer programmes. I would like to express my appreciation to industry for their assistance to DPI in this regard. It has already generated benefits to industry and DPI.

Questions

GM: Northern Pelagic Program tagged a large number of shark in the "Rachel" cruises, John do you know how many?
JS: There was a large tagging programme in which we tagged about 10 000 sharks. There is a paper describing the results. The work was mostly in the Arafura Sea and a few were tagged in the Gulf. We will foward a copy of this paper to all attendants.
GM: The dominant paradigm regarding shark biology at the time of the NPP was that sharks would come into inshore waters to pup, leading to suggestions about nursery areas. How did the NPP change this?

JS: It was a fairly complex analysis. We examined that paradigm and found that there was some evidence that pupping might actually occur offshore. It was not clear cut. There was a degree of pupping offshore and that was something worthwhile learning.

Fisher: Is there an offshore and inshore stock in the Gulf and the Arafura Sea?

JS: There is certainly relatively little mixing between the two areas. So in terms of management you would probably want to treat them as separate areas. It is one stock, genetically and in terms of the fishery the amount of exchange is fairly limited.

Fisher: I think there is something you have to take into account for species composition within catches right from start. Correct me if I'm wrong but the Northern Fishery, that is, in the Gulf, is all set from surface down. Whereas the majority of guys that I know that fish on the East Coast fish the bottom up, not from the top down. I think that has a fair bearing on a lot of things you are going to raise.

GM: NPP found that there was a major species selectivity between gill nets and longlines. The longlines were attracting species that in terms of market situation were unacceptable. The Northern Territory at the time used a grouping of common names, they grouped a number of species under the term 'grey whaler'. These were species that had tough flesh. NPP did not compare bottom sets to surface sets, but did investigate mesh selectivity.

Fisher: Something that has come up, is the dolphin issue. I am concerned that this is going to be a bug bear. The fact is, we've been fishing for 4-5 years now and have never seen a dolphin. Because we set from the bottom.

GM: It may be that because you set from the bottom up the gear interacts less with inattentive dolphins, or it could be an acoustic effect that occurs when the net is attached to the boat and the engine is running, the dolphins can detect it. The NHT funded acoustic study seeks to quantify these data. SEANET is interested in speaking to net fishermen about documenting your observations.

MANAGEMENT

Current Queensland Fisheries Service Policy on Shark Fisheries
Shane Hansford

At this stage, I'm Acting Manager for Inshore Finfish and Crabs, so I am currently running three Management Advisory Committees (MACs), two of which will be discussing shark issues. I see this as a good opportunity to talk to the industry and find out what their concerns are and how they think they can get on the front foot. I do not want to give the impression I have all the answers for you. I am here to find out what your questions are as much as anything.

Given that my talk is supposed to be about current QFS policy on shark fisheries, I'll begin by discussing that. Primarily the QFS administers the Fisheries Act and the objectives of that Act set the policy guidelines for all fisheries, including shark. The objectives of the Act are:

? Ensuring the resource is used in a sustainable way;

- Achieving optimum community and economic benefits from the resource; and
- Ensuring access to the resource is fair.

What I will do is talk a little about the policy development process that occurs under this framework, because that has changed recently. While a lot of you probably know a bit about this, you might not be aware of the full details. The primary source of advice to QFS on fisheries issues are still the MACs, although these have undergone some change. Probably one of the biggest changes is the introduction of the Gulf MAC, which is going to advise both the Qld Fisheries Joint Authority (QFJA) and QFS on all fisheries in the Gulf that are managed under Qld law, including sharks.

There is now also only one East Coast Inshore Finfish MAC, whereas there used to be a Sub-tropical and Tropical Finfish MAC. The Finfish MAC will be advising QFS on East Coast shark issues. Finfish MAC meets for the first time on 3-4th December and Gulf MAC meets for the first time 21-22nd of November. So what I plan to do is to take what I learn from this forum, in particular any concerns that you guys have and feed it into those MAC meetings.

There has also been a change to the Zonal Advisory Committees (ZAC) system. Instead of formal ZAC meetings the QFS will now be running a series of regional meetings, with each region visited probably a couple of times a year. The previous ZAC system was criticised somewhat because there was a perception-true or false-that issues brought up at the regional level were not getting through the system. The way things are operating now regional issues are raised either directly with the Deputy Director General himself or one of the General managers of QFS. So you can be assured that regional issues that are raised are being considered.

The other big change is the revamp of the Fishing Industry Development Council (FIDC). The FIDC is a high level policy advisory body. It gives advice to QFS and/or the Minister, depending on what the issue is. The Minister can contact FIDC and request some policy direction on a particular issue. As an example, the FIDC may very well be asked at some stage whether or not Qld should adopt the recommendations of the National Plan of Action for the Conservation and Management of Sharks. That is a high level policy issue. Another example of a recent issue that FIDC considered was catch sharing arrangements for Tailor. The Minister asked FIDC to give him advice on whether or not Tailor should remain a shared resource between commercial and recreational fishermen. The advice from FIDC was..yes it should.

One of the other things that FIDC will be considering, and which could have some impact on the way some of you guys operate, is the development of a policy for assessing calls for recreational only fishing areas. FIDC is currently developing this policy and are looking at all the issues that have to be taken in to consideration – for example what sort of guidelines applicants have to meet, the possible displacement of commercial effort-those sort of things. This does not mean that FIDC is going to come up with a list of recreational only fishing areas, it is just a way to assess a fairly steady stream of requests for particular areas to become recreational only.

The other body is the Qld Fisheries Advisory Board (QFAB), which provides advice on the implementation of policy. With the development of a number of Fishery

Management Plans there is a danger that these plans may have conflicting aims. QFAB is a way of providing an overview. Hopefully it will play a role in allowing some high level stakeholder participation in the final drafting of management plans. This may help prevent a situation developing such as with the Trawl Management Plan, which was pushed through quickly and then there was major disapproval from a number of stakeholders over the process. As an example QFAB is going to be involved in the development of the draft management plan for the Reef/Line Fishery. They are meeting next week to discuss how that management plan is developing and what elements are likely to make up the framework for that plan.

In regard to sharks, QFS policy is going to be framed under a number of different conventions the government has agreed to. These are international, national and regional conventions. On an international level, Australia has responded to the United Nations International Plan of Action for the Conservation and Management of Sharks. Basically that Plan of Action recognises that worldwide sharks are vulnerable to overfishing. At a national level, under the framework of the United Nations Plan of Action, Australia is developing a National Plan of Action. There is a Shark Advisory Group (SAG) set up for that purpose, of which QFS is a member. The Draft Shark Assessment Report produced by the SAG lists a number of issues, I think about 25 were identified. Some of the major ones are-lack of species identification, the fact we have poor data, few stock assessments have been done, there is no means to assess current management arrangements, shark finning, and ecosystem effects of removing large predators. My understanding is that the current timetable will see a final Plan released in April 2002.
At a regional level, Geoff MacPherson mentioned that a Strategic Operational Plan for Northern Shark Resources is being developed between WA, NT and Qld. There is a workshop in Brisbane 4 and 5th of December to progress that issue, primarily by setting priorities. The major issues that have been identified are-we do not know the species composition of the fishery, we know little about stock distribution, and we do not know very much about environmental impacts and bycatch.

On a more local level, everybody knows about what has happened in the Gulf of Carpentaria. We have a management plan in the Gulf that restricts access to the offshore net fishery that targets sharks. Targeting of sharks in the Gulf is actually conducted under permits issued by the QFJA and administered under Qld law. Gulf MAC is the major source of advice on that fishery. The observer program that some of you were involved in earlier this year reported the capture and mortality of a few dolphins and a turtle. That led to a fair bit of public discussion, in the media etc, and the Minister announced that there would be a review of the fishery conducted within a two week period. A report was put to the Minister that included a number of recommendations. Because of the cross jurisdictional issues, that is the involvement of the NT and Commonwealth through the QFJA, and the need to start talking to people who are going to be affected by some of these recommendations, QFS released that report to the major stakeholders. The objective was to get some feedback before the government and the MACs start talking about whether or not we should implement some of the recommendations.

This is going to be a major issue discussed at the Gulf MAC. One of the major recommendations was that there should be a Bycatch Action Plan produced for that fishery, which would fit well under what is expected through the National Plan of

Action. That probably won't just cover the offshore or N9 fishery, but will also deal with issues such as dugong in the inshore N3 fishery as well. The Gulf MAC is the primary vehicle for developing this Plan, but I expect we will be having a workshop early next year, hopefully just before the fishing season starts up in the Gulf so we can get as many fishers involved as possible. We can get a framework together for what we think might form the Bycatch Action Plan and get the industry involved and any other stakeholders that want to come along. Hopefully that workshop will be held in mid-January.

On the East Coast for shark. The issues are:

- There seems to be an expansion of effort;
- Increased use of reel boats; and
- New entrants coming into the fishery.

QFS is beginning to get a lot of feedback about these issues and this is raising concerns. Great Barrier Reef Marine Park Authority (GBRMPA) obviously has got an eye on what's going on there and that is something industry is going to have to deal with at some stage. While I can see that fishers don't want GBRMPA involved at this workshop, clearly they are a major stakeholder in this Fishery. Darren Cameron is on the East Coast Finfish MAC so he is going to have a fair bit of input into this issue. One of the major concerns that are going to have to be dealt with on the East Coast is that the extent of any bycatch is unknown. Certainly there is going to be a perception that the East Coast will have similar issues as the Gulf.

As far as current initiatives are concerned: as I said, a Bycatch Action Plan is going to be produced for the Gulf Net Fishery and East Coast fishermen might like to keep their eye on that and start thinking about how they can go on the front foot for their fishery. It is part of the reason I am here, to start getting ideas from the fishers as to which way you want to go. The Minister has actually announced in the paper that there will be a ban on shark finning. Qld will introduce a ban on shark finning. So the MACs may have to progress how that is going to occur. There is going to be a continuation and hopefully an expansion of the observer program in the Gulf of Carpentaria. You might like to start thinking about the observer program on the East Coast- I think that's one of the things we will be talking about today.

The Department is involved in research into sonic pingers that Geoff MacPherson will talk about more later on.

One thing that is out at the moment, which probably does not really affect too many people here, is a regulatory impact statement on permitted fish in the trawl fishery. It proposes to impose a restriction of 30 kg of shark for trawlers. Comments on that close on the 27th November so if anyone does want to put in a response, make sure you do it by that date.

There is another big job we are going to have, I am not sure exactly when this is going to start, probably some time next year. We will start to look at net fisheries in general and the shark fishery as a component of that. We will be producing a report that will go to Environment Australia (EA) for assessment of ecological sustainability. All of our fisheries must demonstrate that they are ecologically sustainable if they want to

maintain a license to export and, with the changes that are coming with the Environment Protection and Biodiversity Conservation Act, all fisheries at some stage are going to have to address those issues.

Currently I must say there is no intention, that is there is nothing on the drawing board at this stage, to produce a management plan for the shark fishery. However with the things that are happening, for example the National Plan of Action I would not be surprised to see that change. QFS and the government may decide that shark fisheries are a high priority, though currently the emphasis is going to be on the Reef/Line Fishery. Shark is not really on the list of immediate priorities fore developing a Management Plan at the moment, but I would not be surprised to see that change.

So at this stage any management interventions, whatever is proposed or whatever gets accepted to establish the sustainability of your fishery will most likely be:

- By regulation amendments and/or
- Amendments to permit conditions; and /or
- Perhaps imposing new license conditions.

As I said I didn't come here to be able to spell out exactly the way things are going to happen for your industry, because I do not know precise details, however I hope I have indicated the way these issues will be considered from here on in.

Questions

Fisher: Do you see there is a permit issue coming in?
SH: On the East Coast? No. In regard to the permit issue I was talking in relation to the QFJA in the Gulf of Carpentaria. They are the only permits we have for targeting shark at this stage. So if those conditions change then under the Act we have a show cause process we have to go through to amend those permits.
Fisher: What are permits worth in the Gulf?
SH: A general fisheries permit costs about $100 and there is a cost per metre of net which contributes to the observer programme. For 1200 metres of net its $12 000.
Fisher: What do you see as the biggest problem through your contacts with the Minister as far as shark fishing goes, is it bycatch or finning or what? What would you say is the single biggest issue?
SH: At the moment the single biggest issue is the bycatch issue.

There was some discussion on how to define a dedicated shark fisher. Some fish for shark 12 months of the year and use net reels, while others are shark/mackerel/barramundi fishers that use dinghies to set the net and the net is hauled. Both groups consider themselves shark fishers. For those who fish a variety of species, the definition of bycatch was questioned.

Fisher: How can the legislation can be written up to describe bycatch? A Fisheries Officer comes to my boat and says "what's bycatch? " What do I tell them I'm doing? The word bycatch should not be used. We work in multispecies fisheries.

That's how I fill my logbook out every week. In the logbook, there is a bit on the side there "which is your target species?" I put "I don't target a species, I target what fish are there"

GM: Yes that it is a difficult issue. The East Coast Tuna fishery was a multispecies fishery until regulations appeared that changed the fishery to a target and byproduct fishery. There had been no marketing or fishery induced changes that drove this change. Operators within the fishery could not understand the change.

HISTORIC CATCH INFORMATION ON NORTHERN SHARKS

Collation Of Historic Data on Shark Catch- Sustainability Risk Assessment.

Neil Gribble

This presentation is based on the power-point slides provided by Dr Ilona Stobutzki, CSIRO. Ilona sends her apologies as she cannot attend, but has asked if I could give the talk for her. If you have detailed questions we will pass them along to Ilona.

Firstly some background

What we need to do as a group is to think about what issues are probably coming up and what we need to do in order to address these. Since the passing of the Environment Protection and Bio-diversity Conservation (EPBC) act, and before that the Schedule 4 requirements, if you want to export your product you are going to have to carry out *what is essentially an environmental impact statement for your fishery.* Or at least the managers of your fishery are going to have to. If it is not done the Commonwealth have the powers to refuse to issue export licenses; you could be stopped from sending your product overseas. That is, unless you as a fishery can prove the ecological sustainability of your practices you may not have a market outside Australia. This is particularly relevant for shark fin, which only has a high value in overseas markets.

As pointed out by Shane Hansford there are, International Shark Action Plans, National Action Plans and the Strategic Assessments of various fisheries. The major deadline we have is to show that the "East Coast Shark" is a sustainable fishery by the year 2002, otherwise the fishery may not get export licenses. I must emphasise the commonwealth through *Environment Australia* (EA) have that power.

Sustainability of northern Sharks and Rays.

Ilona's project was designed to cover WA, NT and Qld, to come up with a way of measuring sustainability of sharks and rays. In the process it will also provide a overview of catch and bycatch of northern Australian sharks and rays. Ilona got the funding from Natural Heritage Trust (NHT) and the project has been going for ~18 months now, but it is a desktop study involving no fieldwork. The basic method is to get a hold of whatever information has already been collected of northern sharks and cobble that together in an analysis trying to gain an idea of *the sustainability for the*

stocks. The people involved in the project are from GBRMPA, CSIRO, DPI, Fisheries in NT and WA, and the Bureau of Rural Sciences in Canberra.

The overview of Australian sharks and rays is important firstly in terms of marine biodiversity. Something like half the known shark species occurs in Australia. Secondly, if you look at the commercial value, 5% by weight of Australia's commercial fish catch is actually from sharks. Five percent is an appreciable amount by any standard.

Fisher: Were you talking weight of the shark barrels?
NG: That would be taken from Australian Bureau Agricultural Research Economics (ABARE) figures, that is a summary of kg of whole product.

There has been increasing concerns about sharks due to increases in catches worldwide and the underlying biology of sharks and rays. Some sharks and rays, just because of their biology and geographic distribution are very vulnerable. They are long lived, slow growing, and have low number of pups; all of the wrong things if harvesting the species is to sustainable. It makes these species highly susceptible to overfishing. However, there are other species of sharks that are not as susceptible. They grow fast and show high fecundity (they have lots of pups); they can be shown to be sustainable species to harvest

This is the reason for the NHT project. A desktop study to assess the sustainability risk based on characteristics of the shark biology, shark species caught, and the fisheries. The test case was the shark/ray bycatch from the Northern Prawn Fishery. The reason that this fishery was used is that it represents the best available dataset, because CSIRO had been studying the prawn trawl fishery for the last 20 odd years. [Remember, although we are talking about the North Prawn Trawl Fishery, this method can be applied to any other fishery]. Fifty-six species of shark and rays have been identified from the catch. The problems with the dataset are:

- Sharks are a bycatch not target species;
- There is a high diversity of sharks; and
- There is very limited stock-assessment information, particularly from the prawn trawl logbooks.

Conventional stock assessment was not possible and an alternate approach had to be developed.

To estimate a measure of sustainability two questions were asked. What are the likely species to be caught by a prawn trawler and how many of each species are killed? That's termed susceptibility. The second question was how fast can each species recover? How fast is the population being reduced, balanced by how fast are they coming back up. Plot susceptibility against recovery and you've got a sustainability-risk analysis (Figure 1 at end of this presentation).

You can estimate susceptibility of a species by taking a look at where they occur, where the fishing occurs, and knowing something about their biology. Such factors as where they normally occur in the water column (bottom dwelling, mid-water, highly migratory), natural mortality/survival, what they eat, day vs night catch rates, etc. It

tells you whether or not they are going to be caught by a trawler- that's their susceptibility.

Fisher: Haven't the trawlers got bycatch reduction devices?
NG: Yes now they have TED's - Turtle Exclusion Devices. They exclude just about any large object, including sponges and sharks. This analysis is based on the information they had prior to TED's.

Recovery. That is how fast a population can reproduce. Information that you need for an estimation of recovery is:

- Age reached before they are caught (have they bred);
- How large they grow;
- How many are caught;
- How often they breed; and
- How many pups.

If you have that sort of information on your shark species, then you have a chance of coming up with that graph of the *susceptibility vs recovery* giving you the *sustainability-risk analysis.* The uses for this sort of analysis are going to be addressing EA legislative requirements. If you at least know what species are being caught then you can start managing it.

The progress report so far for the NHT project.

What Ilona has done is to map where the shark species occur and where the trawl fishing occurs, so you can lay the maps on top of each other. This, combined with the biological factors, will give an estimate of susceptibility. Most fisheries have no bycatch information so you have to estimate what species are being caught *based on depth and geographic distribution.*

For an estimate of recovery we have to summarise the biology for all the species and then rank them according to their recovery ability. That is based mainly on how many pups they have and how fast they can put more pups into that fishery. If you do that for all 56 species in the NPF you come up with is a sustainability risk graph for the NPF sharks and rays (Appendix I, Figure 1). Species at the lower left of the graph are the have the highest risk (least sustainable) that is, rays and sawfish. The species towards the upper right of the graph are sustainable and they can be fished; that is, species that are susceptible but recover fast.

So it works both ways. It shows you [for any fishery that it is applied to] the least sustainable and the most sustainable stocks. That is, the shark species that should be avoided, by a code of conduct or possibly seasonal or spatial closure of sensitive areas, and those species that can be **demonstrated** to be sustainably harvested.

What we have to have done by the end of the project in October 2002, is to:

- Carry-out the sustainability risk assessment for the northern Australian shark fisheries;
- Identify the research and information gaps; and

? Have identified and recommended bycatch reduction measures where necessary.

Across the north a major information gap is the unreported bycatch in other fisheries. It is an unknown how much shark is actually being taken across Northern fisheries although we know how much is reported in the targeted shark fisheries. So without a complete picture of the catch we are unsure of the status of the stocks, which makes life difficult if you are trying to come up with assessments for EA

For the Queensland East Coast shark stocks, there is a lack of catch composition information. The logbooks in Queensland record kg of shark fillets and trunks but do not have species. Without species information again there is no way of completing a sustainability risk assessment. We need the assistance of the shark fishers to get this information, to fulfil the EA requirements so the fishery can export its product.

That's Ilona's talk.

Questions

Fisher: Have you got those sustainability levels there for those shark species?
NG: You can contact Ilona for information from the report. Remember that this is for the Gulf sharks - not truly coastal but deeper water sharks.
Fisher: When you say deeper water- how deep?
NG: GoC is only about 20 m deep on average. It is fairly shallow but the observer programme has shown that there is a difference in the species between the inshore gill net fishery and the offshore N9 shark /mackerel fishery, so there are definite differences in those species compositions in the Gulf.
Fisher: Is Ilona's study based on guessing what shark is caught?
NG: Ilona's study is based on what is the available information in the documents and databases that exist now.
Fisher: The amount of highly susceptible sharks and rays that are caught, does she guess a figure for that?
NG: She knows what's being caught as bycatch in the NPF as it has been recorded. There were research studies done by CSIRO on the bycatch and from that they can say which are the ones that are *vulnerable.*
Fisher: That was prior to TED's being introduced. Now they have been introduced they should let all of those larger rays and sawfish out.
NG: Ilona has about six observers out on their boats at the moment checking.
Fisher: But wouldn't that study be incorrect if it was going to October 2002. You'de have to revise all that now the TED's are in.
NG: There are 6 observers out on boats in the Gulf as we speak revising that. Their boats have to have TED's.
Fisher: That graph of susceptibility/risk may not necessarily be correct now the TED's are in. 56 species, some of those in the highly susceptible area may have now become not so vulnerable.
NG: If the TED's are working the way they are supposed to be, yes they should shift. That's for Northern Prawn, where we are talking about trawlers, not gillnets. That's the case study that Ilona used because the data was at least there. There are not too many other fisheries that are as well documented. The method appears to work with that data-set so it can be applied to other fisheries. It is a useful starting

point at least, otherwise you start taking a look at the precautionary principle. The assumption will be that shark fishing is not sustainable and you don't get your export licenses.

GM: It would be fair to say that some of the animals might be less effected over the period to 2002 because of the bycatch reduction devices, but at the same time considering the life history and longevity of some of those animals they might still be affected another generation. An animal that lives for 20 years if they've been affected over the last five or six years- two years isn't going to make much difference. That susceptibility recovery graph is something that is the first step and then it can be refined and that is what Ilona is doing.

NG: It tells you that if a fish is easy to catch and then it has very fast recovery- it's not a problem. If it's easy to catch and very slow recovery-then you have a problem. That's what the graph really tells you. Closed areas of the reef means that you've got refugee-spatial areas where you can't fish, so they are okay there and they send pups/juveniles into other areas where they are vulnerable, but that's another side to it - it's catchability or susceptibility vs recovery.

Fisher: There's one thing about all this, we are talking about a completely different thing, were talking about gillnet fishing and all the information you are passing on to us is from a trawl fishery. They fish a different type of water, different depth, different area to what we catch so really its hard to manage our fishery on information that's not from the gillnet fishery.

NG: What you've got to be able to do is the same thing for the gillnet fishery. It's got be specific to the area and the gear that's used. But you can do the same thing. You take a look at what the vulnerability is vs what the recovery for exactly the gear you are using and come up with a sustainability-risk assessment which is what EA wants.

Fisher: That's down the track, that's not now. You don't have the information available at this stage on the species to complete that. I'de hate to see next year or the year after a knee jerk, where we get restrictions on our shark fisheries. Very easy to put figures up on the board and people sit around and shake their heads. You've got to make sure of what's happening.

GM: The data necessary for doing the same sort of exercise is being collected via observers in the Gulf. A lot of that information is available, its just that Ilona hasn't put it into this form of analysis yet. You also allow for the fact that there is a range of fisheries, each one taking shark as catch or bycatch

Fisher: Gillnet fisheries in the Gulf, how can they be managed just on that?

Fisher: That's just a test case.

Fisher: CSIRO have spent many years researching the biology of the shark, but do you know all the species yet, their birth rates, their life rates etc ?

NG: We know a lot of the northern species from the pelagic northern study.

Fisher: So you have a fair bit of information on that side of it, but what you're saying is they expect that by October 2002, which is less than 12 months away they want all the detailed catch data. We target shark and we just put all the barrels together that go to market, we don't separate them into species. We know a few types of sharks, what we call ridgebacks, blacktips, etc but we have a hell of a lot of different types of shark that all go in as trunks. We don't record species on our logbooks and even if we start know, in less than 12 months they expect all the fishermen to give this data for you to use on that graph and then work out by 2002 which species are susceptible. That's difficult. To be fair to the commercial netting

sector we should have been doing it 20 years ago along with CSIRO for it be a fair estimate.

NG: What they are going to have to do is give us time. This is true in every state in Australia not just Qld. This is EA requirements Australia-wide, every fishery has to prove their ecological sustainability, even the mudcrab fishery. I thought there would be absolutely no problem with mudcrabs because there is no bycatch. That was until I found that there is bycatch- you can catch turtles in mudcrab pots. If you get a hawksbill or a loggerhead, both of which are protected animals, you have to come up with a threat abatement plan. For mudcrab pots!

By the way the threat abatement plan for crabpots is putting in plastic funnels so if the turtles stick their heads in they'll pull the plastic out backwards and won't get the crab pot stuck on their heads. So there are ways. You have to accept EA reports have to be done. You think it through and come up with ways for handling it. Going back to what you were saying about the sharks.

There is a certain amount of information already available. We are hoping to put observers on boats on the east coast to refine that information to get us the species composition of the catch so it will go in realistically into some sort of sustainability-risk assessment which will then satisfy EA. It may not be able to be done within that 12 month deadline and we may have to ask for a stay of execution, [to ask for more time], but I think every single state is faced with that. Ultimately it will have to be done. It is the challenge for the fishing industry, but also for researchers and managers. We're going to have to prove both nationally and internationally that we run sustainable fisheries.

Fisher: You know those crabs you got Neil, with that information you should be also have on another graph what hasn't been caught, what grounds haven't been fished and what's left over.

NG: That is needs to be taken into that vulnerability component. Because obviously if half the spatial range of the species area is in a protected area and you are only fishing the other half, then they have got a fair bit of protection. Spatial refugia is one of the things you have to put in it the vulnerability component.

Fisher: One of the problems that I can see is reporting the different species that fishermen catch. If there's certain people in the sector who couldn't care less, they'll just put that they caught all blacktips for what might be a vulnerable species of shark. If you catch sawshark, because that's a very susceptible species, the whole fishery is going to be closed down because netting catches sawfish.

NG: Part of the code of conduct that was developed in the Gulf inshore gillnet fishery actually dealt specially with ways of releasing these animals alive if caught. It was pro-active, coming up with the solution before they were forced to by management.

Fisher: So if you introduce in a code of conduct that if you should catch a sawshark in your net, you will release it, you'll cut your net and release it.

NG: If necessary and there is a set of instructions for how you can release them alive. Remember if you do not, then no fishery.

Fisher: Okay if we have that in a code of conduct our netting activities would not be closed if we followed the procedure written in the code of conduct. How would they know that we were following that procedure? Would they not accept white shark fins as a fin, for example.

NG: If you've got it in place and you say, okay we will abide it and these are the steps we will take you are ahead. Dugongs, turtles, dolphins, sawfish are all protected species and by law you have to have a way of handling their incidental catch. If you get a dolphin in the net, how do you get it out alive? What are the processes that you go through? If you trapped a turtle and it looks pretty crook, what do you do with that turtle? Do you bring it on board the boat and let it recover or do you just pop it back? Those are the sort of things to cover those in your code of conduct. You can also state that you will collect the plastic that you find and bring it back, all of those sort of things; that's your environmental awareness as well.

Fisher: This term bycatch is sort of thrown at us all the time. Where is the list that people look at for their bycatch. In our crab pots we've caught dingoes, is that a bycatch, you talk about turtles, we've caught dingoes, wallabies, crows. What are they going to stop at, if we don't included all that into our code of conduct, we've got to go through this all again because some person or group have decided that crows are getting scarce. It's not funny because it's just getting out of control, this bycatch thing they keep throwing at commercial fishermen.

NG: All you can do there is to put down what can be reasonably expected of you. Meteorite strikes you can't reasonably put in. Very low probability things like catching dingoes is not going in, but catching juvenile grouper in your crab pot, or turtles or whatever, they are real possibilities and you can actually put in what you would do- release them alive. They're the rules that you put in for yourselves and that's what you apply. Then EA look at it and say right they have already anticipated and done this. This is what they, as an industry, have decided they will do. It's a way of doing it, it may not be the best way, but it is a way of doing it and it's a way of self regulating. Instead of having another outside group saying this is what you will do, you say this is what we have agreed do to.

Fisher: Why don't they look at bycatch from a different perspective. Instead of bycatch being something that you have to hide the fact that you caught it if it's dead. We don't go out to target turtles and dingoes and dolphins and dugongs, but there are communities within our communities, but mainly the native title people that would not call that bycatch. They would call that a target species and they have every right to do so. I don't have a problem with that but why don't they look at bycatch as a product they could use and give it to those people. Instead we have to hide it, because if they find out we catch a turtle for instance they close 700 square kilometres of area to the fishermen. They look at this bycatch as an excuse to get rid of fishermen who are providing a food product to a country and to our export industry all because of a couple of dugongs or turtles or whatever. I understand that they need to exist but if you catch them why don't they look at bycatch and turn it around into something that's useful to a community that eats it. Maybe not the crows, but the dingoes and the dugong.

NG: There is no answer

Fisher: There's no answer because people are trying to set all these policies into our life are listening to groups that are one-track minded, if you want to put it politely. There'll be a handful of people in Holland that think they should tell Australia or America what to do. The bycatch question, even in a code of conduct-I see it time and time again, but it comes back to us to try and prove that we are necessary in the food provision to people even with a code of conduct. I've been involved in a code of conduct with the mud crab fishery in Qld just recently and I understand that it can be done, what I see, no matter what you do, you spend all your time doing it, and you probably find it yourself, the minute you finally think you have

come to an outcome, someone else wants you to do something else to prove your existence.

NG: I think we can handle that this afternoon. That discussion should be had this afternoon.

Fisher: I still think your better off doing it, instead of getting Senator Hill to say no you can't do that at all.

Fisher: What happens with a change of government and Senator Hill is no longer. It is a possibility you have to think about it.

NG: This is an international movement, it is bigger than Australia. Australia is responding to forces that are International such as the International Shark Action Plan. This pressure is there and it is better to respond and handle it than to try and hide from it.

GM: If your really concerned that you have a bycatch issue, you cannot hide it, be up front about it, demonstrate through a plan of action such as a code of conduct that you are really doing something about it. An independent verification of fishers information would allow proven statements to be made about the fishery. Without the information, you have only innuendo. The best approach is to be up front in developing the information. That is what we are looking towards today, to having issues raised and discussed and to gain input and ideas from you people that will assist the development of a research programme which addresses the issues.

ACOUSTIC DEVICES FOR BYCATCH REDUCTION

Use of Acoustic Warning Devices On Set Gillnets

Geoff Macpherson

I would like to describe how acoustic alarms have evolved in Queensland fisheries. Dennis Ballum, myself and Neil Gribble will be in touch with you further about acoustic alarms with more details in association with an NHT study, but for now I would to briefly cover the evolution of the devices evolution with some explanation of how they work.

In 1985 acoustic alarms come in two different forms, active and passive devices. Active devices were called alarms or pingers as they generated a noise underwater. The Japanese were the first to build them, they were about the size of a keg of beer. They fitted onto floating driftnets in the North Pacific set for salmon. The idea was that they would produce a noise in the water that the salmon could not hear but that a species of dolphin could hear and would respond in one way or another, hopefully to avoid the net. It was the first time that this form of bycatch mitigation had been attempted. The gear was difficult to deploy but at least the Japanese in 1985 were concerned about the dolphin bycatch issue and attempted to address it.

A Taiwanese (with minor Australian involvement) gillnet fishery operated in Australian waters up until about 1983. Bycatch of dolphins was considered to be at critical levels with thousands of dolphins being killed each year. A mammal researcher, Durant Hembrey, was involved with the fishery (including Northern Pelagic Program) to investigate ways of reducing bycatch. He was working with devices he referred to passive acoustic devices. A passive device doesn't actually

generate a noise. Durant was hanging air filled aquarium tube, bead chains etc over and through the net mesh as the material would function to reflect dolphin sonar pulses. Deployment proved to be extremely difficult. The idea was that the tubes/chains would provide alternating interfaces of plastic, metal air that would function as a reflector of sonar pulses. The aquarium tubes started filling up with water and didn't work quite so well, the tubes and chains tangled badly.

Fisher: Was it successful?
GM: No. Unfortunately Durant died very soon after the field work for this programme was completed. Durant's general conclusion was that dolphins probably echolocated a lot less than what was popular opinion.

This was early days in the understanding of the biology of dolphins. The feeling before was that dolphins would echolocate frequently and be totally aware of their surroundings. We know that a dolphin can pick up a gillnet at about 100 yards. That is with full power, emitting about 200 decibels at about 50 kilohertz with its sonar. Dolphins can then easily resolve a monofilament gillnet thread and be able to determine the position of the gill net. However shark concentrations can be very patchy. A patch of shark over there, a patch over here and in between there can be nothing. So the ocean around a shark net can be very quiet if there are no sharks struggling in the net. From what Durant used to say if the surrounding ocean is quiet, the dolphin is basically in navigation mode, there is no noise to wake it up. It has one hemisphere of its brain turned off and then one on, off, on, alternating. It is just relaxing and only putting out sonar at a level of about 140 decibels. It will pick up that same monofilament gillnet thread at a range of about 1.5 metres. That's a little bit late.

Fisher: Are they swimming while they are in this navigation mode?
GM: Yes they are asleep, they are swimming, cruising. If something wakes them that's loud enough, say 1 to 20 kilometres away, it could be a sound of a fish or a shark struggling in a net or a working trawler (respectively). Then the dolphin can turn on full power and work out what was happening.

In Otago there were some researchers working on a very small species of dolphin that lived in fairly turbid water. They could see the dolphins, they knew they were feeding on trevally, they said "this will be great to study, we'll put a hydrophone in the water and listen to their sonar." No sonar pulses were detected but the dolphins were actively catching the trevally in midwater. Then the researchers realised that dolphins spent a lot of time listening and they were actually tracking the fish passively, listening to the swirls coming off the fins of the fish. I have aquarium fish at home. Late at night if I turn all the sound off in my house and put a little bit of food in the water I can pick up with a hydrophone the sound of the water swirling off the fins of fish 3 cm in length. Dolphins can pick up on those sounds, they do not have to use active sonar all the time. They are listening. The general idea of the active pingers is to introduce sound into the environment to wake the dolphins, the dolphins then have to make a choice about what to do.

The first detailed research work on low frequency was conducted by Professor Jon Lien of Memorial University Newfoundland. In Newfoundland waters there was a major problem with humpback whales being entangled in codtraps. A codtrap is about

the size of this entire building, a big box of anchored mesh net floating in deep water. The humpback whales were running in to the codtraps as they fed on smaller fish.

This caused a lot of friction with environmental groups, a lot of problems for the fishery in terms of lost gear and time and real concerns about closure of the fishery as humpback whale stock size was at a very low level. Jon Lien's group spent a lot of time observing the behaviour of the animals from high coastal positions around nets fitted with alarms. They could see the whales turn towards the nets with alarms on the nets, coming in to investigate and then move away. So there was a behavioural response. To assess the impact of alarms on the number of bycatch interactions, they set nets both with and without alarms. It became obvious that the alarms reduced bycatch of the humpback whale.

In 1991 Baden Lane from the QSCP invited Jon Lien to Queensland to investigate the humpback whale bycatch problem. He came and started building acoustic alarms. We had some experiments on the Gold Coast where we had acoustic alarms on every second net on the Gold Coast. When we caught two whales in nets that did not have alarms, there was so much pressure on the Department that alarms were put on every one of the nets. There went the experiment to prove whether alarms reduced marine mammal bycatch.

What are acoustic alarms and pingers? I refer to acoustic alarms as devices that produce three kilohertz sounds. When you are at your local supermarket and you are about to be run over by a reversing truck the last thing you hear before you die is a 3 kilohertz reversing alarm. The devices that I refer to as pingers are higher frequency devices at 10 kilohertz. These emit a sound similar to a musical triangle. Some people more than 50 years old who have had significant hearing damage from engines etc can't hear 10 kilohertz. My sons can detect 21 kilohertz emissions which is pretty amazing. When "flipper" chatters it is at around 10 kilohertz, it is what we would refer to as the dolphin "chat" channel. The secret dolphin business is sonar and is above 20 to 100 kilohertz.

Harbour porpoise is the one species of dolphin that really has got into the news with pingers. It's a very small species of echolocating marine mammal that is extremely common in northern hemisphere waters. The harbour porpoises are caught in largely oceanic type fisheries, these are the animals that in the past have been killed in the greatest numbers by drift gillnets.
Using a variety of pinger designs, bycatch of harbour porpoise has definitely been reduced. More and more states in USA or Canada are now legislating that pingers are mandatory. You can choose your model or make, as long as you use what is appropriate for your type of bycatch. With dolphins, that emit a sound, in the "chat" channel is appropriate, with harbour porpoises that only echolocate a warning signal within the echolocation band is appropriate.

There are a range of dolphin alarms/pingers available. QSCP started using them in Queensland in 1991, some were our locally built alarms and some were commercial pingers. Both had early failures although much more effective devices are becoming available. In New Zealand and Natal KwaZulu they are using them to great effect with some interesting results on similar species (Hectors dolphin and Indo-Pacific humpbacks respectively) to what we have in Queensland waters. In some areas of

New Zealand it is now mandatory to use pingers and in others the fishermen in co-operation with the environment and fisheries departments are buying the pingers and setting them on their nets. In Natal KwaZulu pingers are being intensively monitored on shark nets.

In any fisheries bycatch reduction strategy it is probably true to say that a range of solutions may be required. Acoustic alarms/pingers is one solution, there is a whole range of others that relate to closures or modifying fishing gear at different times. Anything about bycatch reduction involves a package of things. Today I am here to talk just about alarms and pingers.

In all the fisheries that have been examined where there was sufficient statistical power assess the issue of acoustic bycatch mitigation, bycatch reduction was always demonstrated or suggested. They have examined this in some US fisheries. They set the pingers at specified spacings and used observers to monitor catches when pingers were deployed or not. Bycatch reduction was of the order of 90% for harbour porpoise. An alternate method was to observe the behaviour of animals around nets using theodolites to observe where the animals surfaced to breathe relative to the pingers and nets. This latter method only works close to a mountainous coastline. The research determined that the mean distance of surfacing from the nets was always greater, or further out when pingers were on nets. As a rough example, for one particular pinger and a harbour porpoise off Seattle, the surfacing distance from a net with no pinger was about 100 metres. They could hear the sound of the net in water current and apparently with the aid of echolocation knew the net was there. When they put pingers on the nets the mean distancing of surfacing was about 150 metres out.

There are some disadvantages with acoustic alarms/pingers. The bycatch reduction is never 100%. In fisheries where bycatch is low, effectiveness would always be difficult to prove statistically. There are some that are concerned about the effect of alarms/pingers excluding mammals from necessary habitat, although that would vary for the species. Another concern that has been expressed is the use of a repetitive signal that mammals may become accustomed to and ignore with disastrous results.

In response to these concerns especially that "bycatch reduction is never 100%" one should consider what device or piece of machinery is ever 100% effective or what really works every time. If you can demonstrate that something is showing a good trend with one method that's great, but if you can use another method and demonstrate the same trend for that device being examined then you can be confident the devices is being effective even if it isn't 100%.

That is what is being attempted in a current NHT funded study to examine the effectiveness of alarms/pingers.

The University of Qld is working with pingers researching the surfacing behaviour of dolphins and dugongs around pingers. QDPI and SEANET are working with commercial fisheries to see if we can reduce the bycatch of dolphins and dugongs using alarms made at NFC Cairns as the cost of using commercial pingers for dolphin bycatch experiments would be prohibitive at this stage.

The only way we can do that is for commercial net fisheries is to have some kind of experimental procedure where pingers are on the nets, pingers are off. The only problem we have had is that when people have used the alarms so far is that want to keep using them as they do not want to catch another marine mammal. There goes our experiment and our opportunity to assess the effectiveness of acoustic devices.

QDPI and SEANET are building acoustic alarms for use by commercial fisheries basically in my garage. From the logistical trials conducted during 2000, we have painted them green because tiger sharks eat the white ones. We have also tested NFC alarms at the University of Hawaii and found there is no electromagnetic radiation leaking from NFC alarms which may alert sharks to the presence of alarms/pingers on nets and scare them away. The reverse may in fact be true. The QSCP has also determined that sharks are not capable of hearing alarms/pinger, some species of fish however may hear them.

We are still making our own type of alarms. These particular ones we have, they are suitable for whales and dolphins and dugongs. The 10 kilohertz ones, the really high ones, will only work with dolphins, the whales and dugongs cannot hear them.

Fisher: Why don't you spend some of your research money working out a pinger that will attract the sharks?
GM: I can but that's not appropriate at the moment, we are working on bycatch reduction.

In different environments pingers and alarms need to be set at different distances apart. Sound propagates at different rates of attenuation in different environments. There are substantial differences between the shallow inshore waters of the Gulf and in the middle of the Gulf. There are different levels of background noise in these environments. The recommended spacing of the alarms takes propagation rates and background noise into consideration for different habitats.

I am trying to build a wall of sound around the nets that we can use as an experiment. The NHT study is attempting to determiner what is appropriate for whales and dugongs, and not particularly energy efficient for use with dolphins. We should have 100 of these alarms ready for the 2002 N3 and N9 fisheries.

There are high frequency pingers becoming available. Two new models have recently appeared in the USA. There is another USA and Unit ed Kingdom model. They all seem to last for a year of fishing operations, they are rugged, they tolerate extremely deep operations however most appear to be somewhere between AUD$160-200 each. The main problem with most of these high frequency pingers is that new versions do not turn off unless manually pulled apart. This would be a major problem for crew working on the vessels. The alarms that we build, at the moment with the electronic components they cost $80.

Conclusion

Experiments to determine the effectiveness of NFC built acoustic alarms in Queensland waters are set to continue next year. Dennis Ballum of SEANET would really like to speak to you about conducting acoustic trials by yourselves and with

QDPI observers next year. At this stage we have little data on which to base our conclusions, we need your assistance.

For dolphin bycatch issues it is most likely that commercially made pingers will be most cost effective for the Queensland offshore fisheries.

Events since the Cairns Workshop

? The manufacturer of the newest US pinger has dropped its unit price to US$55 each. The massive reduction in cost (from approximately US$90) may have been due to a recent order for 500 units for use in US east coast waters. The device has real potential for use in Queensland waters. Issues such as recommended pinger spacing for Queensland waters would have to be determined. For more information contact Geoff MacPherson.

? The DUKANE Corporation, the original manufacturer of 10kHz pingers has indicated that it will no longer pursue acoustic pinger production.

? QDPI (NFC)/ James Cook University/ Defence Science and Technology Organisation have just received a grant from AFMA and Eastern Tuna MAC to investigate the potential for tracking the locations of marine mammals in three dimensional space. The study is essentially an engineering study, however ground truthing should determine if a constructed hydrophone array will accurately locate animals. This study will have major implications for tracking/locating dolphins around gillnets and assessing areas of high dolphin concentrations. Methods should be considerably easier where water depth is substantially less that horizontal distance and tracking solutions approach two dimensional situations.

SHARK IDENTIFICATION

Shark Identification Manual Field Guide Discussion and Instruction
John Stevens

To have reasonable management of a fishery the correct identification of species caught is very important. I will give a brief background as to why we developed this Field Guide and how it is intended to work, followed by an explanation on how to use it. We will then examine a few sharks and ray specimens. I would like some feedback on whether you think this Guide is going to work reasonably well. It is not completely finished which means that we can still get a bit of input from you that may be incorporated into the Guide.

The Guide was developed as a co-operative effort between CSIRO, AFMA and FRDC. It's main aim is to improve fishery collection and monitoring data by obtaining improved identification of the main sharks and rays caught in both target and bycatch fisheries. It is not intended to cover all of the species, as there are about 300 species of sharks and rays in Australia and there is already an identification guidebook (Sharks and Rays of Australia) that describes all of them. This Guide is aimed specifically at fishers and covers the main species that they may encounter. It

covers about 96 species, around one-third of those in Australia. The Guide is not very large and we do not expect instant results, but we hope over time you will become more familiar with it and as a result we will obtain improved logbook data.

The Guide is being produced partly in response to recent legislative changes in fisheries, such as strategic assessments, particularly of Commonwealth fisheries, and Bycatch Action Plans. Consequently, there is a lot of emphasis on improved data collection and improved identification of both target and bycatch species. For many of the other target shark fisheries in Australia there is fairly good information, but in the case of northern shark fisheries, the information on target species is not particularly good, let alone that on the more minor and bycatch species.

The Guide addresses sharks and rays as they tend to be more vulnerable to fishing pressure than other species of fish and as Australia has a particularly rich shark and ray fauna. There are about 1 000 species of sharks and rays in the world and about 300 occur in Australia, that is, about a third of all known species. Around half of the species that occur in Australia only occur in Australia and nowhere else.

The Guide is divided into four main sections, based on area and fishing method. In this way fishers from different areas in Australia can move directly to the section of relevance to them. The four sections are:

- Pelagic species - mainly of relevance to the tuna fishery, that is, the sharks and rays caught in the tuna fishery;
- Northern demersal species - mainly applies to the NPF and to you people;
- Southern demersal species; and
- Rarely caught or protected species.

If you cannot find a particular shark or ray in the Guide, it may not have been included. This Guide was designed primarily for Commonwealth fisheries and it is not possible to include every species known to be caught in every fishery. The Guide had to be a compromise between ease of use and the number of species covered.

Apart from the four main identification sections there are some very short introductory sections covering:

- Markets and trade for sharks and rays;
- Research;
- Data collection; and
- What to do if you catch a protected species.

Icons are used to cover a lot of the information. (Appendix1, Figure 2). In terms of the principal fishing methods that a species is caught by, we have used symbols for gill net, trawl, hook and other symbols for depth range and distribution. It is not finalised yet, we still have a bit of room for a degree of change. We tried to keep it pretty simple and use non-scientific language, but it cannot be completely avoided. There is a glossary to explain unfamiliar terms and an explanatory figure that points out the main features of sharks, rays and chimaeras.

The main identification sections use colour photographs of each species with arrows on them that highlight the main identification features. (Appendix 1, Figure 3). For example, for the shovelnose ray (shown in figure 3) the main features which are used to split it from other species are marked. The icons indicate that the species is caught in the north mainly by trawling, and it occurs mainly on the continental shelf. There is only a fairly small section of text that describes how a species is split from those that are most similar to it. There is also some information on size, usually minimum, maximum and the most frequently caught sizes, with also some text on fisheries remarks or interesting biology. The text has been kept to a minimum.

Fisher: Are there other pictures of shovelnose rays. I've heard them called guitarfish.

JS: That brings up an important point. The use of common names, which are used by fishers, can be a real problem. In this Guide there is the scientific name and the recognised common name, with some other common names in use also listed. The problem is we cannot cover all those other common names. For example, the other day we were sent a shark from Qld and the fisherman called it a pickhandle shark. Have you ever heard of that?

Fisher: No.

JS: That's from the Gold Coast area, which indicates that even within one State from region to region you can have a real problem with common names. We need to find a method of getting a name recorded which is going to be meaningful. So we want to try and encourage either the use of the recognised common name, or probably a less attractive option is that there is also a unique six digit code which is standard for all species around Australia, for example it is in the Seafood Marketing Guide. We do not expect people to memorise codes. In some cases, with the really common species, after time you may get used to just remembering a code for a species, but probably the best way is for you to use the recognised common name.

There is also a key (Appendix1, Figure 4). It is a key that identifies to family level only, not to species level. I don't expect that you will use a key very much, though it is quite simple to use. For scientist or researchers, the normal way to identify a fish is by using a key. Basically, it is a series of multiple alternate choices. If you examine this shark in front of you, there are two choices-has it got 5-7 pairs of gill openings, or has it only got one. Depending on how you answer that, you either go to number '2' or number '43'. So it leads you through with alternate choices. For example, it's got 5-7 pairs of gill openings, so go to '2'. We are then faced with two other choices-is the snout saw-like, flattened and armed with lateral teeth or is the snout not saw-like. There are often pictures alongside each choice to guide you. I do not expect you people to use this key, it may be of more use to observers who we would like to use it. But if you are faced with a shark or ray that is not covered in the guide, this is at least one way you could get it to family. It may look complicated but once you get used to it, it is quite a simple thing to do. This is a modified version of the key out of Shark and Rays of Australia which is our bigger identification guidebook. We modified the key slightly to avoid the use of scientific language.

We do have information from other fisheries that shows that the quality of logbook data can be improved by simpleidentification guides. We produced an identification sheet for the deep water dogfish which are taken as bycatch in the orange roughy fishery that resulted in a large improvement in the commercial logbook data. In fact

the subsequent logbook data was of better quality than the early observer data. Some fishers still may incorrectly record species, though observers on boats tend to reduce the incidence of incorrect logbook entries. However, it is really up to the fishers to realise the benefits of correct species identification for better future management of their fishery.

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I would like to briefly explain the difference between sharks and rays. Most of the fish in the sea are the bony fish that have a skeleton of bone. Sharks and rays, which are the cartilaginous fish and have a skeleton of cartilage, only make up about 7% of all known fish, which is a fairly small group. Cartilaginous fish consist of sharks and rays which you are familiar with, but also these strange looking chimaerids or ghost sharks (Appendix 1, Figure 5). You probably don't see them very often in the north.

We have sawfish and we have sawsharks (Appendix 1, Figures 6 and 7) (there is a species of sawsharks that occurs in the north, but you probably do not see them unless you are out in deeper water). The first of these is actually a ray and the other a shark. Similarly another species, which looks like a ray is actually a shark-an angel shark, and some rays look more like sharks. The main difference between sharks and rays is that in sharks, the gill openings open on the side of the head and in the rays they open underneath it. That is why a sawfish is a ray, because the gill slits are underneath and the pectoral fins join the head in front of the gill slits, whereas in a shark, the gill slits are on the side and the pectoral fins join the head behind the gill slits.

I have also included two tables with some information on the sizes and breeding biology of the principal species caught (Appendix 1,Tables 1 and 2). There is also a list that translates the scientific names used in Tables 1 and 2 to common names (Appendix 1, Table 3).

Shark Identification using The Shark Guide and Shark Specimens at DPI Laboratory.

John Stevens

All attendants moved to the Northern Fisheries Centre laboratory to examine/identify shark specimens using the new Field guide. There was a two hour hands on tutorial on shark identification with fresh shark specimens carried out by John Stevens with the assistance of Jason Stapley, Stirling Peverell and Will Robbins.

About a dozen specimens of different sharks and rays were used as examples for the fishers to familiarise themselves with using the Guide. Fishers with years of experience in shark fishing recognised many of the species of sharks and rays in the Guide. They commented that they would just have to learn the common name applied to those species in the Guide, so correct recording of a shark species in their logbooks would not be difficult. Other with less experience learned how to use the Guide to successfully identify the shark specimens.

The fishers were positive about using the field Guide as it would be improve the accuracy of their identifications and provide consistent use of common names in their logbooks.

ISSUES

(Afternoon Session)

The workshop highlighted a number of issues of concern to the fishers and management. These are discussed more fully below and were:

- Expansion of effort, increased use of reel boats, new entrants coming into the fishery;
- Lack of catch composition information on both target and bycatch fisheries;
- Bycatch;
- Shark finning; and
- Mercury

The main issue, raised by fishers and managers alike, is concern with an expansion of effort in the shark fishery which is increasing pressure on the shark stocks.

Another major issue is the lack of information on catch composition in both target and bycatch fisheries which is complicated by the use of a number of different common names for the same species and a commercial logbook system that requires improvement.

The issues of bycatch in gill nets and shark finning were highlighted and identified as complex and need to be addressed. There were also some concerns over mercury in some shark products.

Expansion of effort, increased use of reel boats, new entrants coming into the fishery

This was the major concern expressed by all fishers. There are around 1200 N1 net licenses on the east coast, though currently only a very small actually catch shark fulltime. However, each one of these net licenses has the right to take shark. There were discussions over the need for some sort of cap on the number of people catching shark. The shark fishers are very concerned that the fishery cannot support much more effort targeted on sharks. They are concerned that with the East Coast Trawl buy back scheme, more prawn trawlers will move into shark fishing and that as other fisheries such as the Reef/Line Fishery are examined more closely, some fishers may leave that fishery and start targeting shark.

Possible management interventions to address this issue and reduce the increasing pressure on shark stocks could be by a number of mechanisms: regulation amendments, amendments to permit conditions or imposing new license conditions.

There were discussions on the issue of how to define a shark fisher. Some fish all year for shark only and use net reels, others fish for shark, barramundi, mackerel and hand haul nets. All consider themselves shark fishers and any management changes need to be fair. Logbooks, that is a fisher's history, may be a fair method to define dedicated shark fishers.

There was concern by fishers about the lack of time to gather sufficient data (that is, accurate catch composition) required to complete a susceptibility/risk analysis on all species of northern shark caught by October 2002. There is some information already available and by placing observers on the East Coast shark fishery that information can be verified and refined and used for a susceptibility/risk assessment.

Lack of catch composition information on both target and bycatch fisheries.

For the Queensland East Coast shark stocks, there is a lack of catch composition information. The logbooks currently used by shark fishers in Qld do not record shark species, only weights of shark, fillets and trunks. Species catch information is needed to complete a sustainability/risk assessment of the northern shark fisheries. The new Environment Protection and Biodiversity Act requires that fisheries must be shown to be ecologically sustainable to maintain a license to export product. Additionally, improved species identification not only benefits management of the fishery, it should also improve marketing of shark product.

With the co-operation of shark fishers, researchers can place observers on board to collect species catch composition data and to verify logbook entries. The current commercial logbook system also needs to be improved. It will have to be a compromise between all the information that scientist would like for stock assessment and what can reasonably be expected of a fisher to record in the time available.

Fishers raised the issue that some in their fishery may not correctly record species if they do not realise its importance, simply do not care or are trying to falsify their catch history in anticipation of management changes. This would result in misleading logbook information. The use of observers could reduce some of this problem so that when data from the logbooks is entered it will be easier to detect if some logbook entries appear erroneous. There is also the possibility of using processor return validation, where the processor also records the catch information. This would provide a cross check for logbook entries that appear erroneous.

In the Gulf of Carpentaria a separate research style logbook was introduced that has room for the recording of more accurate species identification and other information. It was used voluntarily by a number of fishers and now all fishers in that fishery have requested it be in permanent use. Over time with observer verification and this more thorough research logbook system, the accuracy of species recorded by fishers should increase. A similar research logbook could be trialed on the East Coast.

An issue raised was that there are times in the fishing operations when it is just not possible to identify every shark that is caught, due to the need to process the shark quickly. In such cases the fishers could quickly identify to family or group level, for example, hammerheads or milksharks. Information is still recorded and as fishers become more familiar with the correct names used for different sharks, the accuracy of species recorded in the logbooks will increase.

Fishers questioned how information that may affect the susceptibility of species, such as the fact that some shark species may appear under different weather conditions and times of the year could be included in the Strategic Assessment of the northern shark

fishery. It was agreed that this sort of information is too much to be included in the logbooks. However, the observer programme that has been running in the Gulf of Carpentaria has provided an avenue for discussion between shark fishers and observers that allows such information to be recorded.

One other issue discussed was the use of a wide variety of common names for the same animal, which could create problems in analysing logbook catch composition data. In 1992 a survey identified that commercial fishers recognised 135 species of shark while the fishery was landing about 18 species. A new shark and ray field Guide for fishers has been produced which should alleviate these problems if all shark fishers use the Guide and so record the same common name for each species of shark.

Bycatch

Recently in the Gulf of Carpentaria N9 shark fishery the catch of a number of dolphins and a turtle was reported. This resulted in a review of the fishery which provided a number of recommendations, one of which that a Bycatch Action Plan be produced for the Gulf Net Fishery.

There are concerns by Qld East Coast shark fishers that even though their shark fishing methods may be different from those in the Gulf and that there may not be the same level of interaction with bycatch, that their fishery will be perceived to have these same bycatch issues as in the Gulf. The East Coast shark fishers need information on bycatch to verify anecdotal evidence such as: no dolphins are caught in the East Coast shark gillnets. The fishers recognise that is good to be proactive and install acoustic alarms on the nets to reduce bycatch, even if they feel there is no problem with bycatch, but they are concerned about the cost.

Another suggested solution to the bycatch issue was that industry and government work together to produce a code of conduct that would have procedures in place to deal with such issues as bycatch. For such a code of conduct the fishers had concerns about the use of the term bycatch when they consider they are fishing a multispecies net fishery. What part of their catch do they record as target and what as bycatch in their logbooks in situations when their nets haul in shark along with other fish such as mackerel? They were not intentionally targeting mackerel but they are a target net fishery species, though in this situation they were technically taken as bycatch.

The unrecorded bycatch of shark taken in other fisheries is the other part of this issue. The amount of shark bycatch taken across the northern shark fisheries (Qld, NT and WA) is unknown. Environment Australia requires some accurate information on the bycatch of marine mammals in the shark fisheries. The best manner to obtain this information may be to document it through the MAC process and the observer programme rather than rely on commercial logbook data. A lot of community groups perceive that gill nets kill marine mammals and industry and government recognise that the shark fishery needs to document what is actually caught so that statements based on fact can be made.

Shark Finning

Queensland will introduce a ban on shark finning that is, the practice of removing only the fins and discarding the carcass at sea. In 1992, the Qld shark fishing industry recognised the need for some kind of documentation to establish the weight of fins to flesh products.

Fishers raised concerns about the manner in which the shark finning ban may be worded. They stressed the need to be able to remove the fins at sea as they process shark on board. There was also a great deal of concern over the way in which conversion ratios from fin weight to shark flesh product weight will be calculated. This conversion ratio depends on a number of factors: the species and maybe size of shark; the manner in which the shark fin is cut from the body (how much excess meat is left on the fin effects its weight); and the manner in which the shark is processed (fin weight conversions to fillet, trunk or whole weight may vary).

There was also concern that the introduction of a shark finning ban may create difficulties in the marketing of large shark carcasses that have been brought ashore so the fisher can sell the fins. There is an overseas market for large shark, though Australians must compete with other countries that can supply a lot of large shark and the price received is low. This market may not be large enough to take all Australian large shark landed when the finning ban is in place. This may create problems in selling or disposing of large shark carcasses.

Mercury

In recent sampling conducted by AQIS for the National Residue Survey (2001), analyses of East Coast shark product indicated common occurrences of shark mercury content in excess of four times the accepted mercury level. There is a need to be cautious about the marketing of some large shark flesh.

OUTCOMES

The main outcomes of the workshop, which are discussed more fully below, were:

- Communication between government and industry was established;
- A Working Group of fishers was formed to maintain this link;
- There was a willingness to co-operate with the East Coast observer programme with fishers volunteering to have observers on board in the first part of 2002;
- The new sharks and rays field Guide for fishers was seen as a solution to the issue of a variety of common names being used for the same animal.
- Trial of a Research Logbook programme was accepted and a number of fishers volunteered to take part;
- Communication and contact between fishers themselves was set up;
- Details of scientific information discussed at the workshop were requested by the fishers and subsequently mailed to all attendants.
- Future developments and outcomes of the FRDC Research Program will be forwarded to all attendants at the appropriate times.

Communication

The major outcome of the workshop was to open communication between government and industry. Issues, needs and concerns of fishers and government were discussed openly. Fishers realise they must take part in the management of the shark fishery, that is, communicate with government and co-operate to develop appropriate strategies for addressing issues such as capping the increasing fishing pressure on Qld shark stocks, bycatch and shark finning. Industry must be proactive in management, this means the involvement and participation of industry with government at all stages of planning and development for research and management.

Working Group

A Working Group of eight volunteer fishers was formed to provide this communication link between industry and government that will allow continued co-operation and involvement of industry in management. The Working Group members are listed at the end of this proceedings.

Observer programme

With respect to improving species identification data, the fishers willingly agreed to co-operate with the East Coast observer programme and a number volunteered to have observers on board in the first part of 2002. The fishers recognise the long term benefits of this to the shark fishery as the observer programme can be used to collect catch composition information and verify commercial logbook data. The new sharks and rays field Guide for fishers was well accepted as a solution to the issue of a variety of common names being used for the same animal. Other possible outcomes discussed were the need to improve the current commercial logbook and the possibility of using processor return validation to check erroneous logbook entries.

Research Logbook programme

To increase fishers participation in species identification, some fishers also volunteered to take part in filling out a separate research style logbook. This logbook has space for recording more accurate species identification and other relevant information. Such a research logbook has already been trialed, found to be very useful and well accepted in the Gulf shark fishery.

Bycatch

The complexity of the bycatch issue was highlighted at the workshop. Fishers realised that they need to address this issue and be proactive in developing procedures to deal with bycatch. Most fishers were willing to consider trialing acoustic alarms on their nets as the need becomes more pressing and affordable alarms become available on the market. The co-operation with the observer programme will also provide independent data on bycatch interactions.

Shark finning

In terms of shark finning issues, acceptance of the observer programme by fishers also helps address the issue of calculation of conversion ratios for fin weight to body weight of the shark. Observers and fishers can now co-operate to collect this data and ensure that it is used to calculate accurate fin conversion ratios.

Mercury

To deal with mercury concerns fishers need to take care in sending shark to market that may have unacceptable levels of mercury. The most appropriate way for industry to approach this problem may be to conduct its own risk assessment on the implications to the fishery of not addressing the mercury issue.

Fishers Communication

This was the first time that shark fishers on the East Coast have met as a group and the fishers took the positive step of setting up a network of communication among themselves. The fishers requested that all their contact details be forwarded to each other to increase their ability to contact one another and begin to form a shark fishers group.

All of these issues and outcomes that arose out of this workshop will be taken into account in the development of the proposed three year study of the sustainability of northern sharks and rays, Phase II of this current FRDC project. They will also be included in the Strategic Assessment of the northern shark fisheries which is to be submitted to Environment Australia for assessment of the sustainability of northern shark fisheries.

WORKSHOP PROGRAM

8.45- 9:00	Geoff MacPherson FRDC Northern Australian Sharks and Rays Cairns Workshop Agenda
9:00 - 9:10	Geoff MacPherson History of Shark Fisheries in Queensland and formulation of FRDC Collaborative Study
9:15 -9:35	Shane Hansford Current Queensland Fisheries Service Policy on Shark Fisheries
9:45-10:10	Neil Gribble Historic Data on Shark Catch
10:15- 10:40	Geoff McPherson Use of Acoustic Warning Devices on Set Gillnets
10: 40-11:10	*Morning Tea*
11:10-11:30	John Stevens Shark Identification Manual Field Guide Discussion and Instruction
11:30-1:00	John Stevens Shark Identification using the field Guide and shark and ray specimens at Northern Fisheries Centre laboratory.
1:00-2:00	*Lunch*
2:10- 3:30	Open Discussion

WORKING GROUP VOLUNTEER MEMBERS

Kevin Bostock
Russ Butterworth
Wayne Chadwick
Rob Lowden
Russell and Rhonda Marriage
Barrie Pink
Mitch Trezise

See below for contact details.

LIST OF WORKSHOP PARTICIPANTS

Name	Organisation	Address
Shane Hansford	Fisheries Resource Queensland Fisheries Service	Primary Industries Building Ann Street Brisbane 4000
John Stevens	CSIRO	Marine Research CSIRO GPO Box 1538 Hobart Tasmania 7001
Geoff McPherson	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Neil Gribble	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Jason Stapley	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Stirling Peverell	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Cassandra Rose	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Rod Garrett	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Will Robbins	James Cook University Marine Biology & Aquaculture	School of Marine Biology and Aquaculture JCU Townsville Qld 4811
Rob Lowden	Seafresh Australia Fisher	PO Box 712N North Cairns Qld 4870
Jessie Austin	Fisher	6 Henry St Karumba Qld 4891
Christian Bailey	Fisher	PO Box 326 Gordonvale Qld 4865

Gary Bainbridge	Fisher	14 Mill Drive Heatley Qld 4814
Brian Bartlem	Fisher	36 Hasson St Kirwan Thuringowa Qld 4817
Kevin Bostock	Fisher	9 Gretel Court Scarborough Qld 4020
Robin Bryant	Fisher	32 Norris St Bowen Qld 4805
DG & B & R Butterworth	Fishers	PO Box 23 Airlie Beach Qld 4802
Wayne Chadwick	Fisher	5 Marcus Close Mooroobool Qld 4870
Eddie & Di Fisher	Fishers	PO Box 416 Edmonton Qld 4869
Roger & Carol Anne Honey	Fishers	M5 154 475 Four Mile Road Ingham Qld 4850
Trevor Kerr	Fisher	5 Kane St Mundingburra Qld 4812
Eric Lollo	Fisher	PO Box 160 Karumba Qld 4891
Russell & Rhonda Marriage	Fishers	PO Box 252 Sarina Qld 4737
Greg Partridge	Fisher	9 Rivergum Court Condon Qld 4815
Barrie & Nigel Pink	Fishers	8 Maralinga Drive Ashmore Qld 4214
Mark Savins	Fisher	24 Creek St Bowen Qld 4805
Dan von Stanke	Fisher	PO Box 1098 Townsville Qld 4810
Mitch Trezise	Fisher	15 Mendi Close Trinity Beach Qld 4879

Claudine Ward	Fisher	17 Riverview Drive Karumba Qld 4891
Shane Ward	Fisher	PO Box 64 Karumba Qld 4891
David Wregg	Fisher	124 Pinnacle Drive Condon Qld 4815
Alan Buckley	Fisher	no address given

APPENDIX 1

Figure 1: Sustainability risk analysis of the shark and ray species caught in the Northern Prawn Fishery. Plot of susceptibility against recovery. The sawfish and ray illustrated are among the least sustainable species caught in the NPF. Source: Stobutzki, I et al. (2001) Progress report on the sustainability of northern sharks and rays, Natural Heritage Trust.

Figure 2: Icons used in Shark Identification Field Guide. Source: John Stevens, CSIRO Hobart.

Figure 3: Example of species identification from Shark Identification Field Guide. Source: John Stevens, CSIRO Hobart.

Figure 4: Excerpt from Key in Shark Identification guide. Source: John Stevens, CSIRO Hobart.

Figure 5: Illustration of shark, ray and chimaera from Shark Identification Field Guide. Source: John Stevens, CSIRO Hobart.

Figure 6: Examples of sawshark and angel shark. Source: John Stevens, CSIRO Hobart.

Figure 7: Examples of sawfish and guitarfish. Source: John Stevens, CSIRO Hobart.

Table 1: Summary of size information for some of the principal species caught. Source: John Stevens, CSIRO Hobart.

Species	MAX SIZE **(cm TL)**	**Size at maturity (cm TL)**	**Age at maturity (years)**	BIRTH SIZE **(cm TL)**
C.tilstoni	180	110(M) 115(F)	4(M) 4(F)	60
C.sorrah	160	90(M) 95(F)	2(M) 3(F)	50
C.amblyrhynchoides	165	108(M) 115(F)		55
C.amboinensis	245	208(M) 215(F)		60-65
C.brevipinna	276	195(M) 210(F)		70-80
C.dussumieri	88	70(M) 70(F)		38-40
C.macloti	108	74(M) 74(F)		40-45
E.blochii	185	108(M) 120(F)		45-50
S.lewini	320	150(M) 200(F)		45-50
S.mokarran	600	225(M) 210(F)		65
H.microstoma	110	60(M) 65(F)		30
L.macrorhinus	88	64(M) 56(F)		40-46
R.acutus	98	75(M) 75(F)		36

TL = Total length

Table 2: Summary of breeding information for some of the principal species caught. Source: John Stevens, CSIRO Hobart

Species	Mating period	Ovulation period	Birth period	Gestation (months)	No.pups (average)	No.young per year
C.tilstoni	Feb-Mar	Mar-Apr	Jan	10	3	3
C.sorrah	Feb-Mar	Mar-Apr	Jan	10	3	3
C.amblyrhynchoides	Feb	Mar-Apr	Jan-Feb	9-10	3	3
C.amboinensis					9	
C.brevipinna			Mar-Apr		8-13	
C.dussumieri	Year round	Year round	Year round		2	2
C.macloti	Extended	Extended	July (Extended)	12	2	1
S.lewini	Sept-Dec		Oct-Jan	9-10	17	
S.mokarran	Oct-Nov		Jan	10-11	15	7.5
E.blochii	Dec-Feb	Mar-Apr	Feb-Mar	10-11	12	12
H.microstoma			Sept & Feb	6	8	8
L.macrorhinus	Year round	Year round	Oct-Nov Year round		2	2
R.acutus	Year round	Year round	Year round		3	3

Table 3: Translation of scientific names used for shark species in Tables 1 and 2 to some of the common names used. Source: John Stevens, CSIRO Hobart.

Scientific name	Common names
C.tilstoni	Australian blacktip shark, blacktip whaler
C.sorrah	Spot-tail shark, sorrah shark, school shark
C.amblyrhynchoides	Graceful shark, Queensland shark
C.amboinensis	Pigeye shark, Java shark
C.brevipinna	Spinner shark, inkytail shark, longnose grey shark
C.dussumieri	Whitecheek shark, blackspot shark
C.macloti	Hardnose shark
E.blochii	Winghead shark, slender hammerhead
S.leweni	Scalloped hammerhead, kidney-headed shark
S.mokarran	Great hammerhead
H.microstoma	Weasel shark, sicklefin weasel shark
L.macrorhinus	Sliteye shark
R.acutus	Milk shark

APPENDIX II

Detailed information on Fisheries Management, International Plan of Action and National Plan of Action for the Conservation and Management of Sharks, Bycatch Action Plans and Code of Conduct for Responsible Fisheries can be viewed on the Agriculture, Fisheries and Forestry website:

http://www.affa.gov.au

APPENDIX 3: Darwin Northern Shark Fisheries Workshop Proceedings

Northern Australian sharks and rays: the sustainability of target and bycatch fisheries, Phase I

Proceedings from the Northern Shark Fisheries Workshop

Darwin, Australia, 20 November 2001

Edited by Cassandra Rose, Rik Buckworth and Neil Gribble

EXECUTIVE SUMMARY

International, national and regional concern for the sustainability of sharks and rays is increasing. Sharks and rays are more susceptible to fishing pressure than bony fishes, due to their slow growth, late age at maturity and low fecundity. One of the major issues identified on a global level is the under-reporting of shark and ray catches, mainly in the form of bycatch. Management of shark fisheries can be improved through further research into the shark catch and biology, with the primary need for improved catch composition data from both the target and bycatch fisheries. Without this information sustainable fishing levels cannot be adequately assessed.

Sharks have been fished commercially in northern Australia since the early 1970's. The current shark and ray catch across northern Australia taken by target fisheries (~900t pa) is low by international standards but the catch taken as bycatch is unknown. The lack of adequate data on the northern shark fisheries was raised in 1997 and again in 2000 at a Northern Shark Stock Assessment workshop. The new Environment Protection and Biodiversity Conservation Act 1999 requires that if fisheries wish to maintain a licence to export product they must produce a Strategic Assessment to demonstrate that they are ecologically sustainable. Catch composition information is required as an essential part of this Strategic Assessment. As noted in 1997 and 2000 there is a lack of species identification in the catch of Northern Territory and Queensland and a lack of uniformity in reporting shark catch by the various logbook programmes.

Phase I of the current Fisheries Research and Development Corporation project will focus on improving the shark identification skills of fishers and workshopping any issues with fishers. Short pilot observer programmes are to be run as part of Phase 1, to test methods and gain preliminary information on the shark catch. Its outcomes will be used in the formulation of the full project planned for 2002-2005.

The workshop attracted 13 participants who all contributed to the success of the workshop. There were 5 scientists from government that included 3 speakers and 1 observer from the shark observer programme in the Northern Territory and 7 dedicated shark fishers, one of whom is also a seafood processor.

There were a number of presentations that covered: management of Northern Territory shark fisheries; an overview of research on northern sharks; the use of sustainability/risk assessment to determine shark species vulnerable to fishing pressure; acoustic devices to reduce bycatch; and improvements to shark identification using a new Field Guide developed for fishers. Several crew members of the *Son of a Gun* also attended the hands-on shark identification exercise.

The workshop highlighted a number of issues that fishers and management have with the Northern Territory shark fishery. The issue of bycatch of sharks in Northern Territory waters was identified as complex and needs to be addressed. Finning of large sharks especially by non-dedicated shark fishers was an issue of concern. Another major issue is the lack of information on catch composition, particularly for shark discarded and for shark taken as bycatch in other Northern Territory fisheries. Fishers were also concerned that with the current number of shark licences in the Northern Territory, there is the potential for too much effort in the fishery. There were a number of issues with recreational fishers and perceptions of shark fishing among the general community and concern over the uncertain status of shark stocks.

The major outcomes of the workshop were that it provided a forum for fishers and government to discuss shark fishing issues and it improved fishers shark identification skills. The other outcomes were:

- The need for industry and government to improve communication with the general community;
- Recognition by fishers of the need to be proactive in dealing with such issues as bycatch;
- Increased awareness of the benefits of the Northern Territory shark fishery observer programme;
- The new sharks and rays Field Guide for fishers was recognised as a solution to the issue of a variety of common names being used for the same animal; and
- It provided an opportunity to calculate some accurate fin to body weight conversion ratios.

TABLE OF CONTENTS

Workshop Information

- Held Tuesday 20th November, 2001 at the Fisheries Research Laboratory, Northern Territory Department of Business, Industry & Resource Development.

- The number of participants was 13. There was a fisheries manager and 4 scientists from government, that included 3 speakers, one of whom is the observer from the pilot shark observer programme in the Northern Territory. There was a representative from the Northern Territory Seafood Council and 7 dedicated shark fishers, one of whom is also a seafood processor.

Proceedings Structure

The intent of the workshop was to improve fishers shark identification skills and to ensure fishers and management could discuss their respective issues and concerns for input into the planning stage of the full proposed Phase II of the FRDC project on the sustainability of northern sharks and rays. It also aimed to establish further co-operation with fishers in the Northern Territory pilot shark observer programme. In the morning there were six presentations, during which many discussions occurred, followed by a hands-on shark identification session and an open discussion in the afternoon.

Sponsoring Organisations

- Fisheries Research and Development Corporation

- Northern Territory Department of Business, Industry and Resource Development

Workshop Organising Committee

- Mr Rik Buckworth (Northern Territory Department of Business, Industry and Resource Development)

- Mr Nick Spanswick (Northern Territory Department of Business, Industry and Resource Development)

- Dr Neil Gribble (Queensland Fisheries Service)

- Ms Cassandra Rose (Queensland Fisheries Service)

Workshop facilitator

Mr Rik Buckworth (Northern Territory Department of Business, Industry and Resource Development)

Acronyms

AFMA	Australian Fisheries Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EA	Environment Australia
ESD	Ecologically Sustainable Development
FRDC	Fisheries Research and Development Corporation
MAC	Management Advisory Committee
NGO	Non-Government Organisation
NHT	Natural Heritage Trust
NT	Northern Territory
NTBIRD	Northern Territory Department of Business, Industry and Resource Development
NPF	Northern Prawn Fishery
QDPI	Queensland Department of Primary Industry
QFJA	Queensland Fisheries Joint Authority
Qld	Queensland
WA	Western Australia
WWF	World Wildlife Fund for Nature

Abbreviations used for speakers names used in the questions and answers during the presentations.

RB	Rik Buckworth
RC	Ray Clarke
NS	Nick Spanswick
JS	John Stevens
IS	Iain Smith
CR	Cassandra Rose
Fisher	Any of the shark fishers that attended the workshop.

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INTRODUCTION AND BACKGROUND

FRDC NORTHERN AUSTRALIAN SHARKS AND RAYS WORKSHOP AGENDA AND AIMS OF FRDC COLLABORATIVE STUDY
RIK BUCKWORTH

Thanks for coming everybody. This is a Fisheries Research and Development Corporation (FRDC) funded workshop on a FRDC project that we are undertaking. It is the first step in building a stronger monitoring programme for northern sharks. The main idea of the workshop is to get everyone here and get people talking and give a bit of direction in terms of where we are going, what is driving our directions, and what input and what ideas shark fishers have. That is it, that is the simple message.

The workshop today is going to be pretty informal. What I would like is for everyone to be pretty relaxed and if you have any questions, put your hand up and ask.

John Stevens is going to show us a few things about sharks that we will all be interested in, I am sure, and we will finish with a barbecue lunch. The outcome will be that we are all a bit more relaxed with each other and we will have an idea of where we are heading.

The real intention here is to get ahead of problems that are building in the shark fisheries and fisheries that take shark as bycatch. There are global, national and local management issues that all need to be addressed. These generate some research needs to answer particular questions and mostly we need to talk about it. If you want to get ahead of the problems, you have to figure out what the problems are, you have to acknowledge those problems and you have to figure out how to deal with them. It is not up to me or Ray Clarke to work out how to deal with them, it is up to the community.

The way we have structured the workshop today is that Ray Clarke is going to briefly tell you about what management issues are building, particularly in the Australian context. I will talk about research that is going on and that we plan to do, and give you the opportunity to provide input to these research projects and/or any other aspects of northern shark. So put up your hand up and say "I think we ought to be doing this, we need to do that, I have noticed this." Take this opportunity.

MANAGEMENT

Overview of Issues in Managing Northern Australia's Shark Stocks
Ray Clarke

What I would like to do this morning is to provide an overview of national initiatives currently underway in managing our shark stocks. I trust that all shark fishers present are aware of the range of national initiatives being promoted by the Commonwealth, Western Australia (WA), Queensland (Qld) and the Northern Territory (NT).

I am pretty informal about this meeting as the best outcomes will flow from discussions and comments from everyone present, so please stop and ask if anything is not as it seems or if you think I have missed anything. I will just briefly run over the initiatives and come back and talk about any specific requirements or specific interests people may wish to discuss.

Environment Australia (EA) is a Commonwealth government Agency. In the past, seafood products from a wildstock fishery could be exported from Australia. In 1999 the Environment Protection and Biodiversity Conservation Act came into being and under that Act we now have to lodge a submission with the Commonwealth government to demonstrate that all export fisheries are being managed in accordance with Ecologically Sustainable Development principles (ESD). Shark fins, cartilage and other shark products are exported, with most of the flesh sold on domestic markets.

The Commonwealth government have published guidelines on preparing submissions. For the shark fishery we will draft a submission covering the dedicated shark fishery and also where shark is taken as a bycatch, landed by recreational fishers and taken by traditional interests. What we need to demonstrate to the Commonwealth is that generally the fishery is being managed sustainably and if it is not being managed sustainably, that we are moving towards putting in place management arrangements to ensure that it is sustainable both now and into the future.

We have to deal with the target species and with non-target species, that is, the species that you catch while you are fishing for shark. We also have to show that they are sustainable, that what you are doing is not adversely impacting on the ecosystem, that we have adequate management measures in place, and that we are monitoring and collecting the right sort of information. They require us to collect data both from fishers and independently of fishers, which could be done by placing an observer on board, measuring fish or inspecting fish. They also want to know about our information sources.

We will draft a submission that will be distributed to industry as a draft for comment. We will then lodge the submission with EA for consideration. Environment Australia will assess the submission and release the document for public comment.

In terms of timelines, we have to move through this process for every commercial fishery that exports. We started with mudcrabs as that is our most valuable and largest export fishery. Currently we are preparing a submission for the Timor Reef fishery and the Spanish Mackerel fishery and in about 6-8 months time we will commence the submission on the shark fishery. When we start the shark process we will have a meeting with licence holders, fishers and other people who are interested.

Another Commonwealth government initiative is the preparation of a National Plan of Action for Sharks. Australia is a member country to the Food and Agriculture Organisation which have stated that, worldwide, sharks are highly vulnerable to over-fishing. Member countries will undertake a review of their shark fisheries and if it is needed implement a National Plan of Action for Sharks to ensure their shark fisheries are sustainable over the long term.

The National Shark Advisory Group was appointed by the Commonwealth to consider a National Plan of Action. This group has prepared a draft report on the shark catch in Australian waters, which highlights a range of issues. The States, Territories and the Commonwealth will now work together over the next year or two and say we have got this report, we have identified some issues, if we accept the issues, what are we going to do about it.

Many of you are aware that Qld has undertaken a review of its N9 (offshore net fishery for sharks and grey mackerel) and Queensland Fisheries Joint Authority (QFJA) fishery in the central Gulf of Carpentaria. In the past, the Qld Gulf of Carpentaria N3 licensees have targeted barramundi and salmon and some of them have now geared up to take shark and mackerel. In that inshore N3 fishery they want to put catch limits on the shark and grey mackerel. In the offshore N9 fishery, Qld seeks to reduce net lengths from 2.5 kilometres down to 1200 metres, require Vessel Monitoring Systems (VMS), require that net is to be anchored at one end, not to touch the seafloor and is in attendance and suggest a ban on shark finning.

Just briefly, I will touch on the NT and what we are doing here and then I will outline some of our initiatives used to overcome problems experienced in other fisheries. In terms of the NT we currently allow a nil bycatch of shark in the Timor Reef and Demersal Fishery. We released a paper earlier this year stating we had a three for one licence reduction program in our dedicated shark fishery. The principal issue is that we do not wish to see the benefits that flow from that eroded by other fishers increasing their bycatch of sharks.

We are also concerned about one or two operators who indicated they were targeting large sharks, merely for their fins. If they bring the bodies back and sell them as some operators do, fine. However we are totally opposed to the targeting of large shark, particularly with bubble floats and a big hook, simply to remove their fins and discard the body at sea. We also had some concerns raised by industry itself that if people outside the shark fishery were targeting large sharks and removing their fins, the general community would not support that and the shark industry would wear the consequences of it.

We released the paper to all the commercial fishermen's associations earlier in the year. A number of them said they wished to discuss it at their annual meetings and we are hoping that they are going to come back to us shortly. At the same time the finfish trawler operator in the NT chose to voluntarily give up all shark products.

For all other NT fisheries, we have asked them to comment on what the bycatch limit should be. For some fisheries the limit will be zero, no shark, no shark product, no shark bycatch. For the barramundi fishery there is a bycatch of shark. One view is to make them throw the sharks back over the side. Another view is to say we accept that they take a limited amount of sharks, put a limit on that, cap it and they can then continue to take a specified amount of shark. That is a responsible way of dealing with our fisheries. If the barramundi fishers dump sharks on the bank, the general community would be somewhat concerned. Finally, you will have a mix in between these views. So for example, a decision may be that the barramundi fishery be permitted to take shark as a bycatch, but we do not want to allow them to target shark. Currently in the majority of our commercial fisheries there are no limits on shark

bycatch. So at present, people could enter the shark fishery by buying a barramundi licence or a coastal line licence. We want to stop that before it becomes a problem.

We also had concerns raised by community groups about finning of large sharks. We are not aware that it happens in the Territory. We are not aware that it happens elsewhere. It is not a standard industry practice, but f community groups are concerned, we will simply outlaw it. That will appease their concerns and will recognise the current practices that are in the industry.

What we do not see as acceptable is shark fishers going out and targeting large sharks merely for their fins. If you are taking large sharks, you need to have a market for their bodies or we will step in and stop you. For all other fisheries, there is no reason why they should have sharks on board. Barramundi fishery might be the only one where we would say you may have some shark fin, providing you have some shark fillet on board.

RB: There is a current study on the recreational fishery, have you heard any results from that regarding the actual catches of sharks by recreational fishermen. Is it very large?

RC: We are undertaking a survey of recreational and indigenous fishers throughout Australia. The results from the NT survey will become available mid-next year. The issue that we have raised with NT recreational fishers is that some recreational fishers hold a view you need to club sharks to death before you throw them back over the side. In talking with the recreational fishing sector, they agree they would rather see those sharks released.

Very few NT recreational fishermen target sharks or retain sharks when they are landed as an incidental catch. If they want to catch shark and take it home as fillets, fine, but if they do not want it, release it rather than clubbing it to death. We also do not want to see recreational fishers in possession of any shark fins unless they have the corresponding fillets on board.

Sharks are included in the general possession limit of 30 fish, so if recreational fishers are out catching reef fish and they catch a couple of sharks, a couple of jewfish, they all go towards the combined 30 bag limit. If they went out there and just targeted shark, they could take 30 sharks.

Fisher: Is there a bag limit and a possession limit or just a bag limit?

RC: Northern Territory are all possession limits.

Fisher: So in a chest freezer at home you can have 30 sets of fins.

RC: Once you get them home.

Fisher: So they can have a chest freezer full of fins.

RC: Yes, that is legal at this point in time. The only thing that would change our view is if we came across someone with a chest freezer loaded with fins.

RB: Can I clarify this? Currently there is no illegality involved, but it would arouse suspicions if someone were found to have a chest freezer full of fins.

RC: We have raised the issue of shark fins with our compliance group. It is something they inform us about when they come across them.

RB: It is immediately illegal if they try and sell the shark fins.

RC: If they offer it for sale, yes it is illegal.

Fisher: Travelling backwards and forwards down at Dundee Beach, I have seen two drum lines out there in the last 12 months with large hooks on them and just a weight.

Fisher: It is happening, no worries about it.

Fisher: I sold a container of large sharks overseas, they want the skin and the bone. We could not even fill the container up. That is in the vicinity of Darwin. In a whole area in the Gulf, we had 10 sets with 150 hooks, we did not even catch one large shark. In the vicinity of Darwin there are not many big sharks left. So far we have weighed up about 105 fish, one fish went over 100 kg. I listen to all this, but what I see out there is a different story.

Fisher: There might be a black market for the large ones and they might be going out and targeting the large sharks.

Fisher: Every man that fishes has hooks in their boats. Most people have big shark hooks in their boats and when you are coastal line fishing or whatever, you are cutting fish up. A bit of fish goes over the side and if there is a big shark within 2-3 miles it will come in. A lot of people are dropping these float lines with hooks, 4-5 a night around their boat and they might get one or two shark a night when they are there. It adds up after a while. I have people coming from Hong Kong who want to see these fish. I am a bit embarrassed to take them out, the sharks I get are only 1.5-2 m in length.

RB: In contrast, one of the prawn fishermen complained to me that north of Melville Island , the big sharks were "just getting out of control. "

Fisher: No, there is one group of blacktips there. They get stirred up from the trash feed from the trawler. The sharks are outsmarting the nets. But if someone goes there and puts the net on when they have those sharks around the boat, they will not get that problem anymore, it is just a group of about 20-30 sharks. They say it is hundreds of sharks but I do not believe it. I have seen it at times around the boat 20-30 fish. You put your net in, catch those 20-30 and then no more. I have this concern about this agreement to supply large sharks. I have signed the agreement, 25% of the sharks are supposed to be over 100 kg and so far we have got one over 100kg. That is head and all, no guts. These large sharks have not got a lot of meat on them, they have a lot of skin and cartilage and it is for the export market. They want thick skin (which is quite valuable) and the cartilage. Three years ago we did tests with 30-40 hooks in the coastal areas in the vicinity of Darwin to see what we would catch and we always got at least one large shark every 10 hooks. I think it is all the small fishing operators that process fish and over the last 2-3 years they have realised there is a value for the fin, there is a lot of people going around and asking for the fin and they will even pay cash for it. It is happening but you cannot see it. Might be 5 fish, but it is 5 fish caught by people who should not be catching them. If they get caught with 5 sets of fins big deal. An amateur can have 30 sets without worries.

RC: For the shark fisheries throughout northern Australia, we are suggesting that we have an agreed approach to management, research and compliance. The States and Territory can work together to say here is where we are going over the next few years and in fact lead discussion about where management is going. The alternative view is that we do not do that and we continue to manage from year to year and I think that is where some of our problems are coming in terms of the Gulf of Carpentaria fishery.

If we could get agreement across the States and the Territory amongst fishers and set that out over the next 5 years it would allow us to put forward a position, a document to say we are managing this fishery sustainably, leave the management up to the States and Territory. Also, in dealing with the national initiative of this National Shark Plan, WA, NT and Qld governments and industry are working towards agreed management throughout northern Australia. Given that level of coordination and cooperation, we might even say that, possibly, we do not need this National Shark Plan, rather other States should look at the way we are managing our fisheries here. So as a first step what we will do is WA, Qld and NT will meet shortly in order to chat about how we might go about it. Put those thoughts down on paper, come back to industry and say, is this something you really want to get on board for. It is one way to try and take a little bit of politics out of fisheries management and really allow industry and government to work together on future management arrangements.

In terms of the shark fishery, a big problem for us is meeting the sustainability audits with EA and it is not the dedicated shark fishery, it is shark caught by other fishers. So it is making sure we have got those arrangements in place. Recreational fishers are venturing further afield and there are more of them and some have been enquiring about shark fishers in Fog Bay. So we are going to have increased conflict in and around Fog Bay and Darwin. Dealing with those issues is one of informing the general community that fishers have been there for a long time, they will continue to be there and alleviating some of the concerns that there are large numbers of trevallies and queenfish that are being caught and dumped.

In terms of the shark fishery itself, I am going to throw it back and say, "what does the shark industry think of the key issues of concern over the next few years?". One fisher has raised concerns about status of stocks close to Darwin, particularly with big fish.

Fisher: I believe that the licenced shark boats which are there now, 11 or 12, if they were all using the maximum net that they were allowed to use, that we are way over what we should be doing.

Fisher: I believe that using 2000 or 200m of net would not make any difference, just use your net a lot more at night and just be a bit smarter, you just have to tip it out 3 times a night, you get the same amount of net.

Fisher: No way in the world. We run 12-1500 metres, 50 mesh drop. If we had a bigger boat we would put more net out but that is all we can handle. If you had all the boats put out their maximum 100 mesh or 80 mesh drop, that is a lot of net in the water. It is not up to me to say we should take it out, but if they want sustainability in the shark fishery they are going to have to look at it closely. You monitor what we catch in a year, is it going up or is it going down?

RC: As part of meeting EA sustainability audits we need to demonstrate that the management arrangements are appropriate. One of the issues they do look at it is whether catches declining; if catches are declining, they ask, "have you reviewed the reasons why?". It could be fishing effort, could be seasonal changes, it could be that sharks are being taken outside the dedicated shark fishery, whether that be as bycatch or illegal catch, sharks may be moving across our border with Indonesia, being fished in Indonesia. In terms of moving through those issues to meet EA's requirements, we

need to show that we are looking at those issues. As time goes on, we will look at those issues. In terms of the answers, I do not have them for you today.

Fisher: I realise that-I reckon that is one of the biggest issues we have got-sustainability.

RC: In terms of the sustainability issue, starting in 6-8 months time when we move through EA's sustainability audit that will be an issue we will talk about at length with industry. Is there any other issues that industry considers we should be canvassing?

Fisher: At the moment it is mainly a coastal fishery, but no-one really knows what is offshore in the deeper water. Because the nets we are using are not effective once you get out offshore, all they are doing is filling up the water column with net, maybe something is going to swim into it, maybe shoals. Maybe what is to be done is the dirty word, bottom net, but I think for a survey method it is going to have to come that you go out and look at the other 90% of Territory waters between 50 and 100 metres. If we go out and there are only big sharks out there, that could be a good thing for the industry because you are not catching your breeding stock. Your breeding stock is okay, we are fishing nursery areas, basically inshore. As long as the adult stock is protected, you could leave it go for a couple of years and stock will rebuild, but we are just not seeing the large shark inshore. I have done bottom nets in Bass Strait and you are catching a large percentage of your breeding stock but up here you are not. We really just do not know. The method we are using, we have got no idea about what is going on out in the deep water. I think it needs to be done on various boats around the Territory with an observer on board. Just go out to 50-100 m and do the Territory waters and see what is out there, but at the moment we just do not know.

RC: In terms of bottom set nets we outlawed them because they impact with an endangered species of turtle.

Fisher: You do not know until you get out there. Go out there with an observer on board and do one or two shots and if you start catching turtles, pull in the net straight away. But at least give it a go as a survey method because it is by far the most effective. You cannot go out there and longline because your only going to catch the sharks that are hungry and I cannot think of any other method that you are going to be able to survey the rest of the Territory waters.

Fisher: You do not really know what sort of state the fisheries are in if you only fish part of it. It could be sustainable if the stock offshore is breeding, they could keep going for years, but without going out and surveying or working those deep waters you are just not going to know.

JS: It is 15 years since the Taiwanese fished out there and it would be interesting to know how things have recovered out there since. There was a lot of information in that area at that time, but nobody has really been out there since and quite a lot would have changed.

Fisher: Four years ago we went out and had a look in about 90 m with about 100 metres of trammel net. We were struggling to recover it with the amount of shark, it was unbelievable.

RB: If I could summarise this, the issue is that because shark fishing is in the vicinity of the coast, there is a possibility that there are more stocks of sharks (but not necessarily more sharks) and also that we are not getting all of the life history information about the stocks of sharks that we are fishing. There may be a life history component offshore and in deeper water.

IS: The Northern Territory Seafood Council is applying for money to employ a person to develop 8 or 9 codes of practices, that is, on various fisheries, some of them are more complex than others. We have already done one this year, which is the mud crab, which had a very positive effect. It is quite possible that the shark fishery is going to go a step or two further toward the environmental management plan type situation. Barramundi if possible will do it too. Over the next couple of years we are targeting barramundi and shark. There are a lot of incorrect perceptions out there. Ray Clarke is quite right in the fact that for some fisheries the EA audits can be complex. We have gone through one with the mud crab audit and that is a very simple fishery and it got through but once you start to get into shark, barramundi, crocodiles and dugongs, you can have some real problems. The other thing, in regards to management arrangements, is that I am concerned at the extent at which management of shark fisheries has become political, and that this might spill over between jurisdictions. The other thing is that there are increasing concerns from the public in more populated areas like Fog Bay. It is not going to go away, it is going to get worse. About the bottom set gill net, I agree with Ray Clarke, it is not the time to do it, simply because people still remember the turtles of Fog Bay. They do not care where it was. At the same time there is no reason why a structured research program could not be developed to do exactly what you were talking about.

Fisher: I am just talking purely as research, you have an observer on board.

IS: That is quite understandable, someone has to do it, you cannot just assume forever. I get reports from trawlers up the top and over in the Gulf that shark are absolutely thick, they are sick of sharks. Prawn trawlers are a magnet for shark.

RC: I just want to make a comment about one or two issues that have been raised throughout our discussions. In terms of EA sustainability audits, we need to look at sharks and everything that you catch while fishing for sharks. While here in the Territory, we have always referred to it as a shark fishery. We need to look at the issue that it is in fact a shark/grey mackerel fishery.

An issue that we have raised with Qld is that for us to move through the EA environmental sustainability audit, we need to show that shark stocks across northern Australia are adequately managed. While there are no bycatch restrictions on the Qld N3 fishery, that may hold back the NT gaining approval. Environment Australia looks at shared stocks of sharks and if two States share a stock, both need to be managed to give their approval.

So if nothing else, over the next 6-12 months industry and government could think about ways in which we can engage in those discussions. We are saying, let's get out in front and develop a strategic plan over the next five years that tells people where we are going in the fishery. I know a lot of people stand back when you mention strategic plans and operational plans and objectives and goals, they switch off. All where we are saying is let's map out where we want to be in five years so we are headed in the right direction.

Fisher: I have no problems with a strategic plan, I think every fishery should have one. But we will need a real effort by all States.

RC: Qld are going to have bycatch restrictions in the N3 fishery. So we will approach them again through their advisory committee process, make them aware of

NT concerns and again encourage them to move down that path. So that is a key issue we have on board for the next couple of months.

IS: We have some problems in our fisheries here with the recreational sector, in some cases targetting large sharks deliberately for sport, and there is also a lot of small shark killed by recreational fishermen for a whole range of reasons; they do not want to talk about it. When this Labour government came in the Seafood Council Executive met with Peter Toyne, and we made it clear that we wanted a structure which took the politics out of decision making over resource conflict. He formally agreed. The new Minister I have not met yet but he will be told the same thing and so I mean that is a positive.

RC: In terms of the recreational sector, they do club sharks to death and throw them back over the side. We started to engage with them by saying, how do we change that perception and that is something you have to do over time. In terms of the overall impact on the resource, based on the Fishcount survey (we accept that is the only information we presently have), the overall take of shark is relatively low and we want to keep it there. In terms of NT government, the Minister that we had for 2-3 months agreed that we needed a formal process in dealing with resource access issues.

In the shark fishery, because you are using nets and targeting pelagic fish, you are going to have a whole range of resource access issues. We could do something that tries to address those issues over the next 5 years. General government policy has a process of dealing with allocation issues between recreational and commercial sectors. With the shark fishery, do we want to go a little further and say, we do have rat bags out in the community that are pushing a perception that is not based on fact. Do we have a process to deal with that, can we come out and say here is our plan for the fishery, if there is an issue-here is how we are addressing it and it will be addressed over the next few years. Do we want to take that next step? You could wait for the government to decide it wants to do that but it will not work unless the industry wants to get on board with that particular view. You have a shark fishermen's association meeting tomorrow where you may want to talk about that. It is not something that you need to decide on today, but if you do not do that you may have another Qld situation, it will be 5 years away but I think you will be in the same situation. Let's learn from the Qld experiences and look at some better ways to deal with resource access issues.

IS: I think that it would be bold enough to make the prediction that within 12 months, this fishery will be fairly well fire walled from the unsubstantiated rumours and myths that comes out of the recreational sector from time to time. It is a strategy that we are going to discuss tomorrow and one of the things that is going to help the fishery as part of the EA assessment, is to gather together all the known research. One of the big problems that I have found is that information is scattered. For instance, when the Treasurer decided he was going to close the McArthur River to commercial fishing, it was very difficult to get hold of the facts and figures very quickly because they were scattered all over the place. We all know there is absolutely no problem with barramundi in the McArthur River, there is a problem with other fish. By gathering all the relevant information together for the fisheries, we are part way to getting environmental management plans. So we are going to better placed in all fisheries in two years or so. We will do that with shark and barramundi.

RC: Certainly some of the driving forces behind the McArthur River closure were not barramundi.

IS: But they used barramundi.

RC: They used barramundi but some of the concerns that were driving it were the incidental capture of queen fish and jewfish. That is, the bycatch issue was driving where the fishery was going rather than state of barramundi stocks.

IS: But at the same time, some people were saying the stocks of barramundi are low, they have gone right down, they are very difficult to catch. It was amazing some of the statements being made on radio. We have to put out a more proactive stance as an industry and so does the Fisheries Division. The Division did not say anything in all that McArthur River business, except for a couple of people in relation to barramundi stocks and one of the things that we spoke about with Peter Toyne was making the Fisheries Division the lead agency again. Part of that responsibility is for the Division to be able to be impartial and say "this is the state of things".

RC: If we came up with a strategic plan for the fishery that did have all the facts and figures available, I think that is the sort of direction we might head. In terms of some of the emotional discussions, that is, with the general community, fishing groups, recreational and commercial alike, politicians will make decisions on a whole range of reasons. We will not engage them on emotional discussions but we can engage them on the facts.

Fishers: How important are observers to this Department and for what reason?

RC: In discussions with industry a little while ago, industry raised some initial concerns about the intent of an observer program. In terms of moving through EA sustainability audit, EA will question whether at any point in time we have audited to ensure that the data we have includes everything that is being caught, that is, targeted and bycatch species. The Commonwealth view of bycatch is that it is something that you catch and throw over the side, byproduct is something you catch that you were not targeting, but that you retain as it has some value. So for all our fisheries EA will be asking, do you have fishery independent data, that is, data other than that from fishers, what have you been doing to collect the information.

RB: We do not have an observer program, but the current FRDC project has an observer included. The proposed FRDC program includes observers, but not on every boat.

Fisher: How may days funding have you got?

RB: A total of about 4 months of employment for this current FRDC project. The observer will do about 4 or 5 trips, each about a week long. So it will be a low level of observation. We are in a different situation from Qld. We have a much more detailed logbook system, so in terms of the main species caught, the species identification system is way ahead of Qld. These FRDC projects give us the opportunity to put observers on board.

Fisher: Will that be for barramundi and the like?

RB: The next FRDC project (Phase II) includes other fisheries.

RC: In terms of the shark fishery some of you do catch a whole range of sharks and identification of those sharks has been an issue. In terms of observer work it would only be looking at the species diversity, the catch that is taken by the fishery. We can then say, the logbooks provided by the fishermen are adequate for management purposes.

RB: Nick Spanswick is going to give us some details about the observer programme later, but the primary objective is to determine the composition of the catch.

IS: On the issue of shark in other fisheries as bycatch. We had the coastal line association Annual General Meeting last Saturday and a fair bit of discussion was raised on the issue and we are going to progress this matter with the Commercial Fishermen's Association early next year. In January the barramundi fishers are meeting again. So while a lot of people are saying we do not want any bycatch limits, they are aware that there are going to be bycatch limits. There are a couple of sticky points obviously, in the Coastal Line, Coastal Net and Barramundi fisheries, shark is quite a significant player in the economics of running those licences. We will work through it over the next few months.

RC: I think the industry is engaged on the issues and they are aware of the issues we have in dealing with EA. I do not think the benefits that have come from the three for one licence reduction program should be eroded by other industry sectors seeking to increase their catch of sharks. That is what we are pushing to prevent the bycatch of shark increasing.

Fisher: That has increased a lot in the last 2-3 years.

RC: Past catches over the last few years are in the document here, so if you have not seen it, please take one (contact Ray Clarke for further details). That is just for sharks in all fisheries.

Fisher: That mainly deals with the whole shark not the fins.

RC: Yes your right, it is only the dedicated shark fishery that records fins, no one else records them.

Fisher: It could say 10 000 kilos of shark, but that is just 10 000 kilos of wet fillet weight or body weight, it has nothing to do with how much shark has been discarded.

RC: That is probably all I had to say unless there are any more questions.

OVERVIEW OF RESEARCH ON NORTHERN SHARKS AND SUSTAINABILITY/ RISK ASSESSMENT

Research on northern sharks and Sustainability/Risk Assessment
Rik Buckworth

I will try and cover a whole range of research issues, many of which are alluded to in the hand out. When you think about the issues that we have with ESD (Ecological Sustainable Development) compliance, there are two things that stand out which summarise the needs for both the shark fishery and the other fisheries that take shark as bycatch. The basic issue is, if you need to look at the sustainability of a particular species, you need to know what that particular species is.

In the NT we are pretty aware of the main species caught in the shark fisheries because we have had a fairly detailed logbook system. What the logbook misses out on are the animals that are not kept and those animals that are relatively rare. The shark fishery has produced detailed logbooks that actually do identify the sharks while in other fisheries, as a general rule shark is recorded just as "shark". Over the last decade we have had several assessments of shark and the single thing that comes out of each of those is that we have a very detailed picture of what the Taiwanese used to do, which John Stevens wrote up, but we do not have very good information on the

real impact of our fisheries on shark stocks. "A lot of uncertainty" are the words we generally use about whether or not the shark stocks are being impacted heavily. Unfortunately logbook data is not very good at telling us those sort of things- information from logbooks is necessary but not enough. One of the virtues of the NT fishery for shark is that it is a small fishery and it is a few boats. However, in terms of the information that provides, the small size presents a sampling problem- you cannot obtain information such as in the Northern Prawn Fishery (NPF) where you have more than 100 boats all providing samples and information. What you have in the NT shark fishery is a relatively good amount of information but it is only from a few boats, so overall and in terms of sampling it is a small amount of information.

So there are real restrictions on the information that we can collect in the long term that we have to deal with. Environment Australia requirements are driving this one in particular. One current research activity that most of you may be aware of is that for the last couple of years we have been doing a EA project that was funded under the Natural Heritage Trust (NHT) to look at the sustainability of sharks in northern Australia. It is not just the shark fisheries, it is all fisheries that catch shark. The aim was to bring together all the bits and pieces of information that are available on northern sharks. There is all the historical research data. CSIRO have done numerous trawls over large areas in the Southern Surveyor for years. Northern Territory, Qld, WA have all had logbook programs for years. There are various research programmes in the NPF, including bycatch studies. We are putting them all together so we can determine which species of shark are being caught in northern Australian waters. What fisheries catch which shark species, which fisheries and/or shark species are likely to be a problem. To work out which ones are likely to be a problem and which ones are not is a good way to focus on what work we really need to do.

Queensland Department of Primary Industry (QDPI) are researching pingers, which is very pertinent. In addition to the current FRDC project that is funding the pilot shark observer work here (which Nick Spanswick will discuss) there is also a proposed FRDC research programme to begin next year which is really a continuation and expansion of this project. It aims to look at the catch composition, not only in the shark fishery, but at sharks caught in other fisheries. It continues this project and expands it. That is next year.

I will start with some details on the EA project. This is a presentation prepared by Ilona Stobutzki. Ilona is a Sub-program leader at CSIRO at Cleveland. Ilona is running the EA project and she is the Principal Investigator on the proposed FRDC proposal next year. Ilona sends apologies. Neil Gribble is the principal investigator of the current FRDC project that is funding this workshop.

The EA project flows from the global and national concern with shark. Nationally, these mean we need to assess the sustainability of all our species, and identify the ones in northern Australia that really need our attention. There are far too many species, and far too many fisheries to really undertake careful assessments of all species, so firstly you need to identify the information gaps. What do we need to know? It is relatively cheap to start with a desktop study. You can gather all the information you have and then make some projections about what needs to be done.

Australia's sharks and rays are an important part of the northern ecosystems. There are many species in Australia. In fact half of the sharks and rays that occur in Australian waters are found only in Australia. They are an important marine resource, people eat them in Australia and they represent 5% of Australia's commercial fisheries catch. So they are of high value to Australian fisheries economics. All this is against a background of concerns and problems. Global forces mean that there is going to be an increase in pressure on Australian shark fisheries. Shark fisheries in some areas of the world have been overfished and this has forced more effort into other areas, causing a cascade. It has increased the price of shark fins. This problem is not only peculiar to sharks. On a world-wide basis, fisheries are not in good shape. The largest, big industrial fisheries are where the real problems are.

Sharks attract concern because they are animals that grow slowly and they cannot produce pups until they are of advanced age relative to other fish and they do not produce a lot of pups. Things happen slowly in the shark world. Globally there have been a lot of responses in terms of International Plans and National Plans. In northern Australia, in particular, you are dealing with both target fisheries and bycatch fisheries that catch many different species of shark. Our information on species composition is fairly patchy. Although this is not too bad for the NT dedicated shark fishery, in the barramundi fishery shark is caught, in the coastal line fishery shark is caught. However we do not have answers to a number of basic questions, such as "What is the status of the shark fishery?, What is the status of that shark species? Are there shark species there that may be a problem?". Our answer is something like " Maybe, maybe not. We simply do not know."

So this is what led to the EA project. Let's look at all the fisheries in northern Australia, lets see what we know, let's try and sort out what shark species we think might be a problem. Use all the information available first, rather than going straight out on boats.

CSIRO had a large database of information. They had already done bycatch work in the NPF so this was used in the EA project as an example of how to determine the sustainability of shark species. The prawn fishery targets prawns with trawls, catches sharks as bycatch and covers a wide area of ground. Within that area of ground it actually fishes very small areas intensively. A list of all shark species that occur in the area covered by the NPF was compiled. There are 56 different species of sharks and rays that occur. Even with the target species of a dedicated fishery, the amount and quality of data needed for a conventional stock assessment is difficult to obtain. Given this large number of species, CSIRO adopted a "first cut" approach, sort out what species are likely to be a problem, and what are not. The process they came up with simply looks at two factors: susceptibility and recovery. **Susceptibility** measures whether a species is likely to get caught in a particular fishery and **recovery** measures its resilience to overfishing.

CSIRO designed a graph of susceptibility vs recovery (Appendix 1, Figure1). This figure may appear daunting but it just means that if you come up with some sort of measures of the susceptibility and recovery for each shark species you can plot them. The species that fall close to the origin, down in the left hand corner, are the ones you need to concentrate on. They are highly susceptible to being caught and have a low recovery from overfishing. This narrows your research focus. So Ilona and her group

went through this process for the NPF with the information they had on sharks that occur in that area. When you look at a map of where fishing in the NPF occurs, you are immediately able to sort out those shark species that are not found in areas that are fished for prawns, in terms of depth or distance from the coast or other factors that define their habitats. If species are not in the areas fished, they are not susceptible and you do not have to be so concerned about them. So this process sorts the shark species into those species that are likely to be impacted by the fishery, and those that are not. For example, if they are a surface species, they are not likely to be caught by the prawn trawlers.

A species's recovery comes down to whether the animals can breed quickly or not. The contributing factors that define the productivity of a species are how quickly they grow and reproduce, and at what stage in their life history they are caught. If an animal is not likely to be caught in the fishery until it has had a chance to reproduce a few times, there is probably not so much of a problem.

The whole idea, then, is that attention can be directed to those species of greatest concern in terms of sustainabilty and the requirements of the ESD process can then be met. You also get ahead in terms of international concerns.

This EA work is a project in progress. In 2001 we reached the stage where we have maps of all the northern fisheries, maps of where the different shark species occur and we have identified all the information that we have about the shark species and the fisheries. Most fisheries have no bycatch information, which is a real problem in meeting the ESD requirements. We know what people land, that is retain, but we do not know what shark species are caught but not kept. Hence the need for observers to provide more detail than our other sources of information such as logbooks. The information we have on what is caught, and how much, is now in a geographic information system. We also now know all the different fisheries in northern Australia that impact on sharks. The EA project will be finished by next October. It will mostly be a list of species and fisheries that need research and management attention. It will make some recommendations and it will feed into the FRDC projects that we are beginning now. Are there any questions on that one?

Fisher: How far down the track are you already in getting the information?
RB: We assembled all the information we could. Making sense of it is a huge amount of work as it is massive diverse group of data sets from all sorts of research programmes going back 20-30 years. It is impressive when you look at how much information is there.

ACOUSTIC DEVICES FOR BYCATCH REDUCTION

Use of Acoustic Warning Devices on Set Gillnets
Rik Buckworth (Presentation By Geoff Macpherson)

I have some information on acoustic devices of interest to all of us here. I do not know very much about it, Geoff MacPherson (Queensland Fisheries Service) kindly sent me this presentation that he prepared for the Cairns meeting. Geoff has been working on this for several years. He is an electronics dabbler and a shark researcher of some standing and history. One way of addressing the problems that shark fishers

face is to identify a problem and then try to solve that particular one. One of the problems that is very much in the public eye is that shark fishers catch cetaceans-dolphins and small whales. If you can keep the dolphins and small whales away from the gear, it has to be beneficial.

One approach is to exploit the fact that these cetaceans have a very wide range of hearing, while sharks do not. So make use of acoustics. These ideas have been around for a while. The Japanese started work in the 1980's and passive devices were used in the Taiwanese fishery.

JS: It was towards the end of the Taiwanese fishery when it was known that they were catching dolphins. They trialed reduction methods using air-filled tubing on the headline of the net so the dolphins could detect it with their sonar. Offhand, I do not remember how effective it was in reducing the cetacean bycatch.
RB: The Taiwanese were allowed to fish northern Australia waters under licence from the declaration of the Australian Fishing Zone until in 1986 they were constrained by the amount of net they could use. This was a very big fishery and until there was a restriction placed on the net length that they could use, extremely large amounts of net were deployed.
JS: They were setting 15-20 kilometres of net at a time.
RB: It was a really big fishery. Catches were more than an order of magnitude greater than the current Australian fishery's. They had a dolphin bycatch in the order of thousands of dolphins. The scientist who was working on that, Durant Hembre, commenced using these passive systems that John Stevens described. Is it true that these systems were only moderately effective?
RL: Yes I think so. Geoff was saying that they filled up with water. They started off okay but their performance deteriorated. He was saying that of a night time the dolphins are basically in sleep mode and they do not ping very often and that is why they tend to get caught more of a night than during the day. Was the Taiwanese fishery year around or just seasonal?
JS: Year round.
RB: There are both lower frequency and very high frequency acoustic devices. I am not sure what the difference is in terms of cost or application.

Fisher: Geoff is actually making some.
CR: I think he is making the lower frequency ones.
Fisher: Yes. He described them as sounding like a truck reversal beeper. The device is enclosed in a bit of PVC plumbing and attached to the net, so its goes beep beep beep, going constantly. Geoff said the range of effectiveness of these low frequency pingers is lower than the higher frequency one.
CR: The higher frequency ones are available. They are about $160-$200 each and Geoff is making the lower frequency ones for about $60 total cost at the moment.
RB: These are the sort of things that you are going to have to look at if you want to use them and put them on your net at 50 metre intervals to provide enough noise.
Fisher: Are these the ones the Seanet fellow in Brisbane had?
CR: Yes, QDPI and Seanet have been working together. That may have been Dennis Ballum.

IS: Nigel Scullion brought one back and Peter Manning took it to Booroloola to the McArthur River Workshop because we were looking at exactly the same thing for barramundi nets in dugong areas.
RB: Dugongs do not have the echolocation that dolphins have, so you cannot use the real high frequency alarms because they will not hear it. Geoff is warning that these things are not perfect.

Geoff went to a workshop in Seattle that suggested using multiple bycatch reduction methods and even though they are all basically effective, they are never 100% effective in reducing bycatch. There are habitat influences involved that affect the way the acoustics devices work and there are differences between species. For example, humpback dolphins actually use the pingers as a hunting cue, there is a net over here, we will go over and pick up a few fish.

Fisher: One thing Neil Gribble said is that they are using pingers on all the shark nets on the beaches in Qld and the bycatch of dolphins now has been next to zero.
RB: The dolphins also actually learn. They learn that the pingers mean net.
Fisher: How far apart are the pingers?
CR: Geoff was saying that they are trying to experiment with the spacing of the pingers. The spacing needed varies according to the type of water you are in. As you get closer to the shore the water gets noisier, there is more turbulence and the pingers need to be a little bit closer together. So inshore I think the spacing recommended was about 45 metres.
Fisher: About 50 metres. As you move out into deeper quieter waters offshore the spacings can be further apart.
CR: Yes, Geoff is still working on that.
RB: Yes, from Geoff's notes about 45-50 metres apart seem to be an average. The habitat is important and the species that you are dealing with is important. The type of alarm you need depends on the species. As dolphins have high frequency echolocation you can target them very strongly with the high frequency alarms, but you have to use the lower frequency devices for some whales and for dugong.
IS: Have there been any management decisions in overseas shark fisheries which say these pingers are to be mandatory?
CR: I think Geoff said they are mandatory in the USA.
IS: I can see the moment you start talking pingers, either for barramundi or shark net in the Territory, you are going to get a group of people demanding that they become law. I can see that a mile off.
RB: What is interesting is that some of the information Geoff sent me indicated that the people that really complain about fisheries will still complain because they will say the acoustic devices are not 100% effective. You do not win but you can try your best.
RC: If the work in Qld shows that pingers do decrease the incidental catch of dolphins then I think industry and government should say that is a good thing and we will need to push. I would be interested to see the results of any further experimental work with the devices because some of the work so far shows the devices did work and other times the capture of dolphins went up, the pingers may have been set too far apart. If we could do anything that reduces the incidental catch of dolphins it is one less issue that shark fishers would have to deal with.

Fisher: When will that work in Qld be finished?
CR: Geoff said it is very hard to do these experiments. For example, on the Gold Coast they wanted to do an experiment with pingers on net and they placed them on some nets and then a whale, I think, got caught in one net that did not have a pinger on it and as a result there was a lot of public pressure to put pingers on every net, so there went his experiment. He is having a little bit of trouble, it is hard to do these experiments and prove whether they are working or not because every time he gets someone involved they end up putting the pingers on all their nets for various reasons. I think he is still trying to get more experiments up and running.
JS: Yes I agree.

RB: One of the difficulties with this work in terms of experimental planning and design is that you do not catch many animals, same problem you have with turtles in the NPF , you actually do not catch turtles that often.
Fisher: US $200 for one pinger? That is a prohibitive cost, especially if they need to be set every 50 m.
Fisher: I think those dolphins educate themselves pretty well. As long as your boat stays attached to your net and the motor is running, the lights are on, the dolphins educate themselves very well. I see it when I fish an area. The numbers of dolphins around increases a great deal over the nights, you see more and more around the boat feeding on the fish around the boat every night. I cannot see a dolphin problem, particularly if there are not that many people netting.

RB: The real problem is a perception problem. You have to be very wary of perception. The dolphins that were caught in Qld were *Tursiops* dolphins. They are a very abundant species.. They certainly are not endangered or vulnerable. It is not a conservation/fisheries management issue per se. The problem is that it is an issue about whether the public believes that you should catch dolphins at all, of any sort. If the public has that perception, you have to say these are the constraints within which we are happy to work. Sometimes you do things for that reason, not necessarily for the impact that it has.
Fisher: That is what it is all about.
IS: One of the concerns I have is that the fishery may be forced by EA to have this or they will not credit the fisheries and suddenly guys have got several thousand dollars worth of pingers they have to have.
RB: How much do you pay for insurance per boat?
Fisher: Somewhere between $6-20 000 per year per boat.
RB: That is insurance, just in case your boat goes under or whatever. What if you look at the use of these acoustic devices as insurance, for guarding your fishery. I reckon it would be cheap insurance.
RL: I think we should.
IS: It would be smart if the pingers worked, to get ahead of the game.
RB: You want to get ahead of the game.
Fisher: This is mainly politics. The way I see it, the dolphins themselves, they are quite smart. You might just catch the odd one now and then, it might have been asleep.
Fisher: It does not matter. If it has been reported they have been caught in the Gulf waters, people are going to say they are caught here.
IS: If they are mandatory in a lot of the USA fisheries, there must be an enormous amount of work, why are we re-inventing the wheel.

RB: This is not my area, Geoff is basically the man who is doing this.
CR: He did talk about the American pingers. He said they are expensive and they do not turn off. They are mostly using them in Sub-Arctic fisheries where they put them on the nets, throw them in the water and leave the net in for a few days. They do not turn off and if you have them on the back of your boat that constant noise will drive you mad. So Geoff was saying to make the American devices suitable for use in Australia they need to modify the design a bit.
IS: The effectiveness of them irrespective of whether they turn off, must have been proven for them to be made mandatory.

RB: Not necessarily. They had to introduce Turtle Exclusion Devices into the US Gulf of Mexico a long time before they were proved effective. The public pressure must be very large for such action and I would say that with regard to the design of these acoustic devices it is still early days. As there are advances in electronics and advances in our understanding of the reactions of these animals, the devices will get cheaper and perform better.
Fisher: Are they mandatory in the east coast barramundi fishery (for dugongs)?
IS: No, not yet.
RB: That would have to be a fishery where you would be pretty keen to get effective alarms that would stop dugongs, particularly as they may be near Marine Parks areas.
IS: The reason I am interested is that we have to get these in the barramundi fishery of the MacArthur River by Feb 1 next year.

RB: These are what they look like. This is the American one. The battery sits inside and it sits on the top of your net.
Fisher: Do they lose many of them?
CR: Geoff did say that the one he was making he had to paint green as the tiger sharks ate the white ones, but they do not eat the green ones.
RB: This American model. It is set for oceanic conditions of deep water and low noise. I am sorry I cannot tell you much more about this. All I can do is let you all know there are things happening and if you are interested contact Geoff MacPherson (Northern Fisheries Centre, Queenland Fisheries Service, Cairns) directly or through me and get all the available information. So here we have the FUMUNDA and the AIRMARK pingers; they cost a similar price.

Events since the Northern Shark Fisheries Workshop held in Cairns 7 November 2001

? The manufacturer of the newest US pinger has dropped its unit price to US$55 each. The massive reduction in cost (from approximately US$90) may have been due to a recent order for 500 units for use in US east coast waters. The device has real potential for use in Queensland waters. Issues such as recommended pinger spacing for Queensland waters would have to be determined. For more information contact Geoff MacPherson.

? The DUKANE Corporation, the original manufacturer of 10kHz pingers has indicated that it will no longer pursue acoustic pinger production.

? QDPI (Northern Fisheries Centre)/ James Cook University/ Defence Science and Technology Organisation have just received a grant from Australian Fisheries Management Authority (AFMA) and Eastern Tuna MAC to investigate the potential for tracking the locations of marine mammals in three dimensional space. The study is essentially an engineering study; however ground truthing should determine if a constructed hydrophone array will accurately locate animals. This study will have major implications for tracking/locating dolphins around gillnets and assessing areas of high dolphin concentrations. Methods should be considerably easier where water depth is substantially less than horizontal distance and tracking solutions approach two dimensional situations.

RC: I would like to introduce Nick Spanswick. He is our observer on board for this FRDC project.

OBSER VER PROGRAMME

Northern Sharks and Rays, Phase I Observer Programme
Nick Spanswick

I will be quite brief, as my role in this FRDC project is fairly straightforward. I am to carry out a pilot fishery observer programme which has four main components:

? Establish communication with the fisheries and the fishers;
? Determine the shark catch composition;
? Determine conversion rates for shark fins to whole animals and other flesh products; and
? Establish protocols for observers that will allow accurate data gathering without undue interference in normal fishing operations.

The catch composition and conversion ratios will provide data very much needed for working out stock assessments. The information will also be used in the formulation of the proposal for Phase II of this FRDC work.

In terms of communication, the fact that the shark fishery here involves a relatively small number of fishers makes communication and contact a lot easier. I have met a lot of you already and everyone seems to have a fairly good understanding that this observer work is required to help improve the future management of their fishery. Everyone has been quite open to the project so far. One fisher has had people on his boat before, another has had me on his boat already. So we are already underway.

You are all aware of management issues. They are discussed and dealt with by others. My role is as an observer, going out on boats and collecting information on the sharks. To determine the shark catch composition, I will try to count and identify all the sharks and rays caught. If and when there is time on the boat, we can incorporate more data collection, for example on the last trip we collected stomach bags for some university researchers.

We need to ensure that the collection of the shark data is done in a similar way across northern Australia, ie in Qld, NT and WA. The observers will use the Field Guide that has been developed by John Stevens, in combination with the larger guidebook Sharks and Rays of Australia (Last and Stevens 1994, CSIRO) for the identification of species not in the field Guide. To have all observers use the same identification guidebooks is a good protocol to ensure consistency of identification among all observers.

To determine conversion ratios for fins to whole animals involves weighing fins, weighing sharks.

Fisher: It is not straightforward, it is actually very complex.

NS: Yes, at sea we tried measuring the fins with an electronic balance but it would not stabilise. We have to develop another method of weighing small fins accurately at sea. For example, we could use labelled bags of fins, bring them in, weigh them onshore and get them back to you.
Fisher: How will you calculate accurate conversion ratios for some animals, such as sawfish? The fins you keep off a sawfish are different to other sharks and rays. You keep the whole tail of the sawfish, but it has no pectorals of value, so it has two dorsals and a whole tail. If you sell the flesh as fillets, you get a really low recovery or if it is sold as trunk, the recovery is different.
NS: We weighed a sawfish.
Fisher: How did you weigh the body?
NS: It was cut up. I know it is not completely accurate, but it is not too far off. We measured the shark, the fisher then took the portion he wanted to keep and we weighed that. We could not weigh the fins because the scales were not applicable for that and the electronic scales were not working. So the next trip we plan to bag the fins separately, bring them ashore and weigh them.
Fisher: The conversion ratio also depends on the way the fin is cut.
NS: This is a pilot observer programme and so we are developing protocols. We will need to have standardised methods for cutting off the fins.
Fisher: What are the outcomes of the observer programme? Will it have an input into whether you can discard sharks or not?

NS: That is part of the management side of this project, my part is to gather the data.
RC: We would like to know the total shark catch. If we have a weight for fillets and a weight for fins and we have conversion ratios, we can then calculate the total catch of shark. There may be some difficulties that we can address together as they arise.
Fisher: Are you looking at the shark catch only in the shark fishery?
RC: At this point in time it is the dedicated shark fisheries. Given how shark is taken in other fisheries, that is something we have to look at over time. My understanding is that the funding for Phase 1 of this project is to only look at the dedicated shark fishery at this point in time.
RB: This year, yes.

NS: When I go out on the boats I realize every boat operates a little differently and I need to accommodate that. I try and work out where to stand so as to

cause minimal disruption to your processing. It worked out quite well on the last trip. The shark came out of the net, they got passed to a pile, I weighed the whole fish, did a range of measurements, did a few other things, put it back in the processing line, the guy processed it, then it would come back to me at the front and I collected stomach bags. When it got busy on the last trip, my work was slowing down the process too much, so we just did the measurements and did not do the trunk weight. It then became too rough and we could not take any weights because the scales were unreliable. But we still got some information. As the amount of data from the observer work increases, the accuracy of the information will increase.

RB: One of the problems we found when we looked at the extent of shark finning was that we could not accurately work out the whole catch. We could work out the recorded catch of shark fin, but allocating those catches to species and trying to convert them to whole shark was a matter of using an average conversion ratio, and estimating that it represented so many tonnes of shark.
Fisher: A concern is, that in Qld, where they are bringing in a finning ban, how are they going to calculate conversion ratios that accurately cover all species and size ranges of shark. Once the ban is in place if you have more kilos of fins than body weight on board, you will be in strife. That is why there is a lot of concern about how they work out fin weight to body weight ratios. You want it to go higher rather than lower. It might be set at, say, 4 % while in actual fact it might be 5.5%.

RB: That is a reasonable concern. When the observer shark data is collected, information on size, species, sex, weight, length etc will also be collected. More accurate ranges of values can then be calculated. The conversion ratios do also depend on things like how well you cut the fins off.
Fisher: What happens if you catch say 200 milksharks of a night which are not edible and not saleable, are you supposed to put them back with the fins on or keep the fins. There has been no firm decision made, but politically they are being pushed to say you can have so many kilo of fins and you must have so many kilo of meat, that is the way it is going in Qld.
IS: That is a crazy system! You catch something, part of it is valuable, it is part of your bycatch and it is nonsense to go that way. That is the way NSW went too, except you had to land them with the fins on.
Fisher: Obviously the shark fishery is not practical there.
Fisher: There is quite a range in the different species of shark and what they will return in fin weight. When you compare say *C. sorrah* and *C. limbatus*, the dorsals are much thicker on *C. limbatus* than they are on *C. sorrah.* They just all return different, and you will get an average that will vary from trip to trip, depending on the species of shark you are catching.

NS: Yes this is the kind of information we can collect in the observer programme. Initially, this pilot phase is mainly to identify and count the sharks, weigh sharks and fins where possible and develop protocols for data collection for input into the next Phase of the FRDC project, Phase II.

One of the outcomes of the observer work will be to collect facts. This will provide verification, or not as the case may be, of fishers anecdotal evidence. When emotional statements appear in the media or wherever, the fishers and government will then have facts they can use to make definitive responses.

Fisher: Does the incidental catch of a dolphin go through your book?

NS: At this stage everything that is caught is recorded by the observer. It is better to say that two dolphins were caught in a year, as in the review of northern shark fishery which was done a number of years ago. It recorded three dolphins caught for one hundred and fourteen shots using different types of mesh.
RB: Our reporting requirements for this project are sharks and rays. If we record information, what is written up is an agreement with the association chairman and the FRDC.
Fisher: They are going to want to find out everything about what we do on our boats
RB: It is confidential. What you catch and where you catch it, is confidential.
Fisher: I have nothing against it at all, it is just that it has to be protected a bit. So it does not get out of hand.

RB: My experience with these matters is that if you have information, you have the ability to use information. You are always better off having information, as it allows you to act. The problem with issues such as the perception of cetacean bycatch is firstly recognising there is a problem and then looking for ways to deal with it, such as the use of pingers. In other fisheries there have been problems with disgruntled crew members and so on. There is no way of keeping secrets. It is always a matter of recognising the problems and dealing with them, you are always going to come up better off doing that, than putting your head in the sand.
IS: That is true. You have got to be careful, you do not want to magnify it. One of the things that concerns me is that World Wild life Fund (WWF) have got an office up here. They are one of the drivers around the world for shark fisheries and bycatch and a whole range of things and a number of fisheries around the world are in strife overseas. You read the WWF colour brochures and they say six or ten fisheries are dying overseas, crashing etc and then you will see in small print down the body of the page, there is not much concern about Australia's fisheries at present, but look what can happen. It is the scare tactic that worries me. It is being put in schools, kids are learning that and they are learning it in primary school, which colours their attitudes for the rest of their life. It is frightening.

RC: It is a difficult one to deal with. There was an issue with discarded net. WWF picked it up 3-4 years ago and said commercial industry was dumping net at sea that was entangling turtles and impacting on the wildlife. Government engaged them and said we will approach the Commonwealth for some funding to have a look. When they went out to the beaches, they found the majority, in fact 90% of the discarded net, originated from Indonesia and is simply carried down in currents. It was not the NPF or other Australian fisheries creating the problem. So by injecting a few facts, the situation is clarified and WWF are now saying, all this foreign net is washing up on Australian beaches, we need to do something about it and they are pressuring the Commonwealth government to address the issue. I am sure if we had not engaged them, fishers would still be accused of dumping net.

There are issues in industry and there are two choices, either we do not speak about them and simply deal with the consequences down the track, as has been pointed out

through the Qld experience. A disgruntled crew or someone that has an axe to grind or someone writing a story to the local paper. Without the facts we cannot dispute it, so if there are issues there, we need to make a decision as industry and government. One option is we identify the issues and find solutions to them, or we just continue with what we are doing and this latter option is a high risk strategy. If no one finds out about it you would be fine but if someone finds out about it then you have to deal with the consequences.

JS: Do you have Non-Government Organisations (NGO's) on northern shark management commitees (MACs).

IS: No .

JS: Most of the Commonwealth fisheries have NGO's on the MACs and I do not think that you will find that they have been particularly reactionary.

IS: Some of them are.

JS: WWF is not directly on any of the MACs, rather it is mainly a TRAFFIC representative (an NGO that is a joint programme of WWF and IUCN-World Conservation Union).

IS: WWF is on the fisheries in the south-east fishery.

JS: They have been pretty responsible.

IS: They have been responsible, but I mean there is a whole movement. Individuals are quite nice and committed people. But there is a whole movement there.

RC: In terms of the NT government, we do not engage NGO's through the MAC process but we do hold discussions with NGO's here about issues. The main view behind that is that you get a line of communication going. So if they come here and ask us for the facts we generally provide it to them. It is an attempt to have those discussions from NGO to government rather than through the newspapers. There are varying successes. There are some groups that are quite balanced in their approach, there are other groups who are either out for funding, publicity or for promotion, they seem to pick particular issues and go with them, but again you can either engage them and try to have those discussions on fact or fight them through the newspaper.

IS: A few years ago, Humane Society International (HSI) sought to have gill netting listed as a key threatening process to various species. I became involved in that through the Australian Seafood Industry Council and at a meeting I attended, the HSI representative stated that, he is going to test the levels of where you can go environmentally and if fishers get hurt in the process, who cares. Prawn trawling, otter board trawling is a key threatening process. The amount of money those issues cost the trawl industry was just extraordinary.

NS: There are extreme groups on both sides. If you can make sure that your side is balanced and has information then you can counteract it.

IS: All I am doing is sounding a warning. Certainly you have to identify issues, you cannot hide and say this does not happen. Sooner or later crocodiles will become an issue in the barramundi fishery. Dugong is a huge issue. It is how that discussion takes place. It is alright in house, but then suddenly if it goes outside, people out there are willing to grab it while you are trying to work towards a solution and that is what I am concerned about and that is what some other fishers are concerned about. It is not hiding it, it is simply saying look we have to identify the issue and keep it with ourselves so we control the solution.

NS: That is it from me. I am at this stage basically out to collect data that will be used for development of the next, larger Phase II of this project. So I will be mainly out on boats for the next few months.

SHARK IDENTIFICATION

Shark Identification Manual Field Guide Discussion And Instruction
John Stevens

In the 1980's we had the Northern Pelagic Research Programme and I spent a lot of time on Taiwanese boats. It was a co-operative programme with the NT, WA and Qld looking at sharks around northern Australia from Broome to Cairns. There was a large tagging programme in which we tagged about 10 000 sharks. So although I come from Hobart now, I have had a fair bit of involvement with northern sharks in the past.

We have been developing an identification guide for northern sharks and rays that is aimed specifically at fishers. I would like to describe the Guide and then we will actually handle some specimens. In the Qld shark workshop a couple of weeks ago, there was interest in the tagging programme as nobody knew much about the results. There was also some interest in information on the breeding biology of some of the northern sharks. So I will also run through those and I have some handouts if anyone is interested.

This identification Guide is a co-operative project between CSIRO, AFMA and FRDC. It is aimed at getting better identification from fishers on both target and bycatch species of sharks and rays. The underlying reason is to improve the fisheries data collection and monitoring and to try and improve the information from the logbook system. We need observers as well but if we can actually improve data from logbooks that is obviously cheaper. We are not trying to cover all the species, we do not expect people to identify everything. This guide has about 100 species in it, which is about a third of all the species occurring in Australia. It is mainly aimed at the principal species that are caught both in targeted fisheries and also in bycatch.

The Guide addresses sharks and rays as they tend to be more vulnerable to fishing pressure than other species of fish and there is international concern about sharks. We are producing the guide now as part of a process that links in with the Strategic Assessments of fisheries and Bycatch Action Plans. It is not just aimed at the northern fisheries, it is principally aimed at all the Commonwealth fisheries which take sharks as target and also as bycatch. The Guide had to be a compromise in that we cannot cover all species of sharks. It is not finalised yet and we would be keen to get any comments from you on whether you think it is going to work.

The Guide is not very large. There are short introductory sections on sharks in research, conservation of sharks and markets and trade data for sharks. The main part of the book is the identification sections. The Guide is divided into four main identification sections, based on area and fishing method. In this way fishers from different areas in Australia can move directly to the section of relevance to them. The four sections are:

- Pelagic species-mainly of relevance to the tuna fishery, that is, the sharks and rays caught in the tuna fishery;
- Northern demersal species-mainly applies to the NPF and to you people;
- Southern demersal species; and
- Rarely caught or protected species.

There are difficulties with common names. Even within the NT, what is called one name in an area may be called another name just 20 miles away. It can be very confusing, particularly when this information is entered in the logbooks. That information is then reviewed and if there is an unknown name it can be a real problem. In the Guide we have a common recognised name and other common names which are also in use. There is also a six digit code which is standard for all species through Australia.

The main identification sections use colour photographs of each species with arrows on them that highlight the main identification features. (Appendix 1, Figure 3). Icons rather than words are used to cover a lot of the information on the sharks and rays. (Appendix 1, Figure 2). Symbols are used to indicate the principal fishing methods of gill net, trawl and hook that a species is caught by. Symbols are also used for the depth range and habitat, and the main distribution will be marked on a map. For example, in the case of the guitarfish (Appendix 1, Figure 3) it is mainly caught on the bottom by trawl, on the continental shelf and the map shows its main distribution. The arrows on the colour photograph of the guitarfish indicate the main features that split it from the most closely related species. The text is kept to a minimum.

Size information is included, usually minimum, maximum and the most frequently caught sizes and also some text on fisheries remarks, interesting biology, and markets. For example, the guitarfish fins attract high prices. The idea would be that you move directly to the section of relevance and then you identify the shark from the colour photographs. We are only trying to record the principal species caught. In your fishery we already have some information on this. In other fisheries, for example the NPF, there was very little information about the bycatch species which could be improved markedly by recording say the top 5 species.

Fisher: There is now a nil bycatch of shark in the NPF.
JS: Yes there is now. No retention of shark products, though we still need to know what actually gets caught, even if it goes back over the side. What is recorded in the NT logbooks in terms of shark species?
RB: The main species are actually identified on the logbook and there is another column.
JS: So we have for example, blacktips and sorrah sharks.
RB: Yes, depending on the expertise, some fishers might record all the details.
JS: The NT logbook system for shark is more detailed than that of Qld, where it is recorded only as shark. Qld has a more diversified shark fishery and there is little information on the shark species caught.
RB: Our main species are covered in the logbook.
Fisher: Can you just record the coded number instead of the name for the shark.

JS: That would be ideal, but this is aimed at fishers and it is probably going to be difficult to get fishers to use a code. If they could that would be ideal, it is unambiguous.
Fisher: It would be a damn sight easier than trying to write the common name.
JS: It varies. For example, a fisher that catches *C. tilstoni* knows what it is and it will be much easier to write down a common name rather than memorise the code. The idea would be that if this book was kept in the wheelhouse, over time you might get familiar with that code and that would be the best way of recording the shark.

We tried to keep the scientific language to a minimum. It cannot be avoided altogether and there are some scientific terms with a glossary explaining them. There are also illustrations of sharks, rays and chimaerids with the main scientific terms marked (Appendix 1, Figure 5). The chimaerids are bizarre looking ghost sharks. You probably do not see too many of these, as they are mainly in deep water. In the tropics they occur out on the Qld plateau, offshore in deeper water than you would fish.

RB: A fisher brought one in when he was longlining up here. He caught it in real deep water, that is, more than 200 metres.
JS: There are only about 30 species of chimaerids altogether, it is a fairly small group, but they are related to the sharks and rays so that is why they are in the guide.
Fisher: How big do they grow.
JS: The largest recorded so far is about 120 cm. They have actually got 2 sets of claspers so they are pretty well equipped.
RB: Not a lot to do in those depths.

JS: There is a key in the Guide that identifies to family level, not to species level (Appendix 1, Figure 4). If you are faced with a shark or ray that is not covered in the Guide, this is at least one way you could get it to family. It may look complicated but once you get used to it, it is quite straightforward. The key may be of more relevance to observers, as we would also like observers to use this Guide. Scientists normally identify things by using a key. It is a series of alternate choices. So if you had a fish in front of you, say a sawfish and you did not know what it was. At the beginning there are 2 choices-does it have 5-7 pairs of gill openings or does it have only one gill opening. Depending on how you answer that you move through the key and there are also illustrations for many of the features. You just follow your way through until you identify the fish.

There are about a thousand species of cartilaginous fish, that is the sharks, rays and chimaerids. In terms of numbers, they represent about 7% of all living fish, which is a fairly small group. I would like to briefly explain the difference between sharks and rays. Most of the fish in the sea are the bony fish that have a skeleton of bone. Sharks and rays, which are the cartilaginous fish have a skeleton of cartilage. There are sawsharks and there are sawfish (Appendix 1, Figures 6 and 7). Sawsharks are not common in the north, they are more common in southern Australia. Sawsharks are actually sharks, while sawfish are rays. Some species that look like rays are actually sharks. The main ways of telling them apart are:

? Sharks are mainly streamlined, while rays are mainly flattened;

- The gill openings in a shark are on the side of the head and in a ray they are underneath; and
- In a shark, the gill slits are on the side and the pectoral fins join the head behind the gill slits whereas in a ray the pectoral fins join the head in front of the gill slits.

Among the rays there are quite different families that have a similar shape. There are eagle rays, manta rays and butterfly rays all of which are much wider than they are long, and then there are others such as electric rays, skates and stingrays which superficially resemble each other.

Fisher: When is this book going to be available.

JS: It is supposed to be finished now and we are late. So probably about February.

Fisher: How do we get it, through fisheries.

JS: It is mainly designed for Commonwealth fisheries. It will be distributed to all Commonwealth fisheries and if State fisheries decide they wish to use the Guide, it will sell for about $25-30.

JS: Regarding the tagging programme and reproductive information, there are a number of copies of the tagging paper here and these two figures illustrate the findings for a number of species (Appendix 1, Figures 8 and 9). The tagging work was done in the 1980's. There is a translation table for the scientific names to common names (Appendix 1, Table 1). We tagged nearly 5000 *C. tilstoni*, the common blacktip and we had 400 tags returned, which is about an 8% return rate. The maximum time we had one at liberty was 13 years, so the common blacktip probably lives to be 15-20 years old. We tagged about 3000 *C. sorrah* shark. Interestingly there was a much smaller return rate. Around 10 years at liberty was the maximum time for *C.sorrah*. The hardnose shark had a maximum time at liberty of about 10 years.

Fisher: What is a good recovery rate.

JS: It varies greatly. If you tag a species that is wide ranging such as an oceanic species, a recovery rate of 2-3% back would be good, *C. tilsoni* had a good return rate in this tagging programme. By comparison, in the Southern Shark Fishery where there is very high exploitation rates, we used archival tags which record data on depth and position. There is a lot of incentive for the fishers to return these tags as they are interested in the information. The return rate was nearly 35 % for school sharks. That is a concern and you can see why this species is going down hill.

RB: What was the source of most returns? You began this when the Taiwanese fishery was still operating?

JS: Yes that is all in the paper which I can give you, but most of them came from the Taiwanese fishery and then mainly Australian gill-netters.

RB: That is indicative of the different habits of the two species, where you have a large return from the Taiwanese for the species that tends to be a bit more offshore.

JS: Most of the tagging was actually done inshore but although the Taiwanese probably returned most of the tags during the period when both fisheries operated together, the fishing effort of the Taiwanese was three or four times as great as the inshore fishery. So that was obviously biasing the number of returns. When you take fishing effort into consideration, not that many sharks move from inshore to

offshore. This suggests that there is limited mixing between the inshore population and the offshore population. Some sharks moved a thousand kilometres, but on average they did not show that much movement. Around 50% of the returns were from within 50 km of where they were tagged.

Fisher: So what do you think about their movements, are they fairly localised?
JS: I think most of them are. I think it is like a lot of species. In terms of management you probably want to treat inshore and offshore stocks separately. There is exchange between them but most of the movements seem to be pretty localised. So if you had heavy fishing pressure in one area, you would certainly knock that stock down quicker than it could be replenished from outside.
Fisher: If the stock inshore was fished right down, when the outside stock come in, are they going to realise there are less other sharks and be inclined to stay?

JS: Yes I think so but I cannot be categoric about that. These are the figures for the tagging results. Most of these were tagged close to shore so some moved offshore because that is where the Taiwanese fishery operated. There is a lot of returns but when you take the Taiwanese effort into consideration, about 3% of sharks moved offshore from inshore. The returns from the Australian fishery are much closer to the shore. There are some big movements, though most of them generally show pretty restricted movements.

Here is some brief biological information on some shark species (Appendix 1, Tables 2 and 3). There are data on maximum size and size at sexual maturity. For example *C. tilstoni* reaches a maximum size of about 180 cm, males mature at 110 cm and females at 115 cm. *C. tilstoni* is one of the few species that we have aged; age at maturity for both sexes is about 4 years. For *C. sorrah* it is a bit less than that, 2 years for males and 3 for females.

There is also some breeding information in Table 3, such as mating, ovulation and birth periods, gestation time, and the number of pups produced. For example, *C. tilstoni* and *C. sorrah* both produce an average of 3 pups and the gestation period is 10 months. This is the average number of pups, the range is from 1-8. The females breed every year, so that means on average there are 3 young produced per year. They give birth in January, that is the peak of the birth period. You would have noticed when you are processing sharks when they have big eggs, that is when they ovulate. They mate and then they ovulate and become pregnant and 10 months later they give birth and then they go into another cycle. Some, but not all female sharks breed every year. For example, the great hammerhead, *Sphyrna mokarran* (the one with the tall sickle shaped dorsal fin) can have quite big litters, on average about 15, but they breed every other year, so that means they are producing 7.5 pups per year. An interesting one is the hardnose shark that only has 2 pups and breeds every other year, so it is only producing one pup per year. You look at that with a bit of concern in terms of its ability to withstand heavy fishing pressure.

RB: For a few of those species, it looks like there is not a lot known about their breeding.
JS: Yes it is fairly limited in what we know for some species. Some sharks have a seasonal cycle and some breed all year around, like the blackspot shark and the milk shark.

We have been doing a bit of work on northern shark liver oils. There was a preliminary project in which chemists looked at the oil content out of the livers of northern sharks. There are some commercially important oils present in the liver which may represent a potential for value adding.

Shark Identification using the Shark Guide and Shark Specimens at the Fisheries Research Laboratory

John Stevens

All attendants moved to the laboratory to examine shark specimens using the new Field Guide. About a dozen specimens of different sharks and rays were used as examples for the fishers to familiarise themselves with using the Guide. The fishers have had years of experience in shark fishing and recognised many of the species of sharks and rays in the Guide. They commented that they would just have to learn the common name applied to those species in the Guide, so correct recording of a shark species in their logbooks would not be difficult.

The fishers were positive about using the Field Guide as it could provide consistent use of common names in their logbooks and improve the accuracy of their identifications of some of the less commonly caught species.

ISSUES

The workshop highlighted a number of issues of concern to the fishers and management. These are discussed more fully below and were:

- Bycatch;
- Shark Finning;
- Inadequate catch composition information on both target and bycatch fisheries;
- Potential for increased fishing effort;
- Recreational fishers and community perceptions of shark fishing; and
- Uncertainty over status of NT shark stocks.

The issues of bycatch of sharks in NT waters was identified as complex and needs to be addressed. Finning of large sharks and by non-dedicated shark fishers was an issue raised. Another major issue is the lack of information on catch composition, particularly for shark taken as bycatch in other NT fisheries. Fishers were also concerned that with the current number of shark licences in the NT, there is the potential for too much effort in the fishery. There were a number of issues with recreational fishers and perceptions of shark fishing among the general community and concerns over the uncertain status of shark stocks.

Bycatch

For most fisheries in NT the bycatch of shark taken in other fisheries is unknown and unrecorded. The information on bycatch of the shark fisheries is also limited. This is a major concern as this information is needed to determine the sustainability of northern fisheries as part of Environment Australia requirements for their assessment of the shark fishery. An observer programme in the shark fishery could collect information on the bycatch of the shark fishery and address part of the issue. However there is still a need to determine the bycatch of shark in other fisheries.

Another issue with the unknown bycatch of shark in other fisheries is that it may impact on the status of shark stocks caught in the shark fishery. There has been a restructuring of the NT dedicated shark fishery in the form of a three for one licence reduction programme. Government and industry do not want to see the benefits of this eroded by the bycatch of shark in other NT fisheries. Currently in the majority of fisheries there are no limits on shark bycatch. To address this issue the government has asked all other NT fisheries to consider what is an appropriate shark bycatch limit for their fishery as a precursor to further discussions between the fisheries and the government.

With regard to the bycatch of the shark fishery, there is a perception in the general community that gill nets kill marine mammals. Industry and government recognise that the shark fishery needs to document what is actually caught so that statements can be made based on fact. In addition to the collection of this bycatch information through the observer programme, the benefits of a proactive approach such as using acoustic alarms on the nets to reduce bycatch were recognised by fishers. However they were concerned about the cost and effectiveness of the acoustic devices. It was

recognised though, that such a cost could be viewed as insurance and a precautionary measure to guard the fishery against incorrect perceptions.

Another proactive solution to the bycatch issue was that industry and government work together to produce a code of conduct that would have procedures in place to deal with such issues as bycatch. The Northern Territory Seafood Council is currently applying for funding to assemble a code of practice for the shark fishery and other NT fisheries.

Shark finning

Managers are concerned over information that one or two shark fishers were targeting large sharks just for their fins and discarding the carcasses. The NT government opposes this practice. Industry and managers were also concerned that people outside the shark fishery were targeting large shark for their fins and that the shark fishery would wear the consequences from the general community.

Fishers were also concerned with the finning of sharks by recreational fishers and in other fisheries as there is anecdotal evidence that it does occur. Currently, recreational fishers can be in possession of up to thirty sets of fins; however it is illegal for these to be sold. Fisheries compliance officers have not reported any recreational fishers with large numbers of fins in their possession. Only the dedicated shark fishery records fins so there is no information on the extent of finning in other fisheries.

There were discussions over the shark finning ban to be introduced in Qld and concerns over the manner in which conversion ratios from fin weight to body weight will be calculated. This conversion ratio depends on a number of factors: the species and maybe size of shark; the manner in which the shark fin is cut from the body (how much excess meat is left on the fin affects its weight); and the manner in which the shark is processed (fin weight conversions to fillet, trunk or whole weight may vary).

Inadequate catch composition information on both target and bycatch fisheries.

There is a lack of species identification for all species of shark caught in NT waters. The species discarded in the shark fishery have not been identified and the composition of the shark bycatch in other fisheries is unknown. To assess the sustainability of the fishery all species caught must be determined.

In the NT shark fishery the commercial logbook system is more detailed than that of Qld and there is good information on the principal species taken. However there is a need to improve the data on the discarded species and the observer programme can address this by collecting such information.

Another issue raised was the use of a wide variety of common names for the same animal, which could create problems in analysing logbook catch composition data. A new shark and ray Field Guide for fishers has been produced which should alleviate these problems if all shark fishers use the Guide and so record the same common name for each species of shark.

There is an issue with the current lack of fishery independent data on the NT shark catch in both the target and bycatch fisheries. Independent data is required for ecological assessment of the fisheries. This FRDC project has a pilot observer programme for the shark fishery that can verify the accuracy of the catch composition information recorded in the logbooks and collect data on the bycatch composition. The observer programme may be expanded in the next, larger proposed phase of this project where the information on bycatch in other fisheries will also be addressed. Fisheries independent observer data will also enable the government to make firm statements about the catch composition of sharks in NT waters.

Potential for increased fishing effort

Some fishers raised concerns that if all 11-12 licenced shark boats in NT waters used the maximum amount of net allowed that there would be too much net in the water for the shark stocks. There has been a restructuring of the dedicated shark fishery to address the issue of increasing effort, though further discussion between the shark fishing industry and government may be needed on the amount of potential net in the water.

Recreational fishers and community perceptions of shark fishing

Fishers are concerned with the amount of shark taken by recreational fishers. Based on the available information from Fishcount Surveys, the overall take of shark by recreational fishers is relatively low. A national survey of recreational and indigenous fishers is underway that will improve the information on the recreational shark take in NT waters.

Concerns were expressed by the shark fishers that recreational fishers and some small operators are targeting large shark for their fins, which could affect large shark stocks. The shark fishers commented that over the last 2-3 years recreational fishers have realised the value of fin, as buyers have been actively seeking shark fin and offering cash. They are concerned by the fact that shark are included in the general possession limit of 30 fish and that with so many recreational fishers active in NT that this could pressure large shark stocks.

Managers have raised concerns with the recreational sector over some recreational fishers practice of clubbing sharks to death before they throw them back. To address this issue the government has engaged the recreational sector that agree it is a mind set that needs to be changed and recreational fishers need to be encouraged to release the sharks alive.

Recreational fishers have been travelling more widely in the NT which has increased the level of contact between recreational and shark fishers. To address this and avoid potential conflicts the recreational sector and the general community need to be informed about shark fishing operations and issues facing the industry. Industry and government need to work together to determine how this can be done. One solution is for industry and government to co-operatively develop a strategic plan for the shark fishery. The government recognises that a formal process is required for dealing with resource access issues between recreational and shark fishers. A strategic plan could address concerns over resource allocation, develop codes of practice for other issues,

provide industry with direction and inform the general community about shark fishing issues and that they are being addressed.

A general concern raised by both fishers and management is the need to educate the public about shark fishing. The correct information needs to be taught in schools, provided to conservation groups, the media and other members of the public.

Uncertainty over status of Northern Territory shark stocks

Shark stock assessments of the NT shark fishery have concluded that there is uncertainty over the status of NT shark stocks. The difficulty in northern waters is that there are a many different shark species caught across the target and bycatch fisheries. Logbook data does not provide sufficient information to allow a thorough assessment of the stocks. An alternative approach to assess sustainability is the development of a sustainability/risk analysis, which is already underway. This analysis provides a method to determine those species of shark that are vulnerable to fishing pressure. Management attention can then be directed towards the species and fisheries of greatest concern. It also addresses EA's requirements for assessment of ecological sustainability of the shark fishery.

Fishers were concerned about the lack of knowledge of offshore shark stocks that they do not fish, as it is difficult to determine the status of stocks and sustainability of the fishery if you are only fishing part of it. There was a lot of information on sharks gathered in the offshore waters when the Taiwanese where operating around 15 years ago, but since then there have been virtually no surveys. Fishers suggested a research programme with gear such as bottom set nets be undertaken to survey these stocks. Managers agreed that information from a survey of offshore stocks would be valuable; however, as bottom set nets have been outlawed in NT waters to avoid the capture of turtles, the risks of conducting a survey at this time with gear that may interact with turtles may outweigh the benefits.

OUTCOMES

The main outcomes of the workshop, which are discussed more fully below, were:

- Constructive discussions between industry and government on shark fishing issues;
- The need for industry and government to improve communication with the general community;
- Recognition by fishers of the need to be proactive in dealing with such issues as bycatch;
- Increased awareness of the benefits of the NT shark fishery observer programme;
- The new sharks and rays Field Guide for fishers was recognised as a solution to the issue of a variety of common names being used for the same animal; and
- It provided an opportunity to calculate some accurate fin to body weight conversion ratios.

Communication

The major outcome of the workshop was that it provided a forum for fishers and government to discuss shark fishing issues. The issues, needs and concerns of fishers and government were discussed openly. Fishers realise they must take part in the management of the shark fishery, that is, communicate with government and co-operate to develop appropriate strategies for addressing issues such bycatch, shark finning, potential conflicts with recreational fishers and misconceptions that the general community may have about shark fishing. Industry must be proactive in management, this means the involvement and participation of industry with government at all stages of planning and development for research and management.

Bycatch

The complexity of the bycatch issue was highlighted at the workshop. Fishers realised that they need to address this issue and be proactive in developing procedures to deal with bycatch. Fishers were willing to consider trialing acoustic alarms on their nets as the need becomes more pressing and affordable alarms become available on the market. The co-operation with the observer programme will also provide independent data on bycatch interactions. Industry and government could work together to develop codes of conduct to address bycatch issues.

Observer programme

The workshop raised awareness among the fishers of the long term benefits of an observer programme to the shark fishery. It can be used to verify commercial catch composition information, collect information on the species of shark discarded and also provide fishery independent data required for assessment of ecological sustainability. The new sharks and rays Field Guide for fishers was well accepted as a solution to the issue of a variety of common names being used for the same animal.

Another positive outcome of the workshop was that it provided an opportunity to calculate some accurate fin weight to body weight conversion ratios. A seafood processor present demonstrated the correct way to remove the fins from the shark and ray specimens brought in for the hands-on identification session. He also gave advice on the appropriate procedure for drying the fins in a mechanical dryer.

All of the issues and outcomes that arose out of this workshop will be taken into account in the development of the proposed three year study of the sustainability of northern sharks and rays, Phase II of this current FRDC project. They will also be included in the Strategic Assessment of the northern shark fisheries which is to be submitted to Environment Australia for assessment of the sustainability of northern shark fisheries.

WORKSHOP PROGRAM

9:10-9:15	Rik Buckworth FRDC Northern Australian sharks and rays workshop agenda and aims of FRDC collaborative study
9:15-9:50	Ray Clarke Overview of issues in managing northern Australia's shark stocks.
10:10-10:40	Morning tea
10:40- 11:00	Rik Buckworth Research on northern sharks and sustainability/risk assessment.
11:00-11:20	Rik Buckworth Use of acoustic warning devices on set gillnets
11:20-11:40	Nick Spanswick Northern sharks and rays, Phase I Observer programme
11:40-12:15	John Stevens Shark Identification Manual Field Guide discussion and instruction
12:15-1:00	John Stevens Shark Identification using the Shark Guide and shark specimens at the Fisheries Research Laboratory.
1:00- 3:30	Lunch and open discussion.

LIST OF PARTICIPANTS

Name	Organisation	Address
Rik Buckworth	Northern Territory Department of Business, Industry & Resource Development	Fisheries Research Laboratory GPO Box 3000 Darwin NT 0801
Nick Spanswick	Northern Territory Department of Business, Industry & Resource Development	Fisheries Research Laboratory GPO Box 3000 Darwin NT 0801
Ray Clarke	Northern Territory Department of Business, Industry & Resource Development	Fisheries Division GPO Box 3000 Darwin NT 0801
John Stevens	CSIRO	Marine Research CSIRO GPO Box 1538 Hobart Tasmania 7001
Cassandra Rose	Queensland Fisheries Service	Northern Fisheries Centre PO Box 5396 Cairns Qld 4870
Iain Smith	Northern Territory Seafood Council	GPO Box 618 Darwin NT 0801
Rob Lowden	Seafresh Australia Fisher	PO Box 712N North Cairns Qld 4870
John Edwards	Fisher	PO Box 39228 Winnellie NT 0821
Malcolm Huxtable	Fisher	PO Box 418 Nightcliff NT 0814
Bill Mounsey	Fisher	19 Bonaparte St Leanyer NT 0812
Biagio Spinella	Fisher	PO Box 663 Sanderson NT 0813
Helen Wilson	Fisher	PO Box 39228 Winnellie NT 0821
David Wren	Fisher	6 Carron St Karumba Qld 4891

APPENDIX I

Figure 1: Sustainability/risk analysis of the shark and ray species caught in the Northern Prawn Fishery. Plot of susceptibility against recovery. The sawfish and ray illustrated are among the least sustainable species caught in the NPF. Source: Stobutzki, I et al. (2001) Progress report on the sustainability of northern sharks and rays, Natural Heritage Trust.

Figure 2: Icons used in Shark Identification Field Guide. Source: John Stevens, CSIRO Hobart.

Figure 3: Example of species identification from Shark Identification Field Guide. Source: John Stevens, CSIRO Hobart.

Figure 4: Excerpt from Key in Shark Identification guide. Source: John Stevens, CSIRO Hobart.

Figure 5: Illustration of shark, ray and chimaera from Shark Identification Field Guide. Source: John Stevens, CSIRO Hobart.

Figure 6: Examples of sawshark and angel shark. Source: John Stevens, CSIRO Hobart.

Figure 7: Examples of sawfish and guitarfish. Source: John Stevens, CSIRO Hobart.

Figure 8: Summary of Tagging results. Source: Stevens JD, West GJ and McLoughlin KJ (2000) Movements, recapture patterns and factors affecting the return rate of carcharhinid and other sharks tagged off Northern Australia. *Marine and Freshwater Research*, 51,127-41.

Figure 9: Summary of tagging results. Source: Stevens JD, West GJ and Mcloughlin KJ (2000). Movements, recapture patterns and factors affecting the return rate of carcharhinid and other sharks tagged off Northern Australia. *Marine and Freshwater Research*, 51,127-41.

Table 1: Translation of scientific names used for shark species in Tables 2 and 3 to some of the common names used. Source: John Stevens, CSIRO Hobart.

Scientific name	Common names
C. tilstoni	Australian blacktip shark, blacktip whaler
C. sorrah	Spot-tail shark, sorrah shark, school shark
C. amblyrhynchoides	Graceful shark, Queensland shark
C. amboinensis	Pigeye shark, Java shark
C. brevipinna	Spinner shark, inkytail shark, longnose grey shark
C. dussumieri	Whitecheek shark, blackspot shark
C. macloti	Hardnose shark
E. blochii	Winghead shark, slender hammerhead
S. leweni	Scalloped hammerhead, kidney-headed shark
S. mokarran	Great hammerhead
H. microstoma	Weasel shark, sicklefin weasel shark
L. macrorhinus	Sliteye shark

R. acutus Milk shark

Table 2: Summary of size information for some of the principal species caught. Source: John Stevens, CSIRO Hobart.

Species	MAX SIZE (cm TL)	Size at maturity (cm TL)	Age at maturity (years)	BIRTH SIZE (cm TL)
C. tilstoni	180	110(M) 115(F)	4(M) 4(F)	60
C. sorrah	160	90(M) 95(F)	2(M) 3(F)	50
C.amblyrhynchoides	165	108(M) 115(F)		55
C. amboinensis	245	208(M) 215(F)		60-65
C. brevipinna	276	195(M) 210(F)		70-80
C. dussumieri	88	70(M) 70(F)		38-40
C. macloti	108	74(M) 74(F)		40-45
E. blochii	185	108(M) 120(F)		45-50
S. lewini	320	150(M) 200(F)		45-50
S. mokarran	600	225(M) 210(F)		65
H. microstoma	110	60(M) 65(F)		30
L. macrorhinus	88	64(M) 56(F)		40-46
R. acutus	98	75(M) 75(F)		36

TL = Total length

Table 3: Summary of breeding information for some of the principal species caught. Source: John Stevens, CSIRO Hobart

Species	Mating period	Ovulation period	Birth period	Gestation (months)	No.pups (average)	No.pups per year
C. tilstoni	Feb-Mar	Mar-Apr	Jan	10	3	3
C. sorrah	Feb-Mar	Mar-Apr	Jan	10	3	3
C. amblyrhynchoides	Feb	Mar-Apr	Jan-Feb	9-10	3	3
C. amboinensis					9	
C. brevipinna			Mar-Apr		8-13	
C. dussumieri	Year roun	Year round	Year round		2	2
C. macloti	Extended	Extended	July	12	2	1

			(Extended)			
S. lewini	Sept-Dec		Oct-Jan	9-10	17	
S. mokarran	Oct-Nov		Jan	10-11	15	7.5
E. blochii	Dec-Feb	Mar-Apr	Feb-Mar	10-11	12	12
H. microstoma			Sept & Feb	6	8	8
L. macrorhinus	Year roun	Year round	Oct-Nov Year round		2	2
R. acutus	Year roun	Year round	Year round		3	3

APPENDIX II

Detailed information on Fisheries Management, International Plan of Action and National Plan of Action for the Conservation and Management of Sharks, Bycatch Action Plans and Code of Conduct for Responsible Fisheries can be viewed on the Agriculture, Fisheries and Forestry website:

http://www.affa.gov.au

APPENDIX 4: Female Reproductive System

Figure 1: Female reproductive system. Source: John Stevens, CSIRO Marine Research, Hobart. Personal communication John Stevens

APPENDIX 5: Results From Pilot Observer Program

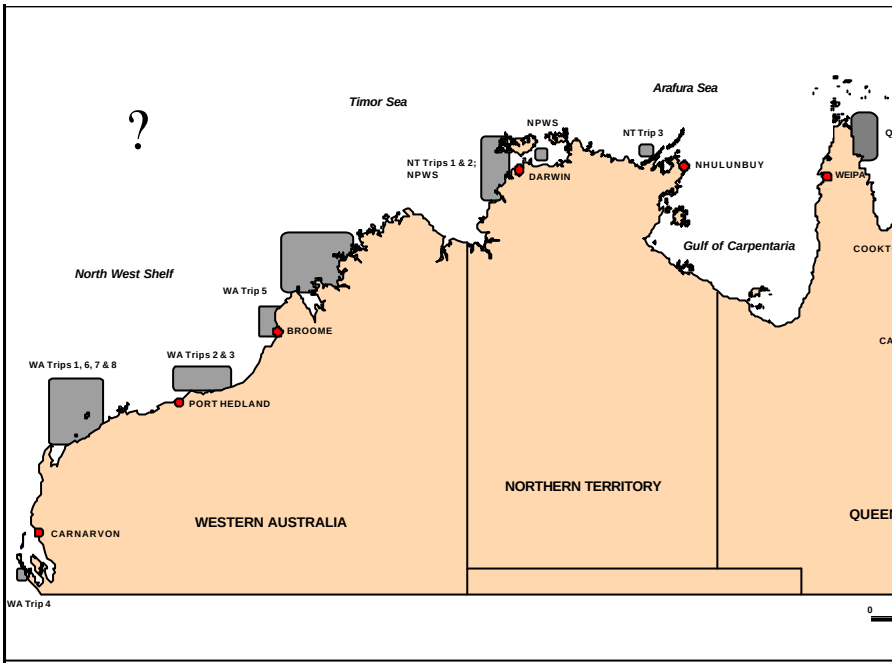

Figure 1: Approximate Location of shark fishery observer trips in Qld, NT and WA.

Catch Composition

Table 1: Species list for all sharks and other species caught in the observer trips in Qld, NT and WA. Both the Scientific and common names are listed. The species caught in each of the States/Territory are identified by an X.

Species names	Common names[1]	Qld	NT	WA
Sharks				
Carcharhinus albimarginatus	Silvertip shark			X
Carcharhinus altimus	Bignose shark			X
Carcharhinus amboinensis	Pigeye shark	X	X	X
Carcharhinus amblyrhynchoides	Graceful shark		X	
Carcharhinus amblyrhynchos	Grey reef shark	X	X	X
Carcharhinus brevipinna	Spinner shark	X	X	X
Carcharhinus dussumieri	Whitecheek shark	X	X	X
Carcharhinus falciformis	Silky shark	X		
Carcharhinus fitzroyensis	Creek whaler	X	X	X
Carcharhinus macloti	Hardnose shark	X	X	X
Carcharhinus melanopterus	Whitetip reef shark	X	X	X
Carcharhinus obscurus	Dusky shark			X
Carcharhinus plumbeus	Sandbar shark/ thickskin shark			X
Carcharhinus sorrah	Spot-tail shark	X	X	X
Carcharhinus tilstoni	Australian Blacktip shark	X	X	
Carcharhinus tilstoni/limbatus	Australian Blacktip /Common blacktip			X
Galeocerdo cuvier	Tiger shark	X	X	X
Loxodon macrorhinus	Sliteye shark			X
Negaprion acutidens	Lemon shark		X	X
Rhizoprionodon acutus	Milk shark	X	X	X
Rhizoprionodon taylori	Australian sharpnose shark	X	X	X
Triaenodon obesus	Whitetip reef shark	X		X
Nebrius ferrugineus	Tawny shark			X
Eusphyra blochii	Winghead shark		X	X
Sphyrna lewini	Scalloped shark	X	X	X
Sphyrna zygaena	Smooth hammerhead			X
Sphyrna mokarran	Great hammerhead	X	X	X
Rhynchobatus djiddensis	White-spotted guitarfish	X	X	X
Anoxypristis cuspidata	Narrow sawfish		X	
Hemipristis elongatus	Fossil shark	X	X	
Stegastoma fasciatum	Zebra shark		X	X
Pastinachus sephen	Cowtail stingray		X	
Aetobatus narinari	White-spotted eagle ray	X	X	
Mobula eregoodootenke	Pygmy devilray		X	
Rhinoptera neglecta	Australian cownose ray	X		
F. Rhinobatidae/Rhynchobatidae	Shovelnose rays/Sharkfin guitarfishes			X
F. Dasyatididae	Stingrays			X
Other Species				
Scomberomorus semifasciatus	Grey mackerel	X	X	
Scomberomorus commerson	Spanish mackerel		X	
Scomberomorus munroi	Spotty mackerel		X	
Rastrelliger brachysoma	Short mackerel	X		
Thunnus tonggol	Longtail tuna		X	
Lutjanus johni	Golden snapper		X	
Lutjanus sebae	Red emperor			X
Selaroides leptulepis	Yellow striped trevally		X	
Carangidae sp.	Trevally sp.	X	X	
Apolectus niger	Pomfret		X	

Rachycentron canadus	Cobia/black kingfish	X	X	X
Istiophorus platypterus	Indo-pacific sailfish		X	
Scomberoides commersonianus	Queenfish	X	X	
Caranx para	Banded scad		X	
Euthynnus affinis	Mackerel tuna		X	
Chirocentrus dorab	Wolf herring		X	
Sphyraena putamiae	Military sea pike		X	
Eleutheronema tetradactylum	Blue threadfin salmon	X	X	
Lates calcarifer	Barramundi		X	
Megalops cyprionoides	Tarpon		X	
Protonibea diacanthus	Jewfish		X	
Diagramma labiosum	Painted sweetlip	X		
Carangoides talamparoides	White-tongued trevally	X		
Carangoides gymnostethus	Bludger trevally	X		
Gnathanodon speciosus	Golden trevally	X		
Echeneidae sp.	Remora/suckerfish	X		
Lobotes surinamensis	Jumping cod	X		
Epinephelus suillus	Estuary cod			X
Epinephelus multinotatus	Rankin cod			X
Pristipomoides multidens	Goldband snapper			X
Lagocephalus scleratus	Norwest blowfish			X
Pagrus auratus	Pink snapper			X
Arius sp.	Catfish sp.	X		X
Opistognathus sp.	Jawfish			X
Scomberoides sp.	Queenfish			X
F. Istiophoridae	Marlin			X
F. Scombridae	Mackerel			X
F. Carangidae	Trevally			X
F. Sphyraenidae	Barracuda			X
F. Serranidae	Cod			X
Other scalefish				X
Eretmochelys imbricata	Hawksbill turtle		X	
Portunus pelagicus	Sandcrab		X	
Hydrophiidae sp	Seasnake	X		
Total number of individuals		535	3622	2644
Total number of shark species		20	24	26

1. Common names of sharks are those used in Last and Stevens 1994.

Queensland

Table 2a: Catch composition (%) of Queensland Observer Trip 1.Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals

Shark species	n	% comp^{n} total	% comp^{n} sharks	Other species	n	% comp^{n} total
C. sorrah	7	15.9	20.6	*Arius sp.* [1]	6	13.6
C. amboinensis	7	15.9	20.6	*S. semifasciatus*	3	6.8
C. fitzroyensis	12	27.3	35.3	*S. commersonnianus*	1	2.3
C. tilstoni	4	9.1	11.8			
S. lewini	3	6.8	8.8			
S. mokarran	1	2.3	2.9			
Total no. sharks	34			Total no. others	10	
Total all individuals	44					
% Catch composition		77.3				22.7

1. 3 released alive

Table 2b: Catch composition (%) of Queensland Observer Trip 2.Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals

Shark species	n	% comp^{n} total	% comp^{n} sharks	Other species	n	% comp^{n} total
C. tilstoni	43	24.3	36.4	*S. semifasciatus*	22	12.6
S. lewini	26	14.7	22.0	*Arius sp.* [4]	15	8.6
C. amboinensis	15	8.5	12.7	*E. tetradactylum*	8	4.6
C. sorrah	7	4.0	5.9	*S. commersonnianus*	7	4.0
R. taylori [3]	6	3.4	5.1	*C. gymnostethus*	3	1.7
R. neglecta [1]	5	2.8	4.2	*C. talamparoides*	1	0.6
C. macloti	4	2.3	3.4	*Hydrophiidae sp.*	1	0.6
R acutus [2]	4	2.3	3.4	*L. surinamensis*	1	0.6
S. mokarran	3	1.7	2.5	*R. brachysoma* [1]	1	0.6
A. narinari [1]	2	1.1	1.7			
C. dussumieri	1	0.6	0.8			
C. fitzroyensis	1	0.6	0.8			
R. djiddensis	1	0.6	0.8			
Total no. sharks	118			Total no. others	59	
Total all individuals	177					
% Catch composition		66.7				33.3

1. released alive; 2. 1 released alive; 3. 2 released alive; 4. 7 released alive

Table 2c: Catch composition (%) of Queensland Observer Trip 3.Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals

Shark species	n	% comp^{n} total	% comp^{n} sharks	Other species	n	% comp^{n} total
C. amblyrhynchos	30	26.5	29.1	*D. labiosum*	5	4.4
C. tilstoni	29	25.7	28.2	*Caranx sp. (juv)*	2	1.8
C. sorrah	16	14.2	15.5	*Echeneidae sp.* [1]	1	0.9
C. dussumieri	15	13.3	14.6	*G. speciosus* [1]	1	0.9
C. melanopterus	6	5.3	5.8	*R. canadus*	1	0.9
S. mokarran	3	2.7	2.9			
T. obesus	2	1.8	1.9			
H. elongatus	1	0.9	1.0			
R. djiddensis	1	0.9	1.0			
Total no. sharks	103			Total no. others	10	
Total all individuals	113					
% Catch composition		91.2				8.8

1. released alive

Table 2d: Catch composition (%) of Queensland Observer Trip 4-as part of Coastal Fisheries Resource Monitoring Project..Catch composition is expressed as a percent of total catch. Bycatch was not recorded. n-no. individuals

Shark species	n	% comp^{n} total
C. tilstoni	70	34.5
S. lewini	53	26.1
R. acutus	29	14.3
C. dussumieri	18	8.9
C. brevipinna	14	6.9
S. mokarran	6	3.0
C. macloti	6	3.0
C. sorrah	5	2.5
G. cuvier	1	0.5
C. falciformis	1	0.5
Total no. sharks	203	

Northern Territory

Table 3a: Catch composition (%) of Northern Territory Observer Trip 1.Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals

Shark species	n	% comp^n total	% comp^n sharks	Other species	n	% comp^n total
C. tilstoni	246	33.0	37.2	*S. semifasciatus*	47	6.3
C. sorrah	158	21.2	23.9	*S. commerson*	11	1.5
E. blochii	87	11.7	13.1	*E. tetradactylum*	6	0.8
S. lewini	47	6.3	7.1	*Carangidae sp.*	6	0.8
C. ambionensis	35	4.7	5.3	*A. niger*	4	0.5
A. cuspidata	21	2.8	3.2	*R. canadus*	2	0.3
R. acutus	21	2.8	3.2	*P diacanthus*	2	0.3
C. brevipinna	19	2.5	2.9	*E. imbricata*	2	0.3
C. fitzroyensis	15	2.0	2.3	*T tonggol*	2	0.3
C. macloti	9	1.2	1.4	*S. munroi*	1	0.1
C. dussumieri	1	0.1	0.2	*C. dorab*	1	0.1
G. cuvier	1	0.1	0.2			
P. sephen[1]	1	0.1	0.2			
H. elongata	1	0.1	0.2			
Total no. sharks	662			Total no. other	84	
Total all individuals	752					
% Catch composition		88.7				11.3

1. Released alive

Table 3b: Catch composition (%) of Northern Territory Observer Trip 2. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals

Shark species	n	% comp^n total	% comp^n sharks	Other species	n	% comp^n total
E. blochii	82	18.4	27.5	*A. niger*	60	13.5
C. tilstoni	54	12.1	18.1	*E. tetradactylum*	51	11.4
C. sorrah	42	9.4	14.1	*S. semifasciatus*	12	2.7
C. fitzroyensis	40	9.0	13.4	*S. commersonianus*	12	2.7
C. ambionensis	24	5.4	8.1	*S. munroi*	5	1.1
R. taylori	15	3.4	5.0	*T. tonggol*	3	0.7
S. lewini	13	2.9	4.4	F. Carangidae	2	0.4
R. acutus	9	2.0	3.0	*L. calcarifer*	1	0.2
C. macloti	7	1.6	2.3	*M. cyprinoides*	1	0.2
A. cuspidata	6	1.3	2.0	*C. dorab*	1	0.2
C. dussumieri	2	0.4	0.7			
S. mokarran	2	0.4	0.7			
C. melanopterus	1	0.2	0.3			
N. acutidens	1	0.2	0.3			
Total no. sharks	298			Total no. other	148	
Total all individuals	446					
% Catch composition		66.8				33.2

Table 3c: Catch composition (%) of Northern Territory Observer Trip 3. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals.

Shark species	n	% comp^n total	% comp^n sharks	Other species	n	% comp^n total
C. tilstoni	319	13.1	46.0	*S. semifasciatus*	1462	60.8
C. sorrah	217	8.9	31.3	*S. commerson*	110	4.6
R. acutus	51	2.1	7.3	*P. pelagicus*	56	2.3
S. mokarran	36	1.5	5.2	*L. johni*	22	0.9
S. lewini	26	1.1	3.7	*S. leptulepis*	14	0.6
C. macloti	12	0.5	1.7	*A. niger*	11	0.5
C. dussumieri	8	0.3	1.2	*S. munroi*	11	0.5
A. cuspidata	6	0.2	0.9	*R. canadus*	7	0.3
E. blochii	4	0.2	0.6	*I. platypterus*	4	0.2
H. elongata	4	0.2	0.6	*S. commersonianus*	3	0.1
R. djiddensis	3	0.1	0.4	*C. para*	3	0.1
C. amblyrhynchoides	2	0.1	0.3	*E. affinis*	3	0.1
S. fasciatum	1	<0.1	0.1	*C. dorab*	3	0.1
A. narinari	1	<0.1	0.1	*S. putamiae*	1	0.0
C. amblyrhynchos	1	<0.1	0.1			
C. ambionensis	1	<0.1	0.1			
C. fitzroyensis	1	<0.1	0.1			
M. eregoodootenkee	1	<0.1	0.1			
Total no. sharks	694			Total no. other	1712	
Total all individuals	2406					
% Catch composition		28.6				71.4

Western Australia

Table 4a: Catch composition (%) of Western Australia Observer Trip 1. No scalefish were caught. Catch composition is expressed as a percent of total catch. n-no. individuals
Effort - 23 320 hook hours.

Species	n	% comp^n total
C. plumbeus	52	53.6
R. acutus	23	23.7
G. cuvier	7	7.2
C. sorrah	5	5.2
S. lewini	3	3.1
C. albimarginatus	2	2.1
C. amboinensis	2	2.1
C. tilstoni/limbatus	1	1.0
N. acutidens	1	1.0
N. ferrugineus	1	1.0
Total no. sharks	97	

Table 4b: Catch composition (%) of Western Australia Observer Trip 2. No scalefish were caught. Catch composition is expressed as a percent of total catch. n-no. individuals
Effort- 44 016 hook hours.

Species	n	% comp^{n} total
C. plumbeus	89	42.4
G. cuvier	39	18.6
C. sorrah	31	14.8
R. acutus	15	7.1
C. amboinensis	15	7.1
N. acutidens	5	2.4
C. obscurus	3	1.4
F. Dasyatidae	3	1.4
F. Rhinobatidae/Rhynchobatidae	3	1.4
C. tilstoni/limbatus	2	1.0
S. mokarran	2	1.0
N. ferrugineus	1	0.5
S. fasciatum	1	0.5
S. lewini	1	0.5
Total no. sharks	210	

Table 4c: Catch composition (%) of Western Australia Observer Trip 3. No scalefish were caught. Catch composition is expressed as a percent of total catch. n-no. individu als
Effort- 16 108 hook hours.

Species	n	% comp^{n} total
C. plumbeus	78	56.5
C. sorrah	18	13.0
G. cuvier	17	12.3
R. acutus	13	9.4
N. acutidens	4	2.9
C. obscurus	3	2.2
C. amboinensis	2	1.4
C. tilstoni/limbatus	1	0.7
F. Rhinobatidae/Rhynchobatidae	1	0.7
R. taylori	1	0.7
Total no. sharks	138	

Table 4d: Catch composition (%) of Western Australia Observer Trip 4. No scalefish were caught. Catch composition is expressed as a percent of total catch. n-no. individuals
Effort- 7796 hook hours.

Species	n	% comp^{n} total
C. plumbeus	16	43.2
G. cuvier	8	21.6
C. obscurus	7	18.9
R. acutus	3	8.1
T. obesus	2	5.4
S. zygaena	1	2.7
Total no. sharks	37	

Table 4e: Catch composition (%) of Western Australia Observer Trip 5. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals. Effort- 90 911 hook hours.

Shark species	n	% comp^{n} total	% comp^{n} sharks	Other species	n	% comp^{n} total
C. sorrah	337	35.0	35.7	*Arius sp.*	6	0.6
C. tilstoni/limbatus	252	26.2	26.7	*R. canadus*	6	0.6
R. acutus	58	6.0	6.1	F. Carangidae	2	0.2
N. acutidens	48	5.0	5.1	Other scalefish	1	0.1
C. plumbeus	45	4.7	4.8	F. Serranidae	1	0.1
C. amblyrhynchos	42	4.4	4.4	F. Spyraenidae	1	0.1
G. cuvier	34	3.5	3.6	F. Scombridae	1	0.1
S. mokarran	22	2.3	2.3			1.9
C. amboinensis	21	2.2	2.2			
S. lewini	15	1.6	1.6			
R. taylori	14	1.5	1.5			
C. macloti	12	1.2	1.3			
E. blochii	12	1.2	1.3			
N. ferrugineus	8	0.8	0.8			
C. dusumieri	5	0.5	0.5			
S. fasciatum	5	0.5	0.5			
C. fitzroyensis	3	0.3	0.3			
C. albimarginatus	2	0.2	0.2			
C. altimus	2	0.2	0.2			
L. macrorhinus	2	0.2	0.2			
T. obesus	2	0.2	0.2			
C. brevipinna	1	0.1	0.1			
C. obscurus	1	0.1	0.1			
		0.0	0.0			
Total no. sharks	944			Total no. others	18	
Total all individuals	962					
% Catch composition		98.1				1.9

Table 4f: Catch composition (%) of Western Australia Observer Trip 6. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals. Effort - 123 877 hook hours.

Shark species	n	% comp^{n} total	% comp^{n} sharks	Other species	n	% comp^{n} total
C. plumbeus	225	30.2	31.9	*Arius sp.*	1	0.1
C. sorrah	104	13.9	14.8	*E. multinotatus*	1	0.1
R. acutus	98	13.1	13.9	*E. siullus*	2	0.3
G. cuvier	51	6.8	7.2	F. Carangidae	1	0.1
C. tilstoni/limbatus	52	7.0	7.4	F. Istiophoridae	6	0.8
N. acutidens	38	5.1	5.4	F. Scombridae	3	0.4
C. amboinensis	35	4.7	5.0	F. Serranidae	4	0.5
L. macrorhinus	26	3.5	3.7	F. Spyraenidae	7	0.9
S. mokarran	26	3.5	3.7	*L. scleratus*	3	0.4
F. Rhinobatidae/Rhynchobatidae	12	1.6	1.7	*L. sebae*	1	0.1
N. ferrugineus	6	0.8	0.9	*Opistognathus sp.*	1	0.1
R. djiddensis	6	0.8	0.9	*Other scalefish*	3	0.4
S. lewini	6	0.8	0.9	*P. auratus*	1	0.1
C. amblyrhynchos	6	0.8	0.9	*P. multidens*	1	0.1
C. obscurus	4	0.5	0.6	*R. canadus*	5	0.7
C. brevipinna	2	0.3	0.3	*Scomberoides sp.*	1	0.1
F. Dasyatidae	2	0.3	0.3			
C. albimarginatus	1	0.1	0.1			
C. melanopterus	1	0.1	0.1			
E. blochii	1	0.1	0.1			
S. fasciatum	1	0.1	0.1			
Total no. sharks	705			Total no. others	41	
Total all individuals	746					
% Catch composition		94.5				5.5

Table 4g: Catch composition (%) of Western Australia Observer Trip 7. No scalefish were caught. Catch composition is expressed as a percent of total catch. n-no. individuals Effort- 4833 hook hours.

Species	n	% comp^{n} total
C. sorrah	13	31.7
C. tilstoni/limbatus	10	24.4
R. acutus	8	19.5
C. amboinensis	2	4.9
G. cuvier	2	4.9
S. lewini	2	4.9
S. mokarran	2	4.9
N. acutidens	1	2.4
N. ferrugineus	1	2.4
Total no. sharks	41	

Table 4h: Catch composition (%) of Western Australia Observer Trip 8. Catch composition is expressed as a percent of total catch and also for the sharks as % of the total shark catch. n-no. individuals. Effort- 35 271 hook hours.

Shark species	n	% comp^{n} total	% comp^{n} sharks	Other species	n	% comp^{n} total
C. plumbeus	239	62.2	64.2	*Arius sp.*	1	0.3
C. tilstoni/limbatus	35	9.1	9.4	F. Istiophoridae	6	1.6
C. albimarginatus	24	6.3	6.5	F. Scombridae	1	0.3
G. cuvier	19	4.9	5.1	*Lagocephalus scleratus*	3	0.8
C. sorrah	14	3.6	3.8	*Lutjanus sebae*	1	0.3
S. lewini	11	2.9	3.0			
R. acutus	10	2.6	2.7			
C. amblyrhynchos	9	2.3	2.4			
S. mokarran	4	1.0	1.1			
C. brevipinna	2	0.5	0.5			
C. obscurus	2	0.5	0.5			
F. Rhinobatidae/Rhynchobatidae	1	0.3	0.3			
L. macrorhinus	1	0.3	0.3			
R. taylori	1	0.3	0.3			
Total no. sharks	372			Total no. others	12	
Total all individuals	384					
% Catch composition		96.9				3.1

Weights of different fins

Table 5: Different fin types as a mean (±se) percent of total fin weight for *C. tilstoni* (n= 10) and *C. sorrah* (n=8).

Species	Dorsal	Pectorals	Caudal
C. tilstoni	26.5±0.2	53.8 ±0.3	19.7 ±0.3
C. sorrah	23.2 ±0.7	55.1 ±0.9	21.7 ±0.6

Table 6: Percent differences in pectoral fin weights (g) from individual *C. tilstoni* (n= 10) *and C. sorrah* (n=8).

C. tilstoni			*C. sorrah*		
Pectoral 1 (g)	Pectoral 2 (g)	% Difference	Pectoral 1 (g)	Pectoral 2 (g)	% Difference
31.2	24.9	20.2	16.5	15.4	6.7
30.8	26.6	13.6	15.4	16.4	6.1
39.8	37	7.0	27.5	27.7	0.7
36	30.9	14.2	14.4	13.3	7.6
43.6	40.1	8.0	21	16.9	19.5
31.8	29.8	6.3	20.6	19.6	4.9
56.1	53.5	4.6	17.6	17.4	1.1
55.9	56.6	1.2	20.8	22.2	6.3
66.3	65.7	0.9			
65.7	71.4	8.0			

Other body ratios

Table 7: Trunk weight to whole weight and fillet weight to trunk weight mean (±se) expressed as a percent for Qld, NT and WA. n-no. individuals.

Species	Trunk weight/whole weight (%)						Fillet weight/trunk weight (%)		
	Qld [1]		Qld [2]		NT [3]		Qld [1]	NT [3]	
	n	mean	n	mean	n	mean	mean	n	mean
C. tilstoni	10	0.55 ±0.01	16	0.53 ±0.02	182	0.63 ±0.01	0.61 ±0.01	10	0.37 ±0.01
C. sorrah	8	0.56 ±0.01	7	0.56 ±0.02	114	0.61 ±0.01	0.63 ±0.02	10	0.40 ±0.02
C. amblyrhynchos			30	0.49 ±0.00					
C. dussumieri			14	0.63 ±0.01					
C. melanopterus			6	0.54 ±0.01					
C. amboinensis					33	0.54 ±0.02			
C. brevipinna					19	0.65 ±0.02			
R. acutus					6	0.65 ±0.03			
C. macloti					6	0.68 ±0.02			
C. fitzroyensis					11	0.68 ±0.04			
S. lewini					20	0.64 ±0.01		10	0.33 ±0.01

1. sharks measured in the laboratory in Qld
2. sharks measured at sea in Qld.
3. sharks measured at sea in NT.

Table 8: Fork length to total length mean (±se) expressed as a percent from observer trips in Qld, NT and WA. n-no. individuals

Species	Qld		NT		WA	
	n	mean	n	mean	n	mean
C. tilstoni	10	0.79 ±0.00	231	0.81 ±0.00	53	0.89 ±0.01
C. sorrah	8	0.79 ±0.00	158	0.79 ±0.00	169	0.85 ±0.01
C. amboinensis			35	0.81 ±0.00	16	0.87 ±0.01
C. brevipinna			19	0.81 ±0.00		
C. macloti			9	0.82 ±0.00	8	0.86 ±0.00
C. fitzroyensis			15	0.82 ±0.00		
R. acutus			19	0.81 ±0.02	82	0.87 ±0.00
E. blochii			52	0.76 ±0.00		
S. lewini			25	0.78 ±0.01		
C. plumbeus					206	0.87 ±0.00
G. cuvier					53	0.85 ±0.02

Lengths

Table 9: Queensland mean (?se) fork lengths (cm) and size range (cm) of sharks caught across trips 1-3. n-no. individuals

Species	Fork lengths		
	n	mean	range
C. tilstoni	29	98.2 ±3.0	72-140
C. sorrah	16	79.5 ±1.1	73-90
C. amblyrhynchos	30	105.6 ±3.4	70-81
C. dussumieri	15	69.2 ±0.6	64-73
C. melanopterus	6	89.8 ±4.0	28-76

Table 10: Northern Territory mean (±se) lengths (cm) and size range (cm) of sharks caught on each of the observer trips 1-3. n-no. individuals

Species	Trip 1- Total lengths			Trip 2- Fork lengths			Trip 3- Fork lengths		
	n	mean se	range	n	mean se	range	n	mean + se	range
C. tilstoni	242	78.2+0.7	64-125	54	71.5 +1.6	57-103	26	85.6 +3.3	47-115
C. sorrah	158	89.1+0.6	74-116	41	76.3 +1.6	55-100	26	72.5 +2.2	60-119
C. macloti	9	68.3+4.3	40-80	7	59.6 +1.0	55-62	6	71.8 +6.3	62-103
C. ambionensis	35	90.4 +2.9	73-132	24	75.0 +4.8	65-180			
C. fitzroyensis	15	89.9+2.5	77-113	40	98.9 +2.1	30-93			
R. acutus	21	63.0+3.9	41-93	8	46.4 +4.2	38-66			
E. blochii	87	100.4+1.3	80-126	82	85.8 +1.8	56-130			
S. lewini	46	99.6+3.1	71-146	12	96.8 +5.2	66-120			
A. cuspidata	13	120.5 +15.1	55-211						
C. brevipinna	19	86.7 +1.6	68-95						
R. taylori				15	40.7 +1.0	36-48			

Table 11: Western Australia mean (±se) fork lengths (cm) of sharks caught on each of the observer trips 1-8. n-no. individuals

Species	Trip 1		Trip 2		Trip 3		Trip 4	
	n	mean	n	mean	n	mean	n	mean
C. plumbeus	52	138.0 ±1.3	89	136.0 ±0.8	75	135.3 ±0.9	16	136.0 ± 4.4
C. sorrah			31	82.7 ±2.2	12	76.3 ±2.9		
C. tilstoni/limbatus								
R. acutus	19	68.7 ±1.6	15	64.0 ±1.9	10	64.9 ±1.4		
G. cuvier	6	187.0 ±23.6	39	151.4 ±8.2	15	131.2 ±10.8	7	184.6 ±26.5
N. acutidens								
C. amboinensis			15	179.9 ±3.4				
C. amblyrhynchos								
S. mokarran								
S. lewini								
L. macrorhinus								
C. albimarginata								
C. obscurus							7	215.9 ±8.6
F. Rhinobatidae/Rhynchobatidae								
R. taylori								
E. blochii								
C. macloti								
R. djiddensis								

Species	Trip 5		Trip 6		Trip 7		Trip 8	
	n	mean	n	mean	n	mean	n	mean
C. plumbeus	43	139.6 ±0.9	220	133.5 ±1.3			221	129.5±1.5
C. sorrah	317	75.5 ±0.5	95	79.9 ±1.0	12	80.3±2.5	14	73.4±1.8
C. tilstoni/limbatus	241	109.9 ±1.6	48	139.1 ±4.7	10	119.6±6.0	34	112.3±3.5
R. acutus	51	68.0 ±0.8	95	67.9 ±0.5	6	66.8±0.5	7	70.0±1.1
G. cuvier	31	194.4 ±15.2	47	162.0 ±8.9			18	199.4±21.4
N. acutidens	45	205.7 ±1.6	38	204.4 ±2.5				
C. amboinensis	19	181.3 ±6.8	34	176.4 ±2.6				
C. amblyrhynchos	36	115.7 ±2.6	6	119.3 ±8.1				
S. mokarran	20	202.6 ±7.6	26	224.7 ±5.9				
S. lewini	15	139.7 ±9.7					8	103.5±10.9
L. macrorhinus			26	58.3 ±1.6				
C. albimarginata							18	101.3±9.1
C. obscurus								

Species	Trip 5		Trip 6		Trip 7		Trip 8	
	n	mean	n	mean	n	mean	n	mean

F. Rhinobatidae/Rhynchobatidae			7	266.6 ±2.9		
R. taylori	14	45.4 ±1.0				
E. blochii	8	97.5 ±3.0				
C. macloti	11	62.6 ±0.9				
R. djiddensis			6	263.8 ±7.8		

Table 12: Fork lengths (cm)(mean ? se) of shark species caught on trips in different locations within each State/Territory. The included.

Species	Queensland Trip 3		Northern Terrritory Trip 2		Trip 3		Western Australia Trips 1, 6, 7, 8		Trips 2 & 3		Trip 4	
	n	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	**mean**	**n**	
C. tilstoni	29	98.2 ± 3.0	54	71.5 ± 1.6	26	85.6 ± 3.3	93	127.4 ± 3.1				
C. sorrah	16	79.5 ± 1.1	41	76.3 ± 1.6	26	72.5 ± 2.2	124	79.0 ± 0.9	12	76.3 ± 2.9		
C. amblyrhynchos	30	105.6 ± 3.4			6	71.8 ± 6.3	6	119.25 ± 8.1				
C. amboinensis			24	75.0 ± 4.8			38	171.1 ± 4.1	17	180.8 ± 3.1		
R. acutus			8	46.4 ± 4.2			128	68.1 ± 0.4	25	64.4 ± 1.3		
S. lewini			12	96.8 ± 5.2			17	125.9 ± 9.5				
R. taylori			15	40.7 ± 1.0								
C. plumbeus							493	132.2 ± 1.0	164	135.7 ± 0.6	16	
G. cuvier							91	181.0 ± 8.0	54	145.8 ± 6.7	7	
Location (see Figure 1)	Margaret Bay to Cape York		Anson & Fog Bay		Bathurst Island		South of Port Hedland		Near Port Hedland		South	
Depth	4-30m		9-16 m		16-28 m		9-157m		20-40 m		35-50	

Sex ratio

Table 13: Northern Territory sex ratio expressed as the percentage of females present in sharks caught on trips 1-3. n-no.individuals

Species	Trip 1		Trip 2		Trip 3	
	n	% Female	n	% Female	n	% Female
A.cuspidata	22	83.3	6	66.7		
C.ambionensis	35	37.1	24	54.2		
C.brevipinna	19	68.4				
C.fitzroyensis	15	26.7	40	37.5		
C.macloti	9	66.7	7	28.6	6	100.0
C.sorrah	158	34.8	42	42.9	26	50.0
C.tilstoni	243	53.5	54	50.0	26	61.5
R.acutus	21	52.4	8	12.5		
R.taylori			15	46.7		
E.blochii	87	43.7	82	19.5		
S.lewini	46	50.0	13	30.8		

Table 14: Western Australia sex ratio expressed as the percentage of females present in sharks caught on six of the eight trips. For Trips 4 and 7 there were no species where >5 male or female individuals were sexed. n-no.individuals

Species	Trip 1		Trip 2		Trip 3		Trip 5		Trip 6		Trip 8	
	n	% Female	n	% Female	n	% Female	n	% Female	n	% Female	n	% Female
C. plumbeus	50	80.0	90	45.6	73	37.0	43	34.9	218	64.2	226	54.9
C. amboinensis			16	50.0			20	40.0	34	67.6		
C. sorrah			31	80.6			317	37.9	95	38.9		
G. cuvier			35	57.1	15	46.7	31	67.7	47	57.4	18	61.1
R. acutus			15	40.0			49	34.7	95	80.0		
C. amblyrhynchos							36	47.2				
C. tilstoni/limbatus							240	58.3	48	22.9	33	51.5
N. acutidens							45	26.7	37	40.5		
S. mokarran							18	66.7	26	69.2		
L. macrorhinus									26	57.7		