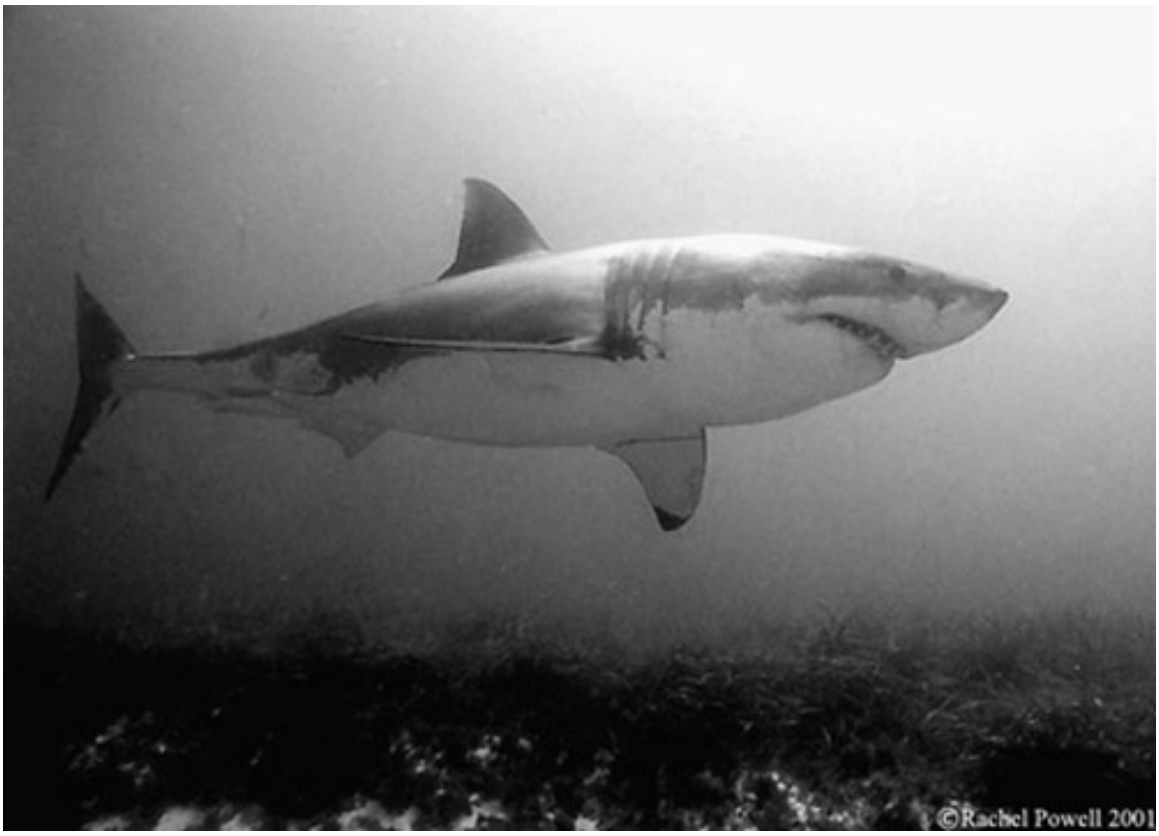

White Shark

(*Carcharodon carcharias*)

Recovery Plan

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White Shark (Carcharodon carcharias)
Recovery Plan

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Recovery Team Membership

Representation on the Recovery Team was drawn from a cross-section of affected and interested parties, including government departments, non-government organisations and individuals involved in or interested in shark conservation and management.

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Sara Williams	Environment Australia
Dennis Witt	Tasmanian Fisheries

List of Abbreviations

AFFA	Agriculture, Fisheries & Forestry Australia
AFMA	Australian Fisheries Management Authority
CALM	Conservation and Land Management (Department of - Western Australia)
CITES	Convention on International Trade in Endangered Species of Fauna and Flora
cm	centimetres
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COFI	Committee on Fisheries
CPUE	catch per unit effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEHSA	Department of Environment and Heritage, South Australia
DPIWE	Department of Primary Industries, Water and Environment, Tasmania
EA	Environment Australia
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESSS	Endangered Species Scientific Subcommittee (now TSSC under new EPBC Act)
FAO	Food and Agriculture Organisation of the United Nations
IPOA	International Plan of Action for Sharks
IUCN	International Union for the Conservation of Nature
km	kilometres
m	metres
MAFRI	Marine and Freshwater Resources Institute, Victoria
MPA	marine protected area
NES	national environmental significance
NHT	Natural Heritage Trust
NSW	New South Wales
NPOA	National Plan of Action for the Conservation and Management of Sharks
PIRSA	Primary Industries and Resources South Australia
Qld	Queensland
QFMA	Queensland Fisheries Management Authority
Qld DPI	Queensland Department of Primary Industries
SA	South Australia
TSSC	Threatened Species Scientific Committee
Tas	Tasmania
Vic	Victoria
WA	Western Australia

PART 1

1.1 INTRODUCTION

This Recovery Plan provides summary information on the White Shark, including biology, habitat, distribution and historical and current threats to its recovery.

The Plan has been developed in accordance with the Guidelines for the Compilation of Recovery Plans under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It therefore sets out the recovery objectives, actions required to achieve those objectives, performance indicators, as well as identifying those responsible for implementing the actions and the timeframes involved. The Plan also identifies an aggregated costing for the recovery of the White Shark.

Additional information is provided such as guidelines for decision-makers and tools to assist the implementation of the Plan.

A comprehensive review of the biological information and current behavioural and ecological knowledge of the White Shark is provided in an appendix attached to this Plan.

1.2 CONTEXTUAL INFORMATION

1.2.1 The Region Covered

This Plan covers all Australian waters in which the White Shark is found.

The White Shark is widely distributed, and located throughout temperate and sub-tropical regions in the northern and southern hemispheres. In Australia, its range extends primarily from Moreton Bay in southern Queensland, with at least one record as far north as Mackay, (Paterson, 1990:154) around the southern coastline and to North West Cape in Western Australia (Bruce 1995).

1.2.2 Conservation Status, Historical and current size of Population

The White Shark, *Carcharodon carcharias,* is also known in Australia as the Great White Shark or White Pointer and is fully protected in Commonwealth waters under the *EPBC* Act where it is listed as a vulnerable species. The listing of the White Shark as vulnerable was based on a number of factors, including evidence of a declining population, its life history characteristics (long lived and low levels of reproduction), limited local distribution and abundance and at the time of listing, and still being under pressure from the Australian commercial fishing industry.

The White Shark is also fully protected in the coastal waters of Tasmania, South Australia, Victoria and Western Australia; and protected in the coastal waters of New South Wales and Queensland with exemptions made for beach meshing.

Internationally White Sharks are listed as ‘vulnerable’ on the IUCN Red List of threatened species (IUCN 2000) as well as protected in South Africa (1991), Namibia, the Maldives, Florida and California (US) and Malta.

There is little historical information on population estimates for the White Shark. The current population status of White Sharks in Australia is difficult to assess due to:

- poorly known stock structure and movement patterns;
- paucity of information on captures across all fishing sectors;
- ambiguities in available data;
- shortage of verified data; and
- lack of suitable indices of abundance or population monitoring programs.

Available data sets suggest a decline in abundance and size of White Sharks in some areas (Reid and Krogh 1992). These data include beach meshing records for New South Wales and Queensland, game fishing records from New South Wales and South Australia, and anecdotal sighting frequencies by tourism operators and divers in South Australia which all report declining catches and sightings (Bruce 1995). This interpretation is complicated by a marked interannual variability that may not be related to population size (Bruce 1995, Fox & Taylor *pers comm.* in Strong *et al.* 1992) as well as other factors such as changes in shark meshing regimes or decreased fishing effort (Peperell 1992). There are also competing claims that the number of White Sharks has increased in certain areas (for examplejuvenile White Sharks in some areas of Victorian coastal waters). Despite the inadequacies in the available data, there appears to be an overall, long-term decline in abundance of White Sharks in Australian waters

There are similarly few data sets from which an assessment for worldwide populations of White Sharks can be made. Game fishing data from the east-coast of North America indicate declines in the proportion of White Sharks taken relative to other shark species caught, similar to that reported off eastern Australia by Pepperell (1992). Casey and Pratt (1985) reported a drop in the ratio of White Sharks to all other sharks captured from 1:67 in 1965 to 1:210 in 1983 for the mid-Atlantic Bight.

Cliff *et al.* (1996a) reported marked interannual variability in the capture rates of White Sharks in the South African beach meshing program, with a cyclical period of 4-6 years. They also reported a significant decline in White Shark captures between 1973 and 1993.

A full description of the Biology of White Sharks can be found at Appendix A

1.2.3 Individuals /groups affected by the Plan's Implementation

Section 270 (2)(g) of the EPBC Act indicates the need to identify interests that will be affected by the plan's implementation.. The list below is not exhaustive and also includes organisations represented on the Recovery Team.

Commonwealth

Department of the Environment and Heritage (Environment Australia)
Australian Fisheries Management Authority
Agriculture, Fisheries and Forestry - Australia
CSIRO Marine Laboratories

State/Territory/Local Government

Queensland Fisheries Management Authority
Queensland Department of Primary Industries and Energy
Fisheries Western Australia
Western Australian Department of Conservation and Land Management
New South Wales Fisheries
Marine and Freshwater Research Institute
Tasmania - Department of Primary Industries, Water and Environment
Department of Primary Industry and Resources South Australia
Department for Environment and Heritage South Australia
South Australian Research Development Institute
Victorian Fisheries

Non-government Organisations and others

Humane Society International
Cage Dive Groups
Tour Groups
Australian Game Fishing Association and other game fishing bodies
Australian Shark Conservation Foundation
Recreational fishers
Surf life saving organisations
Beach users.
Tasmanian Fishing Industry Council
Western Australian Fishing Industry Council
Seafood Industry Victoria Inc
South Australian Fishing Industry Council Inc
Queensland Seafood Industry Association Inc
NSW Seafood Industry Council Inc
Australian Seafood Industry Council

1.2.4 Relevance to Indigenous Australians

There are no known significant interactions between Aborigines and the White Shark.

1.2.5 Relationship between the Plan and other Planning Processes

Comparable regulations or actions that reflect actions within this Plan have been introduced in South Australia, Victoria, Tasmania, New South Wales and Western Australia. The following table provides a summary explanation of the legislation underpinning the protection of the White Shark in relevant Australian jurisdictions.

Table 1. Legislation that protects White Sharks or identifies their status as needing particular conservation action in Australia.

Jurisdiction	Act	Section Summary	Date of Declaration
Comm.	*Environmental Protection Biodiversity Conservation Act 1999*	**Part 13 Div 1** Listed as 'vulnerable' species with prohibition on taking and trade. Part 13 A Prohibition of certain exports and imports.	16 July 1999 Amended Sept 2001
Vic	*Fisheries Act 1995* *Flora and Fauna Guarantee Act 1988*	**S.69** Aquatic Biota can be declared protected by the Governor in Council **S.71** A person must not take, injure, damage, destroy, possess, keep, display for reward, release or sell any protected biota Species listed as *Vulnerable*	4 August 1998 6th October 1997
Tas	*Threatened Species Protection Act 1995* *Living Marine Resources Management Act 1995* *Fisheries (General and Fees) Regulations 1996*	Species declared "Vulnerable" **S.135(2)** A person must not take any protected fish Rule 18(a)3, a person must not take, or be in possession of the white shark	Declared 1 March 2000 Initially declared under previous Act in 1995. Applied 9th December 1998.
NSW	*Fisheries Management Act 1994*	**Part 7a** Threatened Species under Schedule 5 (Species vulnerable to extinction) **S.8** Fisheries Closure Notification- taking of White Sharks prohibited by all methods in all waters except approved shark meshing contractors for scientific purposes	Protected under Part 7a on 14 May 1999 Gazetted January 1997 Section 8. Amended January 1997
WA	*Fisheries Resources Management Act 1994*	**S.46** A person must not take, possess, sell or purchase, consign, bring in to the state: any totally protected fish	November 1997

	Wildlife Conservation Act 1950	S. 14(2)(ba) (i) such fauna is wholly protected throughout the whole of the State at all times; and (ii) a person who commits an offence under section 16 or section 16A with respect to or in relation to such fauna is liable, not withstanding any other provision of this Act, to a penalty of $10,000.	17 December 1999
Qld	*Fisheries Act 1994*	**S.78 (1)** A person must not unlawfully take, possess or sell a regulated fish	18 July 1997
SA	*Fisheries Act 1982*	S.42 A person must not take a fish declared by regulation to be protected Regulations restrict tackle recreational fishers can use and prohibit the use of berleying and mammal baits	January 1998
IUCN		Red List - **v**ulnerable	1996

Table adapted from work compiled by CSIRO Marine Research

1.2.6 Major benefits to other native species or communities

Section 270 of the EPBC Act requires that this Plan specifies any major benefits to species or ecological communities other than White Sharks that may be derived from actions taken in accordance with this Plan. Conservation measures to benefit White Sharks and their habitat may benefit inshore marine communities. In addition, by managing fishery bycatch and researching alternatives to shark meshing, these threats to other species, such as whales, dolphins, marine turtles, pelagic rays, some fish species and other sharks may be reduced,. Some of these species are also threatened or are uncommon. Marine communities may also benefit from any marine protected areas that may be established to protect White Sharks and conversely White Sharks may benefit from marine protected areas established within their range.

1.3 HABITAT CRITICAL TO THE SURVIVAL OF THE SPECIES

The EPBC Act specifies that recovery plans should *identify the habitats that are critical to the survival of the species or community concerned and the actions needed to protect those habitats* (S270 (2)(d).

To date there is little solid information or research findings upon which to identify habitat critical to the survival of the White Shark. An important early step towards the identification of habitat critical for the survival of the White Shark would be the identification of the characteristics of habitat critical to the survival of White Shark. Also as White Sharks appear to move through developmental habitats as they grow, the identification of critical habitat for White Sharks may be difficult given the unknown nature of their developmental needs at various life stages.

A full description of White Shark habitat can be found at Appendix B.

1.4 OVERVIEW OF THREATS AND ISSUES

There are a number of sources of mortality (other than natural mortality) of White Sharks in Australian waters. The most predominant of these are dealt with below.

1.4.1 Commercial Fishing

Despite not being commercially targeted, White Sharks are caught as bycatch on long-lines and in nets of professional fishers and in fin fish farm cages such as tuna farms. This is currently suspected to be the largest cause of mortality. The actual rate of capture of White Sharks by commercial fishers is difficult to assess and has not yet been quantified. This is because captures are not usually recorded, and in many cases, captured sharks are either not landed intact or not landed at all. Estimates of annual capture, based on anecdotal reports, range from less than 10 to 100 per annum in South Australia and 100 to 440 per annum for all fisheries (recreational and commercial combined) in Australian waters.

Further investigations are needed to quantify the capture of White Sharks from commercial fishing in each of the fisheries and establish the impact the commercial fishing industry has on the Australian population of White Sharks. It is necessary for commercial fisheries managers to assist industry to improve reporting of the take or interaction with White Sharks.

A full description of this threat can be found at Appendix C

1.4.2 Recreational Fishing

Prior to the implementation of protective legislation, game fishing for White Sharks was carried out mainly in South Australia, Queensland and New South Wales, but also in Victoria and Western Australia. Game fishing in South Australia for White Sharks was at its height in the 1950s. Between 1980 and 1990 White Sharks were also tagged and released although the survival rate of these sharks is not known. Further research in New South Wales using game fishing data for New South Wales calculated that the ratio of White Sharks to all shark species caught had changed from 1:22 in the 1960s to 1:38 in the 1970s and 1:651 in the 1980s. In the 1990s, capture of White Shark by game fishers off the coast of New South Wales was 13:2103 or 1:162 (Chan 2001). Prior targeting and removal of the largest and oldest of the population by game fishers would have had the effect of removing the most reproductively productive members of the population.

Game fishing groups have expressed a keen interest in accessing White Sharks for tag-release since the species was protected. Other groups have raised concerns that capture induced mortality or sublethal stress from tag-release activities may be unacceptably high. Issues of cryptic mortality, sublethal effect and scientific benefits also need to be addressed.

Other recreational fishers still occasionally capture White Sharks (for example in gill nets in Tasmanian waters and while fishing for other sharks in Western Australia, Victoria and New South Wales, and fishing for snapper in South Australia and Victoria). In some cases small White Sharks are mistakenly identified as other species (for example mako sharks).

A full description of this threat can be found at Appendix C.

1.4.3 Shark Control Activities

Shark control activities in Australia include beach meshing and drumlines, which most often kill the captured shark. Some non-lethal methods that are being trialed include using electrical fields to repel sharks but these practical trials have encountered many logistical problems. White Sharks are a target species in control activities but other non-target species are impacted by shark meshing such as turtles, dugongs and dolphins.

Queensland and New South Wales are the only two States to employ protective beach meshing. There are currently a total of 49 meshed beaches set offshore between Newcastle and Wollongong in New South Wales (approximately 200 km of coastline). In Queensland, a mixture of baited drumlines and nets are used. Drumlines consist of a marker buoy and float supporting a trace and baited hooks anchored to the bottom, and are intended to target dangerous species of sharks and reduce the bycatch of non-target species.

Shark meshing effort has increased over time. If the catch per unit effort (CPUE) equates to some measure of abundance then there has been a significant decline in White Shark abundance in both programs. The average size of White Sharks caught in New South Wales meshing operations has also declined over the period, though this is apparently not evidenced in the Queensland data. The degree to which beach meshing is impacting on White Shark populations is unknown although the decline in captures suggests it is significant.

A full description of this threat can be found at Appendix C.

1.4.4 Trade

The killing of White Sharks for trade targets two main areas – trade in trophy products such as jaws, and teeth and the trade in fins for food items such as 'shark fin soup'. Increasing demand for White Shark products particularly fins, jaws, and teeth, has increased their value. Recent reports have been made identifying values of up to $50 000 paid for jaws from South Africa and $600 for individual teeth, despite their current protection there. Illegal trade in White Shark products may be a threat to the Australian population of White Sharks.

There are several commercial fisheries in Australia that frequently take shark fins as by product. Dried shark fin can attract a high price on Asian markets. The high market value for shark fins is leading to a high level of targeting of sharks that may be unsustainable. There is a growing acceptance that shark finning is both wasteful, when fins are removed and the carcass is discarded. This method is also a possible inducement to fishers to actively target sharks.

A full description of this threat can be found at Appendix C.

1.4.5 Tourism

Tourism does not pose a direct threat to White Sharks but through indirect means may limit the recovery of the population by altering the behaviour of the animal.

Both shark cage diving and shark boat tours are dependent on attracting sharks to an area by berleying (also known as 'chumming'). Berleying involves releasing a mixture of fish oil and/or animal products into the water at regular time intervals to develop a slick to attract sharks in the vicinity. The use of berley may encourage White Sharks to appear or stay longer in a location that they would not normally visit, and there is the possibility that sharks will become habituated and begin to associate humans and boats with food. In addition the effect of berleying in areas adjacent to seal/sea lion colonies may result in higher mortality of seals/sea lions as a consequence of the increase presence of White Sharks. Tourism activities also raise the issue of disturbance to White Sharks and their prey. The effect of watercraft and human activities on sharks and marine mammals in the vicinity needs to be established.

However, it should be noted that some tourism activities in particular cage diving are contributing to data collection for further research

A full description of this threat can be found at Appendix C.

1.4.6 Tag and Release

Tag and release if not undertaken with care or without knowledge can contribute to White Sharks dying through the stress of being captured. Tag and release programs can provide information on movement patterns, site fidelity, growth, population estimates and mortality estimates. Tag and release programs must be assessed against the risk to the individual sharks and the benefit of the knowledge it is proposed to gain.

A full description of this threat can be found at Appendix C.

Part 2. RECOVERY OBJECTIVES

Section 270 of the EPBC Act specifies the content of a Recovery Plan.

2.1 Recovery Plan Objective:

The overall Recovery Plan objectives are:

> 'To recover White Shark numbers in Australian waters, to a level that will see the species removed from the schedules of the *Environmental Protection and Biodiversity Conservation Act 1999.*
>
> To implement the actions that lead to eventual removal of the species from the threatened species schedules of *Environmental Protection and Biodiversity Conservation Act 1999.'*

2.1.1 Specific Objectives:

The specific objectives of this Plan are to:

A. monitor and reduce the impact of commercial fishing on White Sharks;
B. investigate and evaluate the impact of recreational fishing on White Sharks;
C. monitor and reduce the impact of shark control activities on White Sharks;
D. identify and manage the impact of tourism on White Sharks;
E. monitor and reduce the impact of trade in White Shark products;
F. develop research programs toward the conservation of White Sharks;
G. identify habitat critical to the survival of White Sharks and establish suitable protection of this habitat from threatening activities;
H. promote community education and awareness in relation to White Sharks; and
I. develop a quantitative framework to assess the recovery of the White Shark.

2.2 RECOVERY OBJECTIVES, ACTIONS, PERFORMANCE CRITERIA and TOOLS TO ASSIST IMPLEMENTATION

The cost of this Recovery Plan is likely to be in the order of $2 million. An important corollary to the estimated cost of the actions is that some of the costs will come from recurrent operational budgets of the organisations responsible for the activities. Any funding sought from Environment Australia will be subject to the approval of the Minister for the Environment and Heritage. The priority assigned to each action has been identified according to the following criteria: Priority 1 action is critical to prevent extinction or to provide information critical for setting recovery goals;
Priority 2 action prevents impact short of extinction; and
Priority 3 refers to all other actions.

Table 1

Specific Recovery Objectives	**Actions** ***To fulfil the specific objectives, actions are designed to identify and reduce the threats to White Sharks, determine levels of mortality and reduce that mortality.***	**Responsibility**	**Performance Criteria**	**Timeframe**	**Priority**
A. Monitor and reduce the impact of commercial fishing on White Sharks.	1.Monitor level of White Shark bycatch and mortality in relevant fisheries including the following: • Southern Shark Fishery • Vic/Ocean General Fishery • SA Snapper and Tuna Fisheries • WA Shark Fishery • SA Finfish Farms • Tasmania Scalefish Fishery	All fisheries agencies (Comm/state /terr) AFMA PIRSA Fisheries WA DPIWE Tas Fisheries NSW Qld DPI Fisheries Victoria	Relevant fisheries report level of bycatch annually to the central agency identified in Objective I.2	annually	1
	2. Relevant fisheries to modify logbooks to record capture, length and sex of White Sharks.	AFMA PIRSA Fisheries WA Vic Fisheries QDPI	Logbooks used within all relevant fisheries are modified by the end of 2002.	6 month	1
	3. Ensure existing observer programs operating in fisheries record interactions with White Shark.	AFMA PIRSA Fisheries WA DPIWE Tas	Observer programs collect data.	ongoing	1

	4. Strengthen legislation (where required),awareness and compliance to improve reporting of White Shark bycatch and mortality in all fisheries including recreational charter fishing boats and finfish cage aquaculture operations.	AFMA PIRSA Fisheries WA DPIWE Tas Qld DPI NSW Fisheries	Captures reported in all relevant fisheries	Within 2 years	2
	5. Environment Australia to ensure Fisheries Management plans that are reviewed for accreditation under EPBC Act contain actions that are consistent with the recovery of the White Shark, including reduction of bycatch and recording of all interactions.	EA	All Fisheries management plans that are accredited under EPBC Act contain actions that are consistent with the recovery of the White Shark.	ongoing	1
	6. Where relevant fisheries management plans are being reviewed, actions to reduce levels of white shark fishing mortality, including from bycatch are considered.	AFMA All states/territories	All relevant fisheries management plans have considered whites shark fishing mortality, including from bycatch in the review of the plans.	5 years	1
B. Investigate and evaluate the impact of recreational fishing on White Sharks.	1. Develop a standardised reporting format to record White Shark bycatch and sightings and encourage fishers (including gamefishers and aquaculture operators) to report such records to Fisheries management agencies.	Australian Game Fishing Association Recfish Australia Fisheries management agencies	Regular report detailing current catch levels is prepared for the recovery team annually	annual	3
C. Monitor and reduce the impact of shark control activities on White Sharks.	1.Numbers of White Shark taken in shark control activities monitored annually.	NSW Fisheries Qld DPI SA WA	Take of White Sharks in shark control activities is made public.	annual	3

	2. Develop and trial non-lethal shark control alternatives to beach meshing and drumlines with a view to phasing out bottom set shark netting programs of shark control	NSW Fisheries Qld DPI	Alternatives are developed and trialed.	ongoing	2
	3. Continue recording, tagging and biological sampling of shark meshing captures and information collated	NSW Fisheries Qld DPI	Records be made public	ongoing	3
	4. Undertake a review of the effectiveness of shark control programs on public beaches	All States	Review undertaken within 5 years of this Plan	5 years	3
	5. Develop effective predator nets for finfish cage aquaculture operations that protect sharks and aquaculture operations from harm.	All States	Alternatives developed and trialed.	ongoing	2
D. Identify and manage the impact of tourism on White Sharks.	1 Examine the significance of deliberate attracting actions on the behaviour and movement of White Sharks.	EA CSIRO	Research conducted to report to the Recovery Team within 5 years of this Plan	5 years	3
	2. Ensure minimised disturbance to White Sharks by marine based tourism activities, including through • development and implementation of code of conduct, and review of those codes; • review effectiveness of existing codes of conduct; • regulations; • permits (include reporting of daily activities as part of conditions).	relevant tourism associations State authorities EA	Minimised disturbance of White Sharks in their natural environment	2 years	3
	3. Support and continue a tag/resighting program with Shark Cage Dive Operators to improve knowledge of: • demography and migration patterns • estimation of bycatch levels	Shark Cage Diving Association DEHSA PIRSA CSIRO	Sightings recorded and reported to the permitting authority (DEHSA), PIRSA and CSIRO.	annual	2

	4. Ensure all people participating in tagging programs are trained to ensure minimal disturbance to White Sharks	CSIRO Government agencies EA	All operators trained and permits for tagging programs include as one of the conditions that people undertaking tagging operations are trained	ongoing	3
E. Monitor and reduce the trade in White Shark products and parts thereof.	1. Seek to establish a global prohibition of trade between countries in white shark products and parts thereof	EA	White Shark is included on Appendix II of CITES as a step towards the establishment of a ban in trade	Within life of the plan	2
	2. Prepare National Plan of Action for Sharks to give effect to the FAO's International Plan of Action for Sharks.	AFFA	Australia submits the plan to FAO at COFI 2002.	1 year	2
	3. Examine the extent of finning in Australia of White Sharks and where necessary strengthen compliance with relevant legislation prohibiting the take of White Sharks.	all fisheries agencies EA	No White Shark fins are landed	Ongoing	2
	4. Consider nominating the White Shark on relevant international agreements, particularly Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals.	EA	White Shark included on Appendix II of CMS	Within life of the plan	2

F. Develop research programs toward the conservation of White Sharks.	1. Continue to undertake necropsies on all dead White Sharks landed by fishers under permit.	CSIRO All States	Continuation of cooperation between CSIRO and states	ongoing	3
	2. Develop a population dynamics model for the White Shark to assist in understanding: • population status; • rates of recovery; and • population structure and distribution.	CSIRO MAFRI	Model is developed within 3 years	3 years	3
	3. Continue to collect and analyse genetic material to determine the genetic status of Australian white shark populations on a national and a global level.	CSIRO	Material is collected. Initial stock analysis of Australian population is completed by mid 2004.	ongoing	3
	4. Continue research directed at determining characteristics of the white shark that will contribute to identifying the habitat critical to the survival of the white shark	CSIRO All states	Research results are made publicly available	ongoing	1
	5. Evaluation of sublethal effects, cryptic mortality and scientific benefits of targeted/permitted tag and release activities be conducted.	CSIRO/ EA	Evaluation prepared and results agreed by scientific community and EA	Within life of the plan	2
	6. Request Coastwatch patrols to report sightings of White Sharks	EA/Coastwatch	Coastwatch provides reports on White Shark sightings to EA	annual	3

G. Identify habitat critical to the survival of White Sharks and establish suitable protection of this habitat from threatening activities	1. Identify habitat critical to the survival of the species for the White Shark.	EA CSIRO State agencies	Habitat critical for the survival of the white shark is identified, reported and listed on the Register for critical habitat under the EPBC Act and relevant state legislation	Within life of the plan	1
	2. Consider White Shark habitat in identifying and managing MPAs throughout the White Sharks range.	EA State agencies	White Shark habitat is a criteria used in developing the NRSMPA	ongoing	2
H. Promote community education and awareness of White Sharks	1. Develop a community education strategy for White Sharks aimed at the general public, divers and commercial/game/recreational fishers including: • identification and biology • role and importance in the ecosystem; • current threats and status; • reasons for listing; • safe swimming guidelines; • safe diving guidelines; and • shark control activities.	CSIRO EA AFMA State Fisheries State Museums	A community education strategy is developed and being implemented by end of 2003.	1.5 years	2
	2 Develop awareness of reporting requirements of incidental catch and bycatch	Fisheries agencies EA	Increase in reports lodged and accuracy of information	2 years	3
	3. Encourage recreational and game fishing organisations to promote awareness of White Shark biology, juvenile identification, conservation status and reasons for listing	Recfish Australia Game/sports fishing associations Fisheries	Evidence of targeted promotional/education activities provided annually to Recovery team	annual	3

		management agencies.			
	4. Explore avenues in tourism to promote greater understanding and acceptance of the need to protect White Sharks	Relevant tourism operations including cage diving operations. Commonwealth Government and State Governments	Evidence of activities promoting an understanding of the need to protect the white shark provided annually to Recovery team	Annual	3
I. Develop a quantitative framework to measure the recovery of the White Shark.	1. Develop a quantitative framework, to assess the recovery of the species	Recovery Team	Quantitative framework established to measure recovery of the species within 3 years of Recovery Plan.	3 years	3
	2. Identify a central point/agency to take responsibility for the collection, storage and maintenance of data	Recovery Team	Central agency identified	1 year	3

2.3 GUIDELINES FOR DECISION MAKERS

The following actions may hamper the species viability and recovery if carried out along the Australian coastline between Mackay Queensland around the southern coastline and to North West Cape in Western Australia	**Management prescriptions to be followed when actions identified in the first column are being considered**
Capture of White Sharks through commercial fishing activities	Specific State and Commonwealth regulations apply to commercial fishing operations such as closed seasons, restrictions on gear type or finning. Reporting of interactions with White Sharks compulsory under the EPBC Act Accredited Fisheries Management Plans which includes Bycatch Action Plans in place for any commercial fishery that may interact with White Sharks
Capture of White Sharks through recreational fishing activities	The capture of White Sharks is not allowed in any State or Commonwealth waters within its range. Any person who injures, takes or kills a White Shark could be subject to civil or criminal prosecution under the EPBC Act 1999
Keeping of White Sharks in captivity	Under the assessment and approval provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance (NES) are subject to a rigorous assessment and approval process. An action includes a project, development, Threatened species such as White Sharks are considered a matter of NES. Refer to http://www.ea.gov.au/epbc Similar processes exist in all States.
Tourism activities such as cage diving or White Shark feeding	State regulations apply to these activities which include limiting the number of operators, area of activity and type of activity that can occur. Adherence to a code of practice recommended by the responsible State
Activities that have the potential to alter habitat quality (such as aquaculture, new sewerage/storm water outfalls and other coastal development in areas known to be frequented by White Sharks	Under the assessment and approval provisions of the EPBC Act, actions that are likely to have a significant impact on a matter of national environmental significance (NES) are subject to a rigorous assessment and approval process. An action includes a project, development, Threatened species such as White Sharks are considered a matter of NES. Refer to http://www.ea.gov.au/epbc
Shark Control Activities	Specific State regulations apply. Permits under relevant State legislation obtained
Research activities involving interference with a White Shark.	Appropriate procedures to assess research to ensure it is bona fide and that impact is minimised. Permits under the EPBC Act or other relevant legislation must be obtained.

2.4 EVALUATION AND REVIEW OF THE PLAN

There are two aspects to the evaluation and review of the Recovery Plan. The first aspectis the legislative requirements. Section 270 (2)(g)(ii) of the EPBC Act states that those who will evaluate the performance of the plan need to be identified – in effect the Recovery Team. An annual review will be carried out by the Recovery Team and a report of that review will be forwarded to the Threatened Species Scientific Committee (TSSC). The EPBC Act also identifies that the plan be reviewed at intervals no longer than 5 years.

The Recovery Team will also carry out the evaluation with the outcome being a report to the TSSC and the Minister. The Recovery Plan may be varied at any time on the request of the Minister (EPBC Act Section 279) but before varying a plan, the Minister must obtain and consider advice from the TSSC on the content of the variation.

The second aspect of the evaluation and review of the plan involves developing criteria to measure the success (or otherwise) of this Recovery Plan. As part of the implementation of the Recovery Plan, a quantitative framework needs to be developed to assess the recovery of the species within the first 3 years of the Recovery Plan to assist in the management of the recovery of White Sharks in Australia.

To contribute to an effective evaluation and review of the plan, a monitoring program needs to be established to measure recovery of the species and evaluate the effectiveness of prescribed actions within the Recovery Plan.

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BIOLOGICAL DESCRIPTION Appendix A

Description of Species

The White Shark, *Carcharodon carcharias*, also known as the Great White Shark or White Pointer, is a close relative of the mako and porbeagle sharks and is classified in the family Lamnidae (mackerel sharks). White Sharks have a moderately stout, torpedo-shaped body; are coloured blue-grey to grey-brown on the upper surface and white below; have large serrated triangular teeth, and a distinctive lateral keel along the body midline immediately before a crescent shaped tail. White Sharks grow to at least 6 metres in length (NSW Fisheries 1997; Last & Stevens 1994), although there are unconfirmed reports of specimens up to 7 metres (Mollet *et al.* 1996). The White Shark also has a heat-exchanging circulatory system allowing it to maintain body temperatures up to 14^{o} C above that of the surrounding seawater (Goldman *et al.* 1996).

Distribution

The White Shark is widely distributed, and located throughout temperate and sub-tropical regions in the northern and southern hemispheres. It is primarily found in the coastal and offshore areas of the continental and insular shelves and offshore continental islands. The White Shark is most frequently encountered off South Africa, southern Australia, northern California and the northeastern United States (Last & Stevens 1994). In Australia, its range extends primarily from Moreton Bay in southern Queensland, with at least one record as far north as Mackay, (Paterson, 1990:154) around the southern coastline and to North West Cape in Western Australia (Bruce 1995).

While White Sharks are uncommon in Australian waters there are areas where encounters appear to be more frequent. These include; waters in and around seal and sea lion colonies in general, Neptune Islands, South Australia, Wilsons Promontory, Victoria (particularly juveniles) the coastal region between Newcastle and Port Stephens, New South Wales (particularly juveniles) and the Recherche Archipelago and the islands off the lower west coast of Western Australia.. D'Ombrain (1957) described packs of White Sharks and larger solitary sharks in the waters around Dangerous Reef and from the Pages (near Kangaroo Island) to Nuyts Archipelago in the Great Australian Bight. Large White Sharks were also taken in the past off Cape Moreton (which was a whaling station) in Queensland (D'Ombrain 1957). Edwards (1997) describes his White Shark filming exploits off Cheynes Beach whaling station Western Australia in 1976. Whaling activities and stations were something of a magnet for White Sharks due to the easily available food from moored whale carcasses and discarded offal (Mead 1973, Grady 1986). Large numbers of sharks, some of which are White Sharks (Coastwatch reports to Environment Australia), often attend floating whale carcasses.

Long-term movement patterns of White Sharks are poorly known. However the White Shark is capable of swimming long distances and for extended periods. For example, offshore tracking of a large shark with sonic tags indicated that it moved 190 kilometres in 2.5 days at an average cruising speed of 3.2 kilometres per hour (Carey *et al.* 1982 *in* Bruce 1992). Recent tracking of a satellite tagged shark called 'Neale' recorded 2946km over 113 days. Other archival and satellite tag research in Australian waters has also recorded shark movements mainly restricted to shelf and coastal waters and swimming depths down to 94 m (Bruce. B, D. Malcolm H. & Stevens J.D. 2001)

There are several reports of individual White Sharks being sighted at the same locality over several years (Bruce 1992, Strong *et al.* 1996, Klimley and Anderson 1996) and tagged White Sharks recaptured up to 1400 km from the point of tagging (Cliff *et al.* 1996*).* They may also move in and out of areas at the limits of their range on a seasonal basis in some areas (for example in the Mediterranean – see Fergusson 1996).

There is evidence that some larger non-breeding individuals have a wider temperature range and penetrate tropical waters where carcharinid sharks are located, and may also pass through the waters off oceanic islands. Captures of adult specimens at the Azores Islands indicate that some degree of transoceanic migrations over considerable distance may occur (Compagno 1984a In Fergusson 1996). In the case of the Azores this may be as a (largely) west-to-east nomadic journey within the Gulf Stream from North America (Fergusson 1996: 337). Rare mid-ocean records are also known from the Pacific, at the Hawaiian, Marshall, and Easter Islands (Fergusson 1996), and there have been reports of sightings of the shark in the tropical south-west Indian Ocean, including Madagascar, Mauritius and Kenya (where a pregnant female was taken in 1996 in an artisanal fishery) (Natal Sharks Board). All the sharks in these cases appear to be large (greater than 4 metres). This suggests that equatorial waters may be a deterrent to large-scale movement but not a complete barrier. A possible mechanism is tropical submergence, where the shark descends into and travels within deeper, cool oceanic waters across the equatorial zone. Consequently, populations may not be genetically isolated (Fergusson 1998).

Studies of Great White Sharks sighted at pinniped colonies indicate that the sharks appear to be largely transient, with a few longer term residents (Klimley and Anderson 1996, Strong *et al.* 1992). Individuals are known to return to feeding grounds annually on a seasonal basis. A number of studies indicate that some populations appear often to be small and highly localised, with a high degree of site attachment. For example, in one study in the Spencer Gulf area (South Australia), 36 per cent of sharks were resighted always in their original location (Strong *et al.* 1992). A further study in South Africa found that of 147 Great White Sharks tagged, 30 individuals were resighted a total of 59 times, one of which was resighted 10 times. Of the 30, all but two were resighted at the same area in which they were originally observed (Ferreira and Ferreira 1996). The resighting of individual Great White Sharks at particular localities is well documented in other areas of the world (Bruce 1995), such as Western Cape (South Africa) (Cliff *et al* 1996) and California (Klimley and Anderson 1996).Research suggests that White Shark populations may segregate according to size and gender, and for reproduction. Strong *et al.* (1992) found that, in South Australia, the ratio of females to males was 6:1 at Dangerous Reef and other inshore islands, whereas around the offshore islands of the North and South Neptunes it was 1:20. This segregation can fluctuate with location and over time(Strong *et. al.* 1996).

Habitat and Diet

White Sharks are normally found in inshore waters in the vicinity of rocky reefs and islands, and often near seal colonies. They have been caught at varying depths to 1280m (Compagno 1984). While White Sharks are widely distributed they appear to be far more common in some locations such as South Africa, Australia and United States of America than at others. Particular areas are also seen as important pupping grounds.

White Sharks have few natural predators and do not feed continuously; a large meal such as a seal may last a medium sized shark for as long as a week (Bruce 1995). White Sharks appear to exhibit an age/size preference for certain foods. This developmental change in diet reveals a preference for fish in the juvenile White Sharks (less than 2.7 metres) ((Bruce. B, D. Malcolm H. & Stevens J.D. 2001). As they increase in size the diet will expand to include other sharks, rays , marine reptiles, sea birds and marine mammals. Some larger White Sharks that change their diet to include marine mammals may also continue to prey on finfish (for example snapper) and other sharks. In areas of suitable habitat where large seal and sea lion populations reside, they are the preferred prey for adult White Sharks. Ellis and McCosker (1991) noted that there are very few regions of the world that support White Shark populations without a corresponding pinniped population. Where there are concentrations of cetaceans large White Sharks will actively hunt small cetaceans and scavenge on available carcasses of larger species (Long and Jones 1996).

Life History

Due to their rarity and large size, it is relatively difficult to obtain information on the biology of White Sharks (NSW Fisheries 1997).

Reproductive Biology
Female White Sharks mature at between 4.5-5.0 metres and attain a greater length and weight than males (Francis 1996). Males mature at about 3.6 - 3.8 metres . (Bruce. B, D. Malcolm H. & Stevens J.D. 2001). Minimum ages at maturity for females and males are estimated to be 18 and 10 years, respectively. (Bruce. B, D. Malcolm H. & Stevens J.D. 2001).

The reproductive mode of the White Shark is thought to be oophagy, where embryos eat large numbers of nutritive unfertilised eggs that are ovulated during gestation (Compagno et al., 1997, Francis 1996,). The gestation period is unknown but is estimated to exceed 12 months (possibly 18 months) with females breeding only every 2-3 years (. (Bruce. B, D. Malcolm H. & Stevens J.D. 2001).). Female White Sharks produce up to 10 pups per litter (Francis 1996).

Young
Pups are fully developed and independent at birth; 1.2 – 1.5 metres in length; and may weigh up to 32 kg (Compagno *et al.* 1997). It is not known whether White Sharks give birth in particular pupping areas. Juveniles (estimated to be less than 1.5 m in length) are most commonly captured between December and June suggesting a summer-autumn pupping period. . (Bruce. B, D. Malcolm H. & Stevens J.D. 2001).

Longevity of adults
There have been few studies on age and growth of White Sharks (Calliet *et al.* 1985, Cliff *et al.* 1996). Most specimens examined have been less than five metres in length and methods of age determination have yet to be validated. Longevity in White Sharks is unknown but is considered to be in excess of 30 years.

Appendix B

HABITAT OF WHITE SHARK

White Sharks are uncommon but there are areas in Australian waters where encounters appear to be more frequent. These include; waters in and around seal and sea lion colonies such as Neptune Islands, South Australia and larger solitary sharks in the waters around Dangerous Reef and from the Pages (near Kangaroo Island) to Nuyts Archipelago in the Great Australian Bight and the Recherche Archipelago in Western Australia. Many of the land areas occupied by seals are protected areas but there is a need for threatening activities to be excluded from the marine environment adjacent to the seal colonies.

Studies of Great White Sharks sighted at pinniped colonies indicate that the sharks appear to be largely transient, with a few longer term residents (Klimley and Anderson 1996, Strong *et al.* 1992). Individuals are known to return to feeding grounds annually on a seasonal basis. A number of studies indicate that some populations appear often to be small and highly localised, with a high degree of site attachment. For example, in one study in the Spencer Gulf area (South Australia), 36 per cent of sharks were resighted always in their original location (Strong *et al.* 1992). A further study in South Africa found that of 147 Great White Sharks tagged, 30 individuals were resighted a total of 59 times one of which was resighted 10 times. Of the 30, all but two were resighted at the same area in which they were originally observed (Ferreira and Ferreira 1996). The resighting of individual Great White Sharks at particular localities is well documented in other areas of the world (Bruce 1995), such as Western Cape (South Africa) (Cliff *et al* 1996) and California (Klimley and Anderson 1996).

White Sharks of all sizes occur throughout their Australian range. However, there is a tendency for juveniles to occur in different areas to subadults and adults. Juveniles are most commonly encountered in inshore areas, often in the vicinity of the open coast beaches. The Great Australian Bight, Victor Harbour Coorong region (South Australia), areas off Portland and Ninety Mile Beach (Vic), Garie beach – Wattamolla and Port Stephens – Newcastle (New South Wales) and some areas off southern Queensland appear to be seasonally important for juvenile White Sharks. (Bruce. B, D. Malcolm H. & Stevens J.D. 2001). The areas where juveniles are mostly found are most likely pupping grounds. Pupping grounds may require some seasonal protection between the months of December to June when it is estimated that pups may be born. However, more research on the reproductive cycle of female White Sharks however is needed before concluding more accurately the months of the year that White Sharks reproduce and that these sites are indeed “pupping grounds”.

Research suggests that White Shark populations may segregate according to size and gender, and for reproduction. Strong *et al.* (1992) found that, in South Australia, the ratio of females to males was 6:1 at Dangerous Reef and other inshore islands, whereas around the offshore islands of the North and South Neptunes it was 1:20. This segregation can fluctuate with location and over time (Strong *et. al.* 1996).

Some identification of the characteristics of habitat critical to the survival of White Shark would be useful and would allow their inclusion into any planning process. Given the apparent need for White Sharks to move through developmental habitats as they grow, the identification of critical habitat for young White Sharks may be difficult given the unknown nature of their developmental needs. A project currently funded under the NHT may assist in identifying site fidelity, residence patterns and home range patterns of White Shark. The project is employing listening stations and tagging at Dangerous Reef and North and South Neptune Islands SA. Completion of the project is expected by December 2002.

It is expected that the current research on site fidelity, residence patterns and home range patterns of White Shark will contribute to the identification of habitat critical for the recovery of the White Shark.

Appendix C

THREATS - FULL DESCRIPTION OF EACH THREAT

Commercial fishing

Despite not being commercially targeted, White Sharks are caught as bycatch on long-lines and in nets of professional fishers, and this is currently suspected to be the largest cause of mortality (Presser & Allen 1995). The actual rate of capture of White Sharks by commercial fishers is difficult to assess and has not yet been quantified (Bruce 1992). This is because captures are not usually recorded, and in many cases, captured sharks are either not landed intact or not landed at all. Estimates of annual capture, based on anecdotal reports, range from less than 10 to 100 per annum in South Australia (Bruce 1992) and 100 to 440 per annum for all fisheries (recreational and commercial combined) in Australian waters (Environment Australia 1996, Standing Committee on Fisheries and Aquaculture 1996).

Commercial fisheries that are known to take White Sharks as by-catch include:

- the Southern Shark fishery;
- the snapper fisheries in Victoria and the Gulf of St Vincent and Spencer Gulf in South Australia;
- the tuna farming industry (White Sharks have been killed after entering cages or harassing stock during capture and transport operations);
- the Western Australian Shark fishery; and
- the Tasmanian Scalefish Fishery.

White Sharks are typically bold and inquisitive in their approach to vessels and fishing gear. This behaviour renders them susceptible to incidental capture through becoming entangled in fishing gear and also to targeted killing (for example being shot at the surface without being hooked). Encounter rates between White Sharks and fishing gear may be high in some areas. Bruce (1992) reported that 30 per centof White Sharks sighted at Dangerous Reef, South Australia, had evidence of previous encounters with commercial fishing gear. It is possible that some cryptic mortality occurs after such encounters and subsequent escape from this gear (Bruce and Stevens 1998). The targeted killing of “nuisance” White Sharks (ie. those interfering with fishing or aquaculture operations for other species) has also been reported by several commercial fishers, however the number of White Sharks that continue to be intentionally taken or killed by people prepared to break the law is unknown.

The number of interactions with the domestic longline industry is not known but may be quantified during an observer program scheduled to be implemented with the suite of actions for the *Threat Abatement Plan for the Incidental Catch (or bycatch) of Seabirds During Oceanic Longline Fishing Operations* (Environment Australia 1999). White Sharks have also been occasionally reported taken in prawn trawls in South Australia, gill nets set for reef fish in Tasmania and entangled in rock lobster pot lines in South Australia. In the past, commercial fishers have also received large amounts of money from the sale of shark products such as fins and jaws (NSW Fisheries 1997).

Incidental captures of White Sharks occur in several fisheries world-wide for example commercial fisheries in Western Cape, South Africa (Cliff *et al*. 1996b), New Zealand (Francis 1996), Japan (Uchida *et al*. 1996), eastern North Atlantic and Mediterranean Sea (Fergusson 1996). Few fisheries in these areas have requirements to report catches of White Sharks making this source of mortality difficult to quantify.

Management Response
Various actions have already led to a reduction in the level of threat that commercial fishing poses to White Sharks. These include changes to fishing gear, reductions in fishing effort; nation-wide laws prohibiting intentional targeting and take of White Sharks; and changes in community attitudes towards sharks in general.

The White Shark, *Carcharodon carcharias*, is currently listed as 'vulnerable' on Part 13 Division 1 of the EPBC Act (see Table 2). The taking of White Sharks in Commonwealth waters is prohibited under the Act. Those commercial fishers that operate where there is a risk of capture of White Sharks in Commonwealth waters could be in breach of the Act and therefore subject to prosecution. Under Part 13, Section 265 of the EPBC Act, the Minister may accredit a plan of management or a management regime if satisfied that all persons engaged in fishing under the plan take all reasonable steps to ensure listed marine species are not killed or injured as a result of the fishing, and that the fishery does not adversely affect the conservation status of a listed marine species or a population of that species. This accreditation process is the preferred method of dealing with the bycatch of White Sharks. This allows for the assessment of the fishery to ensure that all reasonable efforts are required as part of the management arrangements to avoid killing or injuring listed species and that the result of any take will not adversely affect the survival or recovery of species in the wild.

Under the EPBC Act the take of a listed species requires a report to the Secretary of Environment Australia within 7 days. Penalties apply under Part 3, Section 18 of the Act for an action that has, will or is likely to have a significant impact on White Shark. There is need to inform fishers of their obligations under the EPBC Act.

The requirement to report incidental catch is not apparent in any of the state legislation (Table 2). Very few reports of these encounters are recorded and it is difficult to estimate the number of incidental deaths of White Sharks from commercial fishing except to surmise that it is significant (Presser & Allen 1995).

Table 2. Obligation to report interactions and hold incidentally caught and killed sharks by jurisdiction.

Jurisdiction	Act	Reporting Requirement	Hold incidentally caught & killed shark
Com.	*Environment Protection and Biodiversity Conservation Act 1999*	Yes – must report with 7 days to the Secretary, EA	Yes with permit issued by Minister under the Act
SA	*Fisheries Act 1982*	No	Yes under **S.31** if in conjunction with SA Fisheries (under delegation of Minister)
Vic	*Fisheries Act 1995*	No	Yes with permit or authority
Tas	*Living Marine Resources Management Act 1995*	No	Yes with permit for purposes of the Act
NSW	*Fisheries Management Act 1994*	No	Yes with permit for purposes of the Act

WA	*Fisheries Resources Management Act 1994*	No	Under S14 exemption
Qld	*Fisheries Act 1994*	No	Yes with permit for purposes of the Act

All Australian Fisheries Management Authority (AFMA) logbooks have provision for the recording of interactions with 'other species'. The following AFMA logbooks provide for the specific recording of white shark captures: the AL05 (long line sectors of the Southern & Western Tuna and East Coast Tuna & Billfish Fisheries and the Christmas and Cocos Tuna Fisheries), NP13 (Northern Prawn and Torres Strait Prawn Fisheries), GN01A (South East Non Trawl, Southern Shark and Fisheries), SQ05 (Squid Jig Fishery), CS01 (Coral Sea Fishery) and NWS02 (North West Slope Trawl and Northern Prawn Scampi Fisheries). Several other logbooks also provide for the recording of wildlife interactions, which can include White Sharks. These include the TPB02 (Southern & Western Tuna and East Coast Tuna & Billfish Fisheries, and the wild sector of the Southern Bluefin Tuna Fishery), TPB03 (the farmed sector of the Southern Bluefin Tuna Fishery) and the OT03 (other sectors of the Southern and Western Tuna and the East Coast Tuna Fisheries). Logbooks will be further refined to provide better information on the interaction with other species. In addition there is a need to verify information generated from logbook records.

Fishing gear used by commercial shark fishers has changed since the 1970s. Nets are now made from lighter mono filament polyamide mesh that can be broken by larger sharks, and mesh-size has decreased becoming more selective towards catching smaller sharks such as school or gummy sharks. Commercial shark fishers report that White Sharks caught in commercial shark nets are more likely to be entangled than enmeshed, and the headline or footline is often involved in this entanglement. Net height has increased separating the headline and footrope and thus reducing the probability that a scavenging White Shark will become entangled.

In 1996, the fishing effort in the Southern Shark Fishery was less than half the peak effort of 1987, partly due to a reduction in the amount of net permitted per fishing operation (Walker *et al.* 1998). In Western Australia, there has also been a significant reduction in effort through gear reduction. The management intent is a 50per cent reduction of effort based on 1993-94 levels by 2000-01 (WA State of Fisheries Report 1997/98). The actual effect of decreased fishing effort on White Shark numbers caught is unknown but would be expected to be favourable.

There has been a closure to shark gillnetting and long-lining in ocean waters within 3 nautical miles (nm) of the Victorian coast since 1988. Small White Sharks appear to occur reasonably frequently in some coastal areas of Victoria and this 3 nm closure may provide a refuge for White Sharks while they are within these waters, and at a size when they may be most susceptible to capture in nets and longlines. Monofilament gill nets are banned in ocean waters off New South Wales.

Changes in the Marine Scale –fish Fishery in South Australia have probably also had some benefits. These changes have included reductions in long-line and handline effort since the 1980's. In 1987/88, gear restrictions were imposed on the long-line fishery with a maximum of 400 hooks per licence permitted (McGlennon and Jones 1999).

Clearly, there is an urgent need to conduct further investigations to assess the accuracy of the current data and identify which fisheries impact on White Sharks and the full extent of the impact the commercial fishing industry has on the Australian population of White Sharks. It is necessary for commercial fisheries managers to improve reporting of the take or interaction with White Sharks.

International response to the over-fishing of sharks around the world has occurred through the United Nations Food Agricultural Organisation (FAO) *International Plan of Action for Sharks* (FAO 1999) (IPOA – Sharks) Under that plan countries have undertaken to prepare national plans to give effect to this FAO initiative. Australia, through Agriculture, Fisheries and Forestry – Australia, is preparing a National Plan of Action for the 2002 Committee on Fisheries (COFI) meeting. This plan will include the principles and objectives of the IPOA – Sharks and identify national actions to manage sharks and shark fisheries responsibly.

Actions related to improving the quantification of bycatch are expected to involve modifying fishery operator's logbooks, and distributing field shark guides to fishery operators. This should improve the State Territory and Commonwealth managed fisheries capacity to report White Shark interactions in logbooks or other appropriate mechanisms.

Recreational Fishing

Prior to the implementation of protective legislation, game fishing for White Sharks was carried out mainly in South Australia, Queensland and New South Wales, but also in Victoria and Western Australia. Game fishing in South Australia for White Sharks was at its height in the 1950s. More recent fishing effort was much lower with an average of 1.4 White Sharks killed per year between 1980 and 1990 (Bruce 1992). White Sharks were also tagged and released during this period, although the survival rate of these sharks is not known.

Pepperell (1992) using game fishing data for New South Wales calculated that the ratio of White Sharks to all shark species caught had changed from 1:22 in the 1960s to 1:38 in the 1970s and 1:651 in the 1980s. The Game Fishing Association of Australia (GFAA) recorded a total of 183 White Sharks caught in New South Wales between 1960 and 1995 (approximately 5.2 per year) (NSW Fisheries 1997). More recently, the average number of White Sharks caught each year was estimated at 1.8 sharks, most of which were captured off Long Reef, Newport, and south of Port Hacking (NSW Fisheries 1997). Pepperell (1992) notes that the declining trend in New South Wales game fish captures of White Sharks may be explained by a tendency for anglers to fish further offshore in recent years, thus concentrating effort away from areas where they were more likely to encounter White Sharks.

Game fishing groups have expressed a keen interest in accessing White Sharks for tag-release since the species was protected. Other groups have raised concerns that capture induced mortality or sublethal stress may be unacceptably high for this practice to resume. The impacts of hooking, playing, capture and then release of White Sharks in game fishing activities has not been critically assessed. Given that the White Shark is protected the timing of such work would only be promoted as a priority when the species has recovered sufficiently to be considered for down listing from the threatened species schedules. Re-instating tag release is only possible under current legislation if the regulatory authorities grant an exemption permit. For such permits to be granted there would need to be scientific benefits in doing so. (For a further explanation on tagging refer to section on Tag and Release)

Satellite tracking and archival tags offer the best opportunities for obtaining data on movement patterns however costs can be high. Attaching the satellite tag to the dorsal fin of a White Shark while it is restrained is the best method of deploying the unit. Archival tags can be effectively deployed by tagging free swimming White Sharks and are programmed to record information such as light, depth, water temperature and location every few minutes for up to several years.

Management Response

There is a need to identify habitat that is used to meet essential life cycle requirements such as mating, pupping and feeding and protect these sites from the impacts of both commercial and recreational fishing activities. (Refer to Section 1.3 Habitat Critical to the survival of the Species for further information).

Recreational fishers that carry out activities that result in the take of White Sharks, which are a listed species under the EPBC Act are subject to certain requirements under the Act. The take of a listed species requires a report to the Secretary of Environment Australia within 7 days. Penalties apply under Part 3, Section 18 of the Act for the killing of a White Shark.

Part 3, Section 18 of the Act specifies a person must not take an action that:
(a) has or will have a significant impact on a listed threatened species included in the vulnerable category; or
(b) is likely to have a significant impact on a listed threatened species included in the vulnerable category.

Civil penalty:
(a) for an individual—5000 penalty units;
(b) for a body corporate—50 000 penalty units.

Therefore, any person(s) who injure, take or kill a White Shark in State or Commonwealth waters will be considered to be impacting on the population and could be subject to civil or criminal prosecution under the EPBC Act. One penalty unit is currently worth $110 Australian dollars.

There is need to inform recreational fishers of their obligations under the EPBC Act.

Shark Control Activities

When V.M. Coppleson published *Shark Attack* in 1959 he recounted many attacks in Australia and elsewhere and particularly the war experiences of downed airmen and shipwreck survivors. These accounts captured the fear that people have of shark attack. Surf bathing became popular after the First World War but shark attacks discouraged the activity and netting enclosures had proven ineffective. The Shark Menace Advisory Committee was formed in 1934 to investigated the issue, and meshing was adopted as the most effective method of control (Coppleson 1959).

Meshing of sharks as a protective measure for swimmers and surfers was introduced to the New South Wales metropolitan beaches of Sydney in 1937, Newcastle in 1950 and, to Queensland beaches in 1962. These are the only two states in Australia that employ this protection measure (Krogh & Reid 1996; Paterson 1990). At the time shark control activities were being introduced, other activities now banned, such as abattoirs discharging offal into the ocean, could have led to a higher incidence of shark attacks.

Shark nets do not completely enclose beaches but are usually 150 m long and 6 m high, with a mesh size of 50 to 60 cm (Krogh 1994). The nets are set parallel to the shore in around 10 to 15 m depth with the bottom of the net resting on the ocean floor and the top supported by a series of floats (Krogh 1994). The purpose of the nets is not to stop sharks coming to the beaches but to intercept and catch them on their regular feeding and territorial runs (Eckersley 1996). There are currently a total of 49 meshed beaches set offshore between Newcastle and Wollongong in New South Wales (approximately 200 km of coastline). In Queensland, a mixture of baited drumlines and nets are used. Drumlines consist of a marker buoy and float supporting a trace and baited hooks anchored to the bottom, and are intended to target dangerous species of sharks and reduce the bycatch of non-target species.

White sharks caught by beach meshing programs are usually small (less than 3 metres), and in many cases, particularly off eastern Australia, are smaller than 2 metres. This suggests that these programs operate close to pupping grounds or in juvenile nursery habitats. However, while beach meshing undoubtedly is detrimental to smaller specimens, the widespread occurrence of similar

small sized White Sharks in areas where beach meshing is not undertaken suggests that nursery habitats are also probably widespread in Australia (B.Bruce, CSIRO, pers. comm.).

If the catch per unit effort (CPUE) equates to some measure of abundance then there has been a significant decline in White Shark abundance in both programs. The trend would be more pronounced for New South Wales if the whole time series were available (White Shark data are only specifically available from the New South Wales program since 1950) as larger numbers of White Sharks were almost certainly caught in the first few years of the program. The average size of White Sharks caught in New South Wales meshing operations has also declined over the period, though this is apparently not evidenced in the Queensland data.

Reid and Krogh (1992) observed that there has been a steady decline of White Sharks in New South Wales meshing data since 1950. Since then and up until the 1998/99 meshing season, a total of 509 White Sharks have been captured in shark mesh nets in NSW (Dennis Reid, NSW Fisheries, *pers. comm.*). The annual average number of White Sharks caught has declined from 13 for the first 20 years of recorded meshing to 4 caught per year in the last 10 years (Dennis Reid, NSW Fisheries, *pers comm.*). New South Wales increased the meshing effort in the early 1970s and this is also reflected in the increase in shark captures around that time (Reid and Krogh 1992).

Since 1962 a total of 670 White Sharks have been caught in the Queensland Shark Control Program. During the first 20 years of beach meshing in Queensland an average of about 20 White Sharks per year were caught by the nets. This rate of capture has dropped to an average of 10 White Sharks per year over the last 10 years (Shark Control Program, QDPI). Paterson (1990) observed that nearly 90 percent of White Shark captures occurred in southern Queensland off the Gold and Sunshine Coasts. The peak in captures also occurred when water temperatures were low (Paterson 1990).

The degree to which beach meshing is impacting on White Shark populations is unknown although the decline in captures suggests it is significant. The New South Wales meshing contract was reviewed in 1972-73, leading to an increase in the number of beaches meshed, the introduction of requirements for nets to be bottom-set, and for the net material to be of synthetic filament (Reid & Krogh 1992). It is interesting to note that from 1972 - 73 to 1989 - 90 the number of catches in three major netting areas in New South Wales showed a reduction to about a quarter of the 1972-73 catch. A similar trend has also been detected in Queensland and South Africa (Queensland Department of Primary Industries 1992).

These data may reflect a decline in the overall abundance of White Sharks along the New South Wales coast or may represent localised depletion. Most of the sharks were caught soon after the meshing was commenced, and further catches consist of sharks moving into the area for opportunistic feeding, breeding, and/or colonisation of vacant territories (Reid & Krogh 1992). A suggested possibility is that White Sharks are actively avoiding the nets but this seems unlikely as many of the nets are set in random locations throughout the year (Reid & Krogh 1992).

Non-target species that are captured in the shark nets include whales, dugongs, turtles and dolphins (Gribble *et al.* 1998). Beach meshing to reduce the threat to humans from shark attack was nominated as a key threatening process under the *Endangered Species Protection Act 1992* in May 1997. This nomination was unsuccessful.

There are indications that drumlines are more species selective than nets (Department of Primary Industries 1992) and that they provide similar levels of shark protection. The biggest problem with drumlines is that they can move in heavy seas (Department of Primary Industries 1992). Experiments using electrical fields to repel sharks have been carried out in South Africa since 1965 (Cliff and Dudley 1992), however practical trials have encountered many logistical problems (Gribble *et al* 1996).

There have been several changes to the structure of nets and the amount of fishing effort over time. To make accurate statements about the degree of impact beach meshing has on White Shark

populations, factors such as fishing effort, catch levels and environmental fluctuations need to be recorded (BRS 1996; Reid & Krogh 1992). In addition, given that White Sharks will be caught occasionally there needs to be some capacity to either tag and release the shark if it is alive and autopsy all dead animals. Continued monitoring of the take of White Sharks is desirable. The need for a broader, coordinated monitoring program is discussed under Research Activities.

Western Australia has considered the issue of shark control and recently adopted the Shark Response Plan which is detailed in the Shark Hazard Report Western Australia 2001.

This report considers the matter of shark hazards in terms of three main issues including prevention, response mechanisms and education. The Response Plan provides that in the event of a shark attacking, or attempting to attack, a person, fisheries officers would, upon verification of the identity of the animal, immediately attempt to kill the shark. To be able to kill a great white in the interests of public safety, the Minister for Fisheries has issued a Standing Order, which authorises Western Australian Police and Department of Fisheries officers, in the event of an attack, or attempted attack, to immediately kill the shark responsible for the attack. The Response Plan also outlines the process for capturing and destroying a shark using a firearm by a Western Australian Police Service Officer, or where this is not possible, by a Department of Fisheries officer. The exemption to kill sharks only applies in Western Australian State waters that is in an area up to three nautical miles off shore). There is no such exemption in Commonwealth waters. (The Department of Local Government Nov 2001).
http://dlg.wa.gov.au/ .

Trade

The international organisation TRAFFIC reports White Shark fins, jaws, teeth and meat are traded in Hong Kong, Taiwan, Thailand and South Korea (Rose 1996). Increasing demand for White Shark products particularly fins, jaws, and teeth, has inflated their value. Recent reports have been made identifying values of up to $50,000 paid for jaws from South Africa and $600 for individual teeth, despite their current protection there (L. Compagno *pers comm.*, in Bruce and Stevens 1998). Those who previously targeted White Sharks for sport, trophy, profit or fear largely no longer do so. However, there is evidence that deaths still occur from fishers who deliberately set out to capture and kill White Sharks for the prized jaws, other products or simply for the thrill. The number of White Sharks that continue to be taken intentionally by people prepared to break the law is unknown

There is evidence of the existence of an international trade in jaws and teeth through the Internet. The Internet makes international illegal trade easier. Frequent and regular advertisements soliciting Great White Shark parts in Australian fishing magazines and the Internet also point towards the possibility of an illegal trade within Australia, with illegal exports likely.

In *Australia's Oceans Policy* (Environment Australia 1998) the Commonwealth Government stated its commitment to seek international protection for the White Shark. To this end Australia, has now listed White Shark on Appendix 111 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This listing requires Australia to issue CITES permits to allow trade and all other Parties trading in the species to issue a Certificate of Origin (stating where the specimens come from). These certificates of origin will be reported to the Secretariat each year in the Party's annual report, enabling a trail to be built up of where exports of the species are coming from and where they were going. This will assist Australia to regulate trade in specimens and enable all Parties to gain a greater understanding of trade in the species and any parts or derivatives of the species. The CITES listing proposal can be found on
http://www.ea.gov.au/coasts/species/sharks/greatwhite.html

There are several commercial fisheries in Australia that frequently take shark fins as by product. Dried shark fin can attract a high price on Asian markets. There is an increasing demand for shark fins and a subsequent rise in mean values (Stoessell 1993). Shark finning is both wasteful, when fins are removed and the carcass is discarded, and a possible inducement to fishers to actively target sharks. The humaneness and wastefulness of shark finning are not discussed in this plan.

Figure 1.

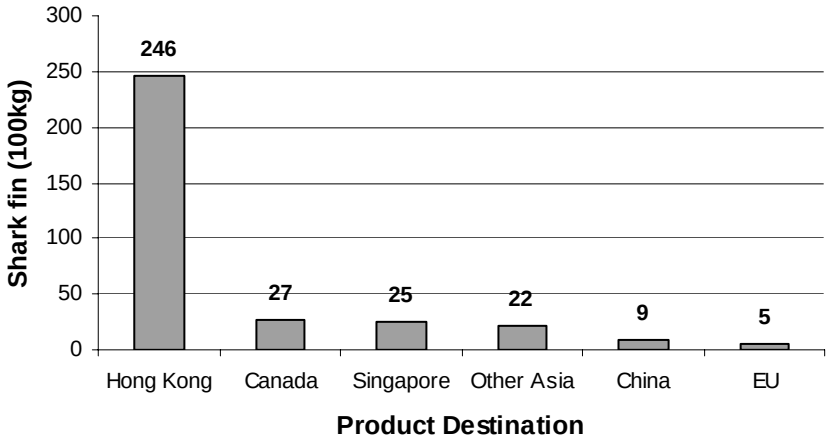

Figure 1. Shark fin exported from Australia between 1 July 1998 and 31 May 1999

The FAO Code of Conduct for Responsible Fisheries (1995) identifies the need to manage resources sustainably and specifically to reduce discarding. The *International Plan of Action for Sharks* (FAO 1999) (IPOA – Sharks) is more explicit stating that full use should be made of dead sharks eg. particularly those that have had their fins removed.

Recently, controversy over shark finning has assumed a very high profile in Hawaii. A coalition of fishers, regulators, Congressional members, and non government environmental organisations have lobbied strongly for the discontinuation of shark finning in the western Pacific pelagic fishery based, upon the fact that the bycatch of sharks has grown from 2200 in 1991 to 60 000 in 1998. Data shows that 98.7 percent of these sharks are killed solely for their fins with the carcasses being dumped overboard. The relevant management council rejected the proposed ban and instead set an allowable 'bycatch' limit of 50 000 sharks.

The apparent increase in the practice of shark finning, where the fins are removed and the carcass discarded, may pose a threat to White Sharks. Effective regulation of shark finning would allow the catch to be monitored for species of interest and provide catch data for management. Without effective regulation of shark finning that applies to all shark species, there is a potential loophole to take White Sharks for trophy items in Australia. Regardless of the competency of individual fishers to recognise a protected species of shark it is even more difficult to identify species from their fins alone without the use of techniques such as DNA analysis. On this basis the retention of all shark trunks that are finned should be written into the regulations of fisheries where sharks are targeted or incidentally taken. Ideally a national ban on the activity would largely remove the threat but this may unnecessarily penalise fishers whose potential to take a protected shark is limited.

In October 2000, an interim ban was placed on the practice of shark finning at sea in the Commonwealth East Coast Tuna and Billfish Fishery and Southern and Western Tuna and Billfish Fishery and the Christmas and Cocos Tuna Fishery. In these fisheries, operators are prevented from possessing, carrying and landing shark fins that are not attached to the trunk of a shark. (AFFA)

Following concerns raised about shark bycatch in the Northern Prawn Fishery (NPF), industry initiated a ban on the take of all shark products. This ban includes fins, trunks, fillets, teeth, saw shark rostrums and skate and ray products. AFMA approved the implementation of this measure from the beginning of the 2001 season (1 February 2001). The Commonwealth is currently considering longer term arrangements on the banning of at sea finning of sharks.

The states of New South Wales, Victoria, Western Australia and Tasmania have also introduced similar bans on finning at sea in response to concerns over the sustainability of some species of shark that are finned, the need to prevent finning of protected species, and issues of waste and cruelty. The state of Queensland is also in the process of implementing a ban on shark finning. (AFFA) In those states where the practise is banned, it is prohibited to take and land any shark species mutilated in any manner other than by heading, gutting or removing gills or for any boat in State waters to possess any shark fins on board. Shark fin production is not well regulated in Australia and accurate figures on the size of the take and the species harvested are difficult to obtain. In the light of international activity and growing national pressures about the status of shark populations, as well as the animal welfare concerns associated with shark finning, it is essential that the Australian situation regarding shark finning be analysed and reported.

The Bureau of Rural Sciences (BRS)) report on shark finning (Rose and McLoughlin 2001) has:

- examined the extent of shark finning in Australian waters by collating available information and identifying how finning threatens shark populations relative to other threatening practices;
- described the regulatory arrangements under which shark finning occurs and how regulation provides either an incentive or disincentive to continue the practice; and
- reviewed the various international mechanisms used to manage the practice and provide a guide to possible options.

Rose and McLoughlin (2001) highlight that the demand for shark fin escalated during the 1990s, with prices received for premium quality dried fin in Australia recently reaching $275/kg, making it one of the most expensive fishery products. Shark fin exports increased during the 1990s from 6.5 tons in 1992-93 to 94 tons in 1998-99 with this last year estimated to be worth $5.5 million (Rose and McLoughlin 2001) (this value is not included in official estimates of the value of the Australian shark catch). Shark fin derived in Australian waters from both target shark fisheries and non-target shark fisheries is nearly all exported, with an estimated 92 tons of the total 1998-99 exports of 94 tons coming from Australian fisheries. Around 35 per cent of the 92 tons of dried fin was potentially derived from the practice of finning, where only the fins are retained and the remainder of the shark is discarded. The majority of this comes from the tuna longline fisheries.

In light of international activity and growing national and international pressures about the status of shark populations, it would be timely that management of shark finning in Australian fisheries be addressed and be consistent across jurisdictions.

Tourism

Both shark cage diving and shark boat tours are dependent on attracting sharks to an area by berleying (also known as ‘chumming’), a method currently causing controversy (Bruce 1995). Berleying involves releasing a mixture of fish oil and/or animal products into the water at regular time intervals to develop a slick to attract sharks in the vicinity (citation Presser & Allen 1995). The use of berley may encourage White Sharks to appear or stay longer in a location that they would not normally visit (Klimley 1994), and there is the possibility that sharks will become habituated and begin to associate humans and boats with food.

Many frequently visited White Shark sites are near pinniped populations and berleying in these areas may have an effect on prey such as New Zealand fur seals and Australian sea lions, especially during their pupping seasons (Presser & Allen 1995). The *Action Plan for Australian Seals* (Shaughnessy 1999) identifies the status of the Australian sea lion (*Neophoca cinerea*), using IUCN criteria (IUCN 1994a) as lower risk, near threatened. Any exposure of this sea lion to increased threats is clearly undesirable and may result in the further decline of the species. Berleying also provides the possibility of viral or bacterial contamination to the marine environment with specific concern regarding the potential impact on colonies of marine mammals (Presser & Allen 1995).

In South Australia the use of mammal products as berley is prohibited under Regulation 35C, Fisheries (General) Regulations 1984. The use of mammal products for berleying is also prohibited in Victoria.

Tourism activities also raise the issue of disturbance to White Sharks and their prey. The effect of watercraft and human activities on sharks and marine mammals in the vicinity needs to be established (Presser & Allan 1995).

Regular viewing trips when properly managed offer good opportunities for data collection (Bruce 1995) as sharks may be tagged without capture and tagged sharks may be recorded. In South Australia the permitting authority, the Department of Environment and Heritage (DEHSA), have made it a permit condition that licensed shark cage dive operators fill out a logbook that records sightings of sharks. The data is shared with CSIRO Marine Research as a part of ongoing research supported by the Natural Heritage Trust.

Tag-Release

Conventional fisheries tag and release programs are normally applied to species that are harvested commercially. The application of this technique to species that are naturally rare or uncommon has limited value as a consequence of the few returns or the difficulty in identifying an individual. Some experiments using tags with colour coding have been trialed. Using simple identification tags can provide information on:

- movement patterns;
- site fidelity;
- growth;
- population estimates; and
- mortality estimates.

Depending on the objectives, a number of factors can influence the results of a tagging program including:

- the number of sharks tagged;
- rate of recapture;
- capture stress or mortality;
- tag shedding;
- non reporting of tags; and
- quality of the data recorded (Bruce 1999).

Game fishing groups have expressed a keen interest in accessing White Sharks for tag-release since the species was protected. Other groups have raised concerns that capture induced mortality or sublethal stress may be unacceptably high for this practice to resume. The impacts of hooking, playing, capture and then release of White Sharks in game fishing activities has not been explored. The effects are likely to vary between size classes of sharks (small sharks are likely to suffer less effects) and on how the shark was hooked and played. Sublethal effects may include reduced

growth, reduced capacity to feed, interrupting reproductive effort or greater chance of attack from other White Sharks (Bruce 1999). There is currently no quantifiable information on survival after such tag-release. Given that a tagged animal must be 'in-hand' to be re-identified there can be little merit in stressing a population through a tagging program that involves a protracted capture process and it would be imprudent to support any targeted tag-release programs unless directed at resolving those issues.

Within the life of this plan it may be possible to critically assess the impact of game fishing tag and release on individual sharks that are caught and played. Given that the White Shark is protected the timing of such work would only be promoted as a priority when the species has recovered sufficiently to be considered for down listing from the threatened species schedules. Re-instating tag release is only possible under current legislation if the regulatory authorities grant an exemption permit. For such permits to be granted there would need to be scientific benefits in doing so. The relative costs and benefits of the work should be considered. Currently the indications are that the population is not sufficiently robust to place at risk through carrying out such studies. However, if such action is undertaken in the future, evaluation on the effect of capture-release by game fishers on White Sharks would include:

- sublethal effects;
- cryptic mortality; and any
- scientific benefits.

A shark does not need to be line caught for tag and release studies. Shark cage diving can be used to passively tag a shark without the stress of capture. The long-term impact of attracting sharks with berley trails has not been explored. It is possible that the behaviour of sharks may alter or that sharks may associate humans or divers with food.

More sophisticated telemetry systems such as satellite tags have to be fixed to the shark more securely. This necessarily means the shark must be briefly boated to affix the tag. It is thought that smaller sharks are less likely to die during the process possibly as a consequence of the ease of handling a smaller animal and the effort required to briefly subdue it. Sophisticated telemetry has the capacity to provide more detailed information of an individual shark's ' behavioural ecology. In August 1999 an archival tag was attached to a free swimming 300cm female shark that was later incidentally killed in a gillnet, set in South Australian waters. The fisher reported the capture to PIRSA and the tag was recovered. The archival tag revealed the depth, light and temperature every four minutes in the time after tagging.

The use of satellite tags by CSIRO scientists on White Sharks is currently being undertaken to provide insight into the movement patterns of White Sharks. To date, two sharks 'Heather' and 'Neale' have been tagged. For further information about this work refer to the following web site http://www.marine.csiro.au/mumeez/sharks and the report by Bruce. B, D. Malcolm H. & Stevens J.D. 2001 A Review of thew Biology and Status of White Sharks in Australian Waters CSIRO Marine Research, Hobart.

Up to September 2001, 219 White Sharks had been tagged in Australia (Table 3). This number includes sharks, which have been tagged while free swimming by researchers and tourism operators, game-fish tag release and tag-release of bycatch from commercial fishing operations. Although the overall capture rate of tagged White Sharks is comparable to the capture rate of some other tagged sharks, the low numbers tagged (and resulting low numbers recaptured) limits the benefit of using conventional tagging to examine broad-scale movement patterns.

Table 3 Number of White Sharks that have been tagged by various methods and captures of tagged sharks by those methods (to September 2001)

Method of tagging	**Number tagged**	**Tagged sharks later caught by game-fishing**	**Tagged sharks reported caught by commercial fishing operations**	**Total % caught**
Tagged free-swimming	143	2	4	4.2
Game-fishing tag release	58	2*	0	3.4
Commercial shark fishing	15	0	1	6.7
Satellite tagging	2	0	0	0
Oceanarium tagging	1	0	0	0
Total	219	4	5	4.1

* one recaptured on same day

Reproduced from Bruce. B, D. Malcolm H. & Stevens J.D. 2001

The overriding concerns must be that any research that proposes to catch White Sharks delivers strategic research results. That is, those results that:

- contribute to knowledge of the White Shark's behaviour and ecology; and/or
- improve our capacity to manage or reduce the impact of threats;
- have sufficient regard to the welfare of each shark captured; and
- ensure that the activity is managed under the relevant permits in the appropriate jurisdictions.