

**SHARK BAY**

**Seaweek 2005**  
March 6 to 13



**SOS**  
SAVE OUR SHARKS

## **The great white shark**

By Brad Norman



The great white shark (*Carcharodon carcharias*) (© Ken Hoppen, [oceannotations@primus.com.au](mailto:oceannotations@primus.com.au))

## THE GREAT WHITE SHARK

By Brad Norman

ECOCEAN Consulting, 68a Railway Street, Cottesloe,  
 Western Australia, 6011 Australia

### Introduction

Great white sharks (*Carcharodon carcharias*) are top order predators that may reach lengths of almost 7 metres. They are, however, particularly vulnerable to exploitation due to their slow growth, late maturation, long generation period of 23 years, small litter size and low reproductive capacity. Where information is available, it shows a dramatic decline in white shark abundance. Their global conservation status is listed as 'vulnerable to extinction' by the World Conservation Union.



Figure 1. The great white shark (*Carcharodon carcharias*)  
 (© Ken Hoppen, oceanotions@primus.com.au).

### History

The white shark, also known in Australia as the 'great white shark' or 'white pointer', is a close relative of the mako and porbeagle sharks of the family Lamnidae. This is a wide-ranging species that occurs world-wide primarily in coastal, temperate waters. In Australia, it has been recorded from central Queensland around the south coast to as far north as the North West Cape region in Western Australia. It is, however, more common in the south.

The white shark (figure 1) has a moderately stout, torpedo-shaped body; is coloured blue-grey to grey-brown on the upper surface and white below; has large, serrated triangular teeth; and has a distinctive lateral keel along the body midline, immediately before a crescent-shaped tail. It has a heat-exchanging circulatory system allowing it to maintain body temperatures up to 14°C above that of the surrounding water.

Although often feared by humans, there are very few attacks by white sharks. In the last 20 years, there has been an average of 1.9 white shark attacks per year recorded in Australian waters, with an average of 0.8 human fatalities per year for the same period, i.e., four white shark attacks recorded in 1989; six in 2000, and five in 2004.

### Distribution

White sharks have been recorded in temperate and sub-tropical coastal waters almost globally. They are found in the Atlantic, Pacific, Indian and Southern Oceans and the Mediterranean Sea. White sharks of all sizes have been recorded from all States (but not in the Northern Territory). They are, however, generally uncommon despite particular areas in Australian waters where encounters are more frequent. These include waters in and around seal and sea-lion colonies at the Neptune Islands, Dangerous Reef, and the Pages (near Kangaroo Island) in South Australia, to Nuyts Archipelago in the Great Australian Bight, and the Recherche Archipelago in Western Australia.

White shark populations may segregate according to size and gender and for reproduction. However, the ratio of males to females may fluctuate depending on location, season and over time. Juveniles are most commonly encountered in inshore areas, often in the vicinity of open-coast beaches. The Great Australian Bight; Victor Harbour—Coorong region (South Australia); areas off Portland and Ninety Mile Beach (Victoria); 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. There is, however, considerable variation in shark abundance within and between seasons in Australia.

### Biology

White sharks have few natural predators and do not feed continuously. A large meal (e.g., a seal) may last a medium-sized shark for as long as a week. They appear to exhibit an age/size preference for certain foods, with smaller individuals (i.e., less than 2.7 metres) feeding on a variety of fish (including other sharks and rays), cephalopods (squid, octopus, etc.) and crustaceans (e.g., crabs). As they increase in size, their diet expands to include marine mammals (seals, sea-lions and dolphins). Seabirds and marine reptiles (turtles) have occasionally been reported as prey. They are also opportunistic scavengers and will feed on the carcasses of larger cetaceans where available. Larger white sharks (>3 metres) are frequently (but not exclusively) found near seal or sea lion colonies in Australia.

## Reproduction

There is limited information available on the reproductive cycle of white sharks because examination of mature adult specimens (in particular females) is rare. Adults are large and relatively uncommon. When captured, their size makes retention and examination of specimens difficult. However, it has been established that the white shark displays oophagy. In this form of reproduction, the embryos eat and are nourished by a supply of unfertilised eggs, which the female continues to ovulate during pregnancy.

Litter sizes vary from 2 to 10 with the length and weight at birth being 120–150 cm and up to 32 kg respectively. Gestation period is unknown, but may be approximately 18 months with females breeding only once every 2–3 years. Although limited information is available on the reproductive cycle of female white sharks, it is suggested that the birth period occurs between December and June. Nursery areas are located in inshore coastal waters.

There have been several age and growth studies on white sharks in different countries, although, in general, a shark will reach a length of 2 metres in about 3 years; 3 metres in 5–8 years; 5 metres in 16–23 years. Males have been reported to mature at about 3.6 metres and females at 4.5–5.0 metres. Minimum ages at maturity for females and males are estimated to be 18 and 10 years respectively. The longevity of these sharks is considered to be in excess of 30 years.

## Habitat and ecology

The white shark is primarily an inhabitant of continental shelf waters, often occurring close inshore near the surf line. This species is capable of swimming long distances. They have been recorded moving approximately 190 km in 2.5 days at an average cruising speed of 3.2 km/hr, while satellite tracking has confirmed migrations of almost 6000 km in 200 days. White sharks have been reported to revisit the same locality in consecutive years.

Sharks tagged by CSIRO in southern Australia have exhibited a wide range of swimming behaviours from regular dives and ascents between the surface and the bottom, swimming deep at night and in shallow water during the day, as well as prolonged periods at the surface or at the bottom. This research has indicated that movements are mainly restricted to shelf and coastal waters in swimming depths down to almost 100 metres.

Information on white shark ecology is limited. Additional research will identify the characteristics of habitat, critical to the survival of this species (e.g., undegraded inshore nursery and feeding areas). However, as white sharks move through

developmental habitats as they grow, this may be difficult because little is known about their developmental needs at various life stages.

## Migration

White sharks can be highly migratory, although some movements may be highly localised, at least during part of the year. Tagged sharks have moved across open ocean areas (e.g. Australia to New Zealand and California to Hawaii) and sharks may make trans-oceanic migrations. As a consequence, protection in Australian waters may be inadequate to ensure the safety of a shark if it migrates to waters where protection is limited or non-existent. There are several international agreements that can now be used to assist with regional cooperation for the conservation of the white shark.

On a national scale, satellite tracking has provided information on the extent of movements in Australian waters. Two sharks nicknamed ‘Heather’ and ‘Neale’ were tracked from their initial tagging location (within Victorian state waters). The data received by scientists at CSIRO indicate migration of 880 km over 46 days for ‘Heather’ and 2946 km over 113 days for ‘Neale’ in 2000 and 2001 respectively (figures 2 and 3).



Figure 2. CSIRO-tagged white shark ‘Heather’ in 2000 (from <http://www.marine.csiro.au/research/pelagic/tagging/heather/index.htm>) (© CSIRO).

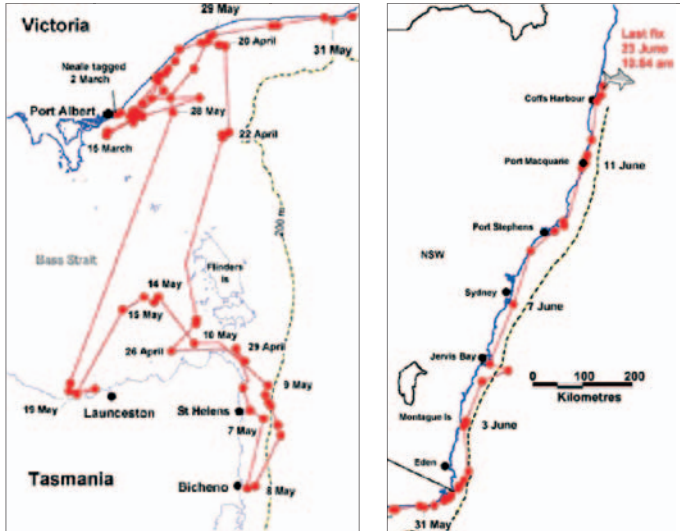


Figure 3. CSIRO-tagged white shark 'Neale' in 2001 (from [www.marine.csiro.au/research/pelagic/tagging/neale/index.htm](http://www.marine.csiro.au/research/pelagic/tagging/neale/index.htm)) (© CSIRO).

More recent satellite tracking by CSIRO in 2004 has recorded movements from South Australia to southern Queensland and northwest Western Australia.

There is also evidence of genetic exchange between white sharks in South Africa and Australia suggesting movement of individuals between these two locations.

## Threats

Sharks in general are known to be particularly susceptible to fishing pressure because of their specialised life history strategies with generally slow growth, late maturity, and low number of offspring. White sharks are one of the less productive species of sharks and produce relatively few young during their life span.

### Commercial and recreational fishing

- White sharks are typically bold and inquisitive in their approach to vessels and fishing gear. Although not specifically targeted, they are caught as bycatch on longlines, in nets set for commercially fished shark species and in finfish farm cages such as tuna farms. Fisheries known to interact with white sharks include the Southern Shark fishery; the snapper fisheries in Victoria, the Gulf of St Vincent and Spencer Gulf in South Australia; the Western Australian Shark fishery; and the Tasmanian Scalefish Fishery. The estimate of white sharks caught by commercial and recreational fisheries is between 100 and 440 each year throughout Australian waters.

### Game fishing

- Game fishing for white sharks is banned in Australian waters.

### Trade in white shark products

- Traded products that come from white sharks include fins, jaws, teeth and meat (fresh, frozen or salted for human consumption), cartilage (used as a health food), and skin for leather. Liver oil is used in medicines, and the carcass can be used for fish-meal and fertilizer. Laboratory DNA testing is being trialled to identify processed white shark fins and fin sets, meat, oil and cartilage. Individual jaws and teeth are easier to identify.

The trade in shark fins is generally on the increase with records from the Food and Agriculture Organization (FAO) of the United Nations indicating that the international fin trade increased significantly between 1980 and 1990. The demand for shark fin escalated further during the 1990s, with prices received for premium quality dried fin in Australia reaching A\$275/kg, making it one of the most expensive fishery products. Fin identification to assist with trade monitoring utilises the *CITES White Shark Fin Manual* and DNA testing equipment.

Jaws and teeth (figure 4) are the most valuable white shark products in trade. These trophies and curios are available through internet trading sites for up to US\$425 per tooth and up to US\$50 000 for a set of large jaws.



Figure 4. International trade in white shark jaws and individual teeth are closely monitored as a result of listing on CITES (© Kate Rodda, PIRSA SARDI).

### *Shark control programs*

- Shark control programs are in place in New South Wales and Queensland waters. 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. Shark nets do not completely enclose beaches but are usually 150 metres long and 6 metres high, set parallel to the shore in around 10 to 15 metres depth. There are currently a total of 49 meshed beaches between Newcastle and Wollongong in New South Wales (approximately 200 km of coastline). White sharks caught by beach meshing programs are usually small (less than 3 metres), and in many cases are smaller than 2 metres. Between 1950 and 2000, a total of 517 white sharks were captured in shark mesh nets in New South Wales. Other non-target species impacted by shark meshing include whales, turtles, dugongs and dolphins.
- A mixture of baited drumlines and nets are used in Queensland. 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. More than 670 white sharks have been caught in the Queensland Shark Control Program since 1962.

### **Protection**

The World Conservation Union considers the great white shark as 'vulnerable to extinction', commenting that 'the white shark is a widely but sparsely distributed top predator with a very low reproductive potential (late maturity and small litter size) and high vulnerability to target and bycatch fisheries (commercial and recreational), some of which supply products (fins, jaws and teeth) for international trade. A recent FAO Review Panel report noted that 'all available evidence suggests that white sharks are naturally rare, have low productivity and have suffered marked population declines in several areas, at least on a local scale'.

The white shark receives protection in part of its range, although its highly migratory nature may make it susceptible outside of these regions.

- In Australia, the white shark is listed as a protected species in all Australian range States.
- The white shark is listed as *vulnerable* under the Commonwealth *Environment Protection and Biodiversity Conservation Act (1999)* and protected in Commonwealth waters.

- The whale shark is listed as *vulnerable* under the *New South Wales Fisheries Management Act 1994*.
- The whale shark is listed as *vulnerable* under the *Tasmanian Threatened Species Protection Act*.
- The white shark is a protected species in the waters of Florida, California, South Africa, Namibia, Maldives and Malta.
- Australia joined Madagascar in proposing the white shark be included in Appendix II of the *Convention on International Trade in Endangered Species (CITES)*. This was successful in October 2004 at the CITES Conference of Parties 13 Meeting. The inclusion of this species on Appendix II of CITES will help ensure that international trade of the species and its parts is not detrimental to its survival in the wild.
- The white shark is listed on both Appendix 1 (endangered migratory species requiring strict protection measures) and Appendix II (species with an unfavourable conservation status that would benefit from the implementation and international cooperative agreements for their conservation and management) of the *Bonn Convention on Migratory Species*.
- The white shark is recognised as a highly migratory species under the *United Nations Convention on the Law of the Sea* further encouraging the minimisation of bycatch and a precautionary approach to the management of this species.

Trade in white shark products (especially jaws, teeth and fins) is of major concern for the long-term survival of this species. Commercial fishing is the main threat in Australian waters. Additional threats are the shark control programs in New South Wales and Queensland; recreational fishers that occasionally take this species; and the degradation of inshore nursery habitats which may impact breeding and/or juvenile survival.

### **For further information**

CSIRO white shark research:  
<http://www.marine.csiro.au/research/whitesharks/wsresearch.html>

Recovery Plan for the white shark in Australia:  
<http://www.deh.gov.au/coasts/species/sharks/greatwhite/plan/index.html>

National Plan of Action for the Conservation and Management of Sharks (Shark-plan):  
<http://www.daff.gov.au/sharkplan>

# SHARK BAY

 **Seaweek 2005**  
March 6 to 13

 **SCS**  
SAVE OUR SHARKS

## Acknowledgements

The following organisations/individuals are acknowledged for their contributions: **Funding:** Natural Heritage Trust and the Fisheries Resources Research Fund (Australian Government Department of Agriculture, Fisheries and Forestry). **Coordination of project:** Marine Industries Environment Branch and the Bureau of Rural Sciences (Australian Government Department of Agriculture, Fisheries and Forestry). **Artwork:** Brett Cullen and Trish Hart. **Reviewers:** Barry Bruce, John Stevens, John West, Carolyn Stewardson and Albert Caton.

© Brad Norman ([ecocean@ozemail.com.au](mailto:ecocean@ozemail.com.au)).

This information sheet may be copied for educational purposes.

For any other purpose please contact the author.

  
**Natural Heritage Trust**  
*Helping Communities Helping Australia*  
A Commonwealth Government Initiative

  
Australian Government  
Department of Agriculture, Fisheries and Forestry  
Bureau of Rural Sciences

  
**MESA**  
MARINE EDUCATION  
SOCIETY OF AUSTRALASIA