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**SHARKS**

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## INTRODUCTION

Through the ages sharks have played an important part in the natural balance of the oceans. Man has viewed them as part nuisance, part destructive, and part dangerous, yet they have contributed greatly to food supplies, commercial products and to the traditions of many cultures.

Sharks are not usually an important target group for fishing activities in the region. They do constitute an important by catch from many types of fishing. There is scope for expansion of the fishery as various species within the group may be utilised for a wide variety of products. There are however, biological limits to increased exploitation of the group.

## TAXONOMY

It has been suggested that carangid fishes have not received the attention warranted within the large coastal pelagic fish group because of the poor state of the taxonomy. Perhaps the same could be said for sharks, especially those of the whaler or requiem genus Carcharhinus which is the dominant shark of the epipelagic habitat, and the shallower neritic province waters in the region.

It has only been in the last six years that the taxonomy of this group was tackled on a circumglobal level resulting in the reviews by Garrick (1982) which was awaited by all, and the definitive review of all the shark species by Compagno (1985). Formanoir (1975, 1976) also provides useful descriptions and ecological notes of Carcharhinus species.

The most commonly seen sharks of the reef and lagoon are those of the family Carcharhinidae. In the turbid nearshore waters of the high islands of the south-western area of the region small Rhizoprionodon sharks are common. Open lagoon or neritic waters of wide continental shelf regions have a shark fauna that includes C. limbatus, C. tilstoni and C. sorrah.

The most common sharks of the shallow reef waters throughout the Pacific are the blackfin reef shark (Carcharhinus melanopterus), lemon shark (Negaprion acutidens) and the reef whitetip (Triacodon obesus). In deeper waters adjacent to reefs the grey reef shark (C. amblyrhynchos) is abundant with large species such as the white fringed whaler (C. albimarginatus) or the galapagos shark (C. galapagensis) more common along the edge of the continental slope.

The tiger shark (Galeocerdo cuvieri), the bull (C. leucas) and java sharks (C. amboinensis) as well as the hammerheads (Sphyrnidae) are large sharks dangerous to man that are found in all these habitats. More oceanic waters are the domain of the silky (C. falciformis) and mako sharks.

## **FISHING METHODS**

### **a) Traditional methods**

Fisheries for neritic and epipelagic sharks exist throughout the region using a variety of nets hooks and lines. Traditional fishing gear such as the rattle and noose gear of Lesu in Melanesia are described by Rubel and Rosman (1981).

Whether or not sharks are be taken for meat, skins etc in some areas, they have great symbolism for many cultures where they may be vehicle for sorcery, reincarnations of deceased men and agents for disposing of the dead.

### **b) Oceanic longline fisheries**

The oceanic longline fisheries in the Pacific region have supplied a substantial proportion of world shark fin landings over many years. Few sharks are taken for meat by these fisheries as they are usually discarded in favour of the higher priced tuna and billfish species.

### **c) Gillnet fisheries**

Chapau and Opnai (1986) described the Taiwanese licensed gillnet fishery in the neritic waters of the Gulf of Papua. Sharks dominated the catch from 80 to 97% by weight while catch rates varied between 0.31 and 2.0 tonnes per net per day.

The largest industrial shark fishery adjacent to the region is the Taiwanese gillnet fishery in north-western Australian waters. Between 1975 and 1978, 24,500 tonnes were taken of which shark represented 78% of the catch (Stevens, in press). In 1979 a 7000 tonne quota was established.

Catch rates for shark in 1977 were about 34 kg/km hour (Stevens, in press), but by 1984 they had dropped to 17 kg/km hour. The Taiwanese catch quota was slightly reduced due to concerns over declining catch rates and as Australian participation in the fishery increased.

However in 1986, due to concerns over levels of cetacean by catch a minimum net length of 2.5 km was established (Stevens, in press) which rendered the Taiwanese fishery uneconomical. Catches of less than 400 tonnes are still maintained by Australian fishermen.

### **d) FAD's fisheries**

With the deployment of offshore FAD's, the oceanic whalers, makos and whitetip (C. longimanus) sharks have become more commonly encountered (Lewis 1985). Trolling around the FAD's and the deployment of vertical longlines and short gillnets are recognised fishing techniques.

**e) Deepwater snapper fisheries**

With the recent establishment of handline and longline fisheries for deepwater snappers an entirely new (to the region) group of sharks with additional utilisation potential has become exploited. The spiny dogfish (Squalus, Centrophorus, Centroscymus and Deania) and the six and seven gilled sharks (Hexanchus, Heptranchus) provide some potential as a food source although alternate products such as squaline oil used in the pharmaceutical, medical and cosmetic industries.

**f) Shark deterrant fisheries**

The constant problem of shark attack has led to large mesh gillnets and drumlines being set adjacent to popular swimming beaches in Australia, South Africa and the United States. Large tiger, hammerhead, great white and whaler sharks are taken. whether these catches reduce the frequency of shark attack is uncertain.

**GENERAL BIOLOGY OF SHARKS**

**a) Mode of reproduction**

The two most important features in the early development of any animal are in the feeding and protection it receives. Sharks have evolved three distinct ways of assisting the viability of their young although at no time is any parental instinct shown. The three processes of reproductive development in sharks and rays are oviparity, ovoviviparity, and viviparity. In the latter two forms, young are born alive.

Sharks and rays that lay eggs are termed oviparous. Examples of include the rays (Rajiidae), the Port Jackson sharks (Heterodontidae), cat sharks (Scyliorhinidae) and some of the carpet and nurse sharks (Orectolobidae).

Most sharks and rays however, are not oviparous but retain their eggs within the body of the mother. The eggs develop into embryos which are released at full term as free swimming juveniles. There are two forms of live bearing in sharks, ovoviviparity and viviparity. They differ in the ways the developing embryos receive nutrition.

In ovoviviparous sharks the embryos are initially nourished by the egg yolk within the thin egg capsules. When this runs out the embryos rupture the thin capsules and feed on nutritive secretions from the surrounding uterus. In some sharks the nutrition available in the uterus is not sufficient and the embryos feed on unfertilised eggs within the uterus. The majority of sharks reproduce in this way. Ovoviviparous sharks include the Hexanchidae, Carchariidae, Isuridae, Alopiidae, some of the Triakidae and Squalidae and most of the deepwater shark families.

Early development of viviparous sharks is similar to that of ovoviviparity. After rupturing the egg capsule the yolk sac is retained after all the yolk has been absorbed from it. It has a well developed blood system as have the walls of the uterus and the two tissues become closely associated as a structure analagous to the mammalian placenta. Viviparity is found in the Sphyrnidae, most of the Carcharinidae and some of the Triakidae.

Fecundity of shark species is usually low. Some sharks do not breed each year, gestation time may range up to two years and clutch size may be as low as two.

#### **b) Movements**

Movements from tagging of two neritic Carcharhinus species in northern Australian waters showed that 20% of both species were recaptured within 5 km of their tagging site. The average distance moved for the remaining 80% of returns was 100 km (Stevens, in press). No seasonal or directed movements were obvious. Some long distance movements have been recorded for whaler sharks along north-south oriented coastlines.

Movements of reef associated species would be expected to be small.

#### **c) Growth**

Slow growth and late sexual maturity is a characteristic of temperate and deepwater sharks. Recent studies on tropical Carcharhinus species (Davenport and Stevens, in press; De Crosta et al.) have shown relatively rapid early growth for some species.

Attainment of sexual maturity is usually earlier than temperate and deepwater species although slow compared to most fishes. Age at first reproduction of C. amblyrhynchos and C. galapagensis is 6 and 10 years respectively (De Crosta et al. 1984).

### **MANAGEMENT AND STOCK ASSESSMENT**

Holden (1977) showed that shark fisheries were particularly sensitive to overfishing. Slow growth rates, low rates of reproduction and density dependent recruitment have resulted in 'boom and bust' histories for many shark fisheries.

The reviews of Holden (1974, 1977) were the first outlines for approaches to stock assessment for shark species. The need for accurate growth and reproduction parameters of shark populations were stressed as perhaps being more critical to efficient stock management than for teleost fishes.

As a top predator sharks generally have nothing to fear. During the course of evolution sharks developed a unique reproductive system (that is, oviparity, ovoviviparity and viviparity) where in the majority of species a small number of embryos are nurtured resulting in the live parturition of highly efficient, although small, predatory fishes. It is ironic that the very adaptive features that made sharks successful by releasing small numbers of successful young, are those that make their survival under heavy fishing mortality tenuous.

The prospect of large scale shark fisheries developing in the Pacific region is low. There is however, potential for localised fisheries for meat, fins and shark oils which could exploit local stocks.

The potential exists for recruitment overfishing on most localised shark stocks. The study of the age and reproduction of at least two Carcharhinus species suggests that the relatively rapid early growth and early maturity of tropical species may endow some species with greater resistance to higher fishing pressure than other groups of shark (Davenport and Stevens, in press).

The fast growth of the early year classes of Carcharhinus species would lend them suitable to length based stock assessment techniques. Vulnerability of most shallow water shark species to a wide variety of fishing gears would facilitate abundance surveys.

## UTILISATION

Problems of efficient utilisation of the present artisanal and commercial shark catches in the region are more pressing problems. The major FAO review of sharks and shark products by Kreuzer and Ahmed (1978) went a long way to putting sharks into a more realistic perspective.

King et al. (1984) provide an excellent summary of the FAO review while Preston (1984) provides the most concise summary of the fishing techniques, species and utilisation potential within the SPC region.

With the oceanic longline fisheries that produce the majority of shark fins shrinking, Lewis (1985) indicated a rising demand for shark fins.

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