**SHARKS AND RAYS (CHONDRICHTHYES)**

**Sharks**

Only about 500 species of sharks are known in the world, compared to over 28,000 bony fishes. In spite of their low number of species, sharks play a major role in the seas of the world. Many are the top predators in the various food chains and serve to keep Nature in balance.

With the decline of so many major fisheries in the world, sharks are being exploited more as a source of food today. The demand for shark fins for the use in the preparation of soup in the Orient continues unabated. As a result, the populations of commercially important sharks are now seriously reduced. Because sharks have relatively few young, and most grow slowly, their populations can be quickly depleted by overfishing.

Sharks differ in many ways from bony fishes. Their skeleton is cartilage, not bone. The jaws of sharks may seem as hard as bone, but it is only calcified cartilage. There are 5 to 7 gill openings on each side of the head of sharks, compared to a single one for bony fishes. Most sharks have a spiracle, which is a rudimentary gill opening found behind or below the eye. In bottom-dwelling sharks and rays, it is functional as the incurrent opening for respiratory water. The skin of sharks is rough to the touch, due to the presence of numerous, small, dermal denticles which are close-set but not overlapping like the scales of most bony fishes. The mouth of most sharks is ventral on the head, thus the snout is overhanging. The teeth are modified, enlarged dermal denticles with a pulp cavity, dentine and a thin layer of hard, enamel-like vitrodentine. The teeth vary greatly in structure among the different species of sharks. Some teeth are sharp and blade-like, with or without serrations; others long and raptorial; and still others molariform for crushing mollusks and other hard-shelled invertebrates. When teeth are broken or worn, they are replaced from intact rows behind. Sharks lack a swimbladder, the hydrostatic organ of bony fishes. To partially offset the greater density of their bodies than seawater, sharks have a very large liver containing much oil. Also they swim with pectoral fins outstretched and angled to give them lift.

All sharks have internal fertilization; the intromittent organ of the male is the pair of claspers, one developing along the medial edge of each pelvic fin (thus the sex of sharks is easily determined externally). Some sharks are oviparous; they lay eggs in leathery cases. Most sharks are ovoviviparous; the eggs develop within the uterus. The requiem sharks (Carcharhinidae, except the Tiger Shark) and the hammerheads (Sphyrnidae) are viviparous; the embryos are nourished by a placenta-like organ of the female. Most sharks have very few young, often only one or two (the Blue Shark and the Tiger Shark are exceptional in giving birth to as many as 80 pups, respectively, at one time). The intestine of sharks is very different from that of
other vertebrates. It contains the spiral valve, much like an enclosed spiral staircase; indigestible items like squid beaks cannot easily pass through the intestine; from time to time a shark will regurgitate such items from its stomach.

Sharks have exceptional sensory systems. Well known is their keen olfaction which can detect attracting substances such as blood in minute quantities. Most sharks feed mainly at dusk or night (but may feed opportunistically during daylight hours); therefore their eyes are adapted to low levels of illumination. They have a tapetum lucidum behind the retina which reflects light (like a cat’s eye at night); light passes through the light-receptor cells of the retina and is reflected back, thus doubling the stimulus. The highly developed lateralis system of sharks, a complex set of canals on the head and one along the side of the body with pores connecting to the surface, enables them to detect low frequency vibrations at considerable distances. Thus they are aware of the movements of prey or predators that they may not see. The pit organs in the snout, termed ampullae of Lorenzini, have been shown to act as electoreceptors. A shark is therefore able to detect the weak electromagnetic field around a sleeping fish at night.

Forty-four species of sharks are known from Hawaiian waters, but 12 of these occur only in deep water. The seven that are most apt to be encountered by divers or snorkelers are illustrated and discussed below.

Of greatest concern to all who venture into the sea is the threat of being bitten by a shark. However, as noted by many authors, shark attack as a cause of death in the world is negligible compared, for example, to automobile accidents. Even lightning causes more deaths than sharks. Between 1779 and 1992, 101 shark attacks have been recorded for the islands, of which 44 were fatal (although nine of the fatalities are believed to have been due to drowning or other causes). Two species of sharks in Hawaiian waters should be regarded as very dangerous, the Great White Shark (Carcharodon carcharias) and the Tiger Shark (Galeocerdo cuvier). The Great White Shark is rare in the Hawaiian Islands. The Tiger Shark, although rarely seen, is undoubtedly responsible for most of the attacks on humans in Hawaiian waters. Nevertheless, most encounters by divers with the Tiger Shark have been uneventful except for the fright they must have elicited in the divers.

**Requiem Sharks (Carcharhinidae)**

This large family consists of 12 genera and 49 species, mainly of tropical seas. It is the most important family of sharks from the standpoint of abundance, impact on marine communities, and commercial use. These sharks feed mainly on bony fishes, but also on octopuses, squids, shrimps, and sea birds. The larger species prey upon smaller sharks, rays, sea turtles, and marine mammals, in addition to bony fishes. Eleven species occur in the Hawaiian Islands; the following four are most often seen by divers.
**GRAY REEF SHARK**  manō  *Carcharhinus amblyrhynchos* (Bleeker, 1856)
Trailing edge of caudal fin black; second dorsal and anal fins black, except basally; no ridge on back between dorsal fins. Attains about 6 feet (180 cm). Dangerous to spearfishermen. Should not be approached if displaying threat behavior (exaggerated slow sinuous swimming with pectoral fins lowered). Indo-Pacific, usually on coral reefs in clear water.

**GALAPAGOS SHARK**  manō  *Carcharhinus galapagensis* (Snodgrass & Heller, 1905)
No conspicuous markings on fins; a low ridge on back between dorsal fins. To about 11.5 feet (350 cm). Circumglobal in tropical and subtropical seas, especially around oceanic islands; common in the Northwestern Hawaiian Islands; a dangerous shark.

**BLACKTIP REEF SHARK**  Manō pāʻele  
*Carcharhinus melanopterus* (Quoy & Gaimard, 1824)
Brownish gray to yellowish brown with conspicuous black tips on all fins; no interdorsal ridge. Largest, 6 feet (180 cm). Indo-Pacific; generally found inshore, often in very shallow water. Ordinarily timid, but has bitten the feet or legs of persons wading on reef or sand flats.