

INTRODUCTION

This pocket guide has been published in response to the many requests for a smaller, easily portable book describing all the shark species included in *Sharks of the World: A Fully Illustrated Guide* (Ebert, Fowler and Compagno 2013). This book hopefully does just that, with 501 species (including 77 new shark species named since 2005) depicted in colour, concise descriptions, key guide and much more essential information; this book is designed to be the shark guide you take with you everywhere.

The reason we have produced these guides is not just because we and so many other people love sharks, but also because the identification of whole sharks and high-value parts, such as teeth and fins, is an essential tool to support shark conservation, fisheries management and international trade regulation, prevent further depletion of stocks, and enable their recovery. As an example, the teeth or jaws of protected species, such as the White Shark, are still offered for sale or traded between countries as curios or trophies. Shark fins of many species are still traded in huge quantities, to meet demand for one of the most highly prized seafood dishes in the world: shark fin soup. It is estimated that the fins of up to 73 million sharks may have entered international trade annually in recent years. The role of the shark fin trade in driving unsustainable shark fisheries is now being addressed through shark finning bans (which outlaw the removal of fins and discard of shark carcasses at sea), prohibiting the capture and retention of some threatened species, and the legal regulation of international trade in products derived from sharks listed in the Appendices of the Convention on International Trade in Endangered Species (CITES) – this guide will support the implementation of these measures.

We also hope that this guide will encourage more people to become involved in field studies of sharks – in the sea and onshore; at fish landing sites and in fish markets; in armchairs, libraries and classrooms. It is not just for scientists and managers, but also for divers, anglers, naturalists and anyone else interested in wildlife and the sea. What is more, because knowledge of shark biodiversity and biology is still sparse in many parts of the world, those who use this book in the field might uncover new information, or even completely new shark species. We all still have a lot to learn about these fascinating animals, which are sadly more seriously threatened with extinction and in greater need of conservation and management action than any other higher taxon of vertebrate animals. We aim, through these pages, to spread our enthusiasm for sharks and encourage readers to improve their future chances of survival by supporting national and international efforts to end over-exploitation in fisheries and allow populations to recover.

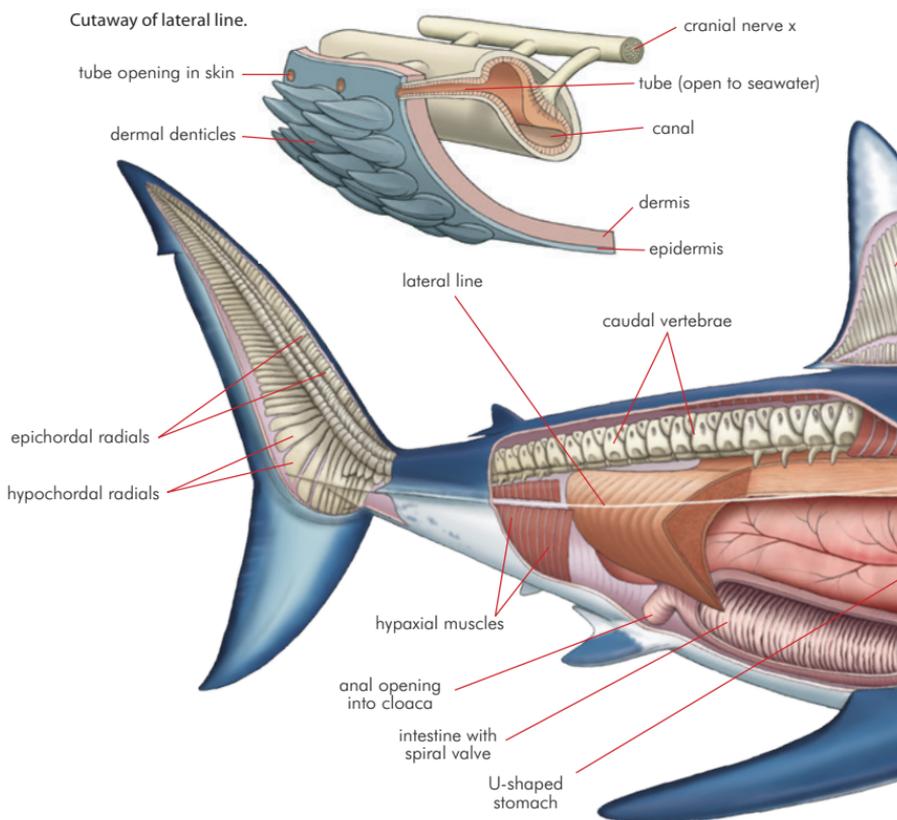
The cartilaginous fishes – Chondrichthyes

There are about 1200 known living species of chondrichthyans (sharks, rays and chimaeras): jawed fishes with multiple gill openings and simple, flexible cartilaginous skeletons. Elasmobranchs, the sharks (~500 species) and their close cousins the batoid fishes (~650 species, most of them skates and rays), are the most common living chondrichthyans. There are also about 50 species of the rarely seen, deep sea chimaeras, or holocephalans. This is a tiny remnant of the numbers that dominated the seas 300 million years ago; more than 3000 predecessors of today's chondrichthyans have been identified in the fossil record (likely only a small proportion of extinct species). Today, sharks and their relatives are in the minority: more than 30,000 of living fishes are teleosts, with bony skeletons.

Biology and ecology

Since the first shark appeared almost 400 million years ago, these animals have occupied a wide range of habitats and adopted a variety of lifestyles and reproductive strategies. Shark species occur in the deep ocean, coastal and intertidal habitats, equatorial waters, frigid Arctic and Antarctic seas, and a few in freshwater. Some are very poor swimmers and clamber around on muscular fins; they may spend their entire lives within a relatively small area of seabed. Others never stop swimming, reach very high speeds and cover huge distances across the world's oceans, moving between warm tropical surface waters and the colder waters of the deepsea or boreal zones.

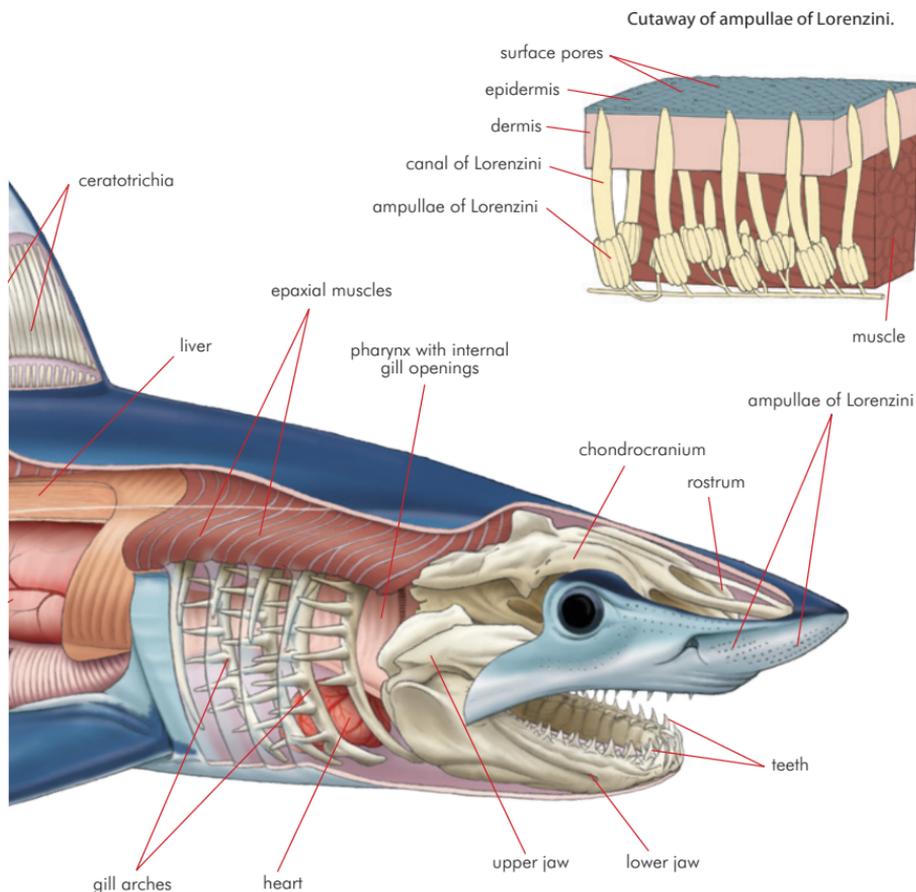
Water temperature is one of the most important environmental factors governing shark distribution. Most sharks are cold-blooded (ectotherms); their body temperature is similar to the water in which they swim because any warmth generated by muscle activity rapidly diffuses away



Shark general anatomy (for topography see pages 11–13).

across their gills. Many cold-blooded species live in warm seas, where they can retain a high enough body temperature to function effectively, and some migrate north and south with the changing seasons. Coldwater ectotherms (e.g. deepsea sharks) have a very low metabolic rate, are often small-bodied, and feed and grow very slowly; they probably die if they enter warm water.

Some mackerel sharks have evolved a complex heat-exchange system that maintains their core body temperature significantly above that of the cold water in which they live. These warm-bodied sharks (endotherms) are faster, more efficient predators, grow rapidly, and have a much higher metabolic rate than ectotherms. However, they also need up to ten times as much food as a similar sized cold-blooded shark, and mostly feed in colder, more productive waters. White Sharks returning from long journeys into tropical waters may be very much thinner than they were when they left their cold-water hunting grounds.



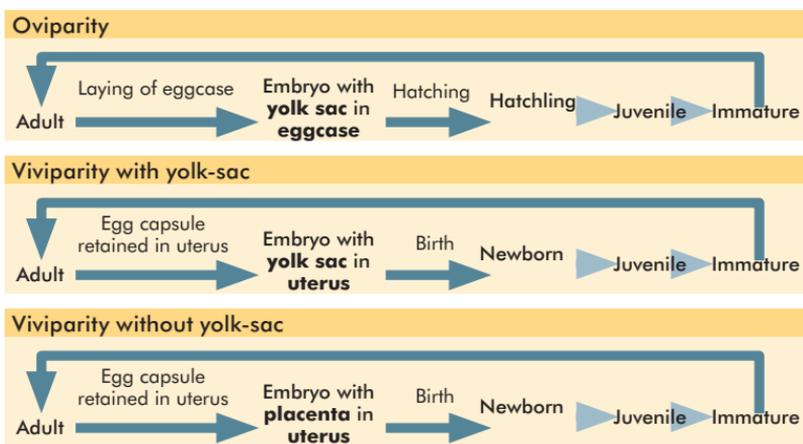
Reproduction

Unlike most bony fishes (which broadcast-spawn huge numbers of tiny eggs, few of which reach adulthood), sharks have internal fertilisation and produce a small number of large young with high survival rates. This reproductive strategy is similar to that of birds and mammals, except that shark pups are born fully-developed and require no further care from their mother.

About 40% of sharks are egg-laying. Each egg has a large reserve of yolk to feed the developing pup, is protected by a tough capsule and develops anchored to the seabed. Some shark eggs may take a year or more to hatch, while species that lay their eggs shortly before hatching reduce the risk that they may be eaten by predators.

All other sharks are viviparous; they give birth to live young. In some species, unborn pups are attached to a yolk sac, with no direct maternal supply of nutrition. Others may have a placental attachment and, like mammals, receive nutrition directly from the mother. A small percentage of sharks exhibit oviphagy, whereby they feed on infertile eggs produced by their mother; the first pups to develop may even feed on their siblings in the uterus.

So much maternal investment means that several species need one or two 'resting' years between litters, to rebuild their energy reserves. Astonishingly, parthenogenesis or 'virgin birth' is known in some captive female sharks, which produced daughters without a father.



Three reproductive strategies in sharks.

Shark senses

Sharks include some of the world's most intelligent and efficient predators, with highly sophisticated social behaviours. Brain size and complexity of behaviour does, however, vary significantly between species. Less intelligence is needed to ambush crabs, crunch molluscs, or slurp plankton, than to locate, stalk and outwit highly intelligent prey animals, or to engage in complex migratory, social and mating behaviours. Carcharhinid sharks have larger brains (relative to body size) than angelsharks. The White Shark's brain is larger than that of the filter-feeding Basking Shark. Hammerheads have the largest brains of all sharks (but are outclassed by manta and devil rays).

All sharks have the same range of senses, although some species use them in a more sophisticated manner. Smell and taste, used to locate prey over long distances, are outstanding. Sight is very important, particularly for clear-water species, with the largest eyes found in top visual predators (e.g. White Shark) and the deepwater sharks. The latter's eyes are designed to capture as much light as possible in deep ocean darkness, and appear to glow green at the surface. In contrast, species that live in murky rivers have tiny eyes, and rely heavily upon their other senses. As well as good hearing, sharks can perceive changes in pressure and electric fields, using sensory cells scattered around their head and mouth, and along their lateral lines. A variety of numerous tiny receptor cells detect changes in pressure caused by other animals moving nearby. Minute organs known as 'ampullae of Lorenzini' pick up the tiny changes in electric fields that are given off by living animals (even when buried in the seabed), inanimate objects, and water moving through the earth's magnetic field. These help sharks to detect and locate prey, to orient themselves during migration, and to follow magnetic highways between feeding and aggregation sites.

Globally threatened species

A global analysis of the conservation status of the world's sharks, batoids and chimaeras used the IUCN Red List categories and criteria to highlight our lack of knowledge of many stocks and the high extinction risk faced by many sharks and their relatives. These large marine predators, which include some of the latest-maturing and slowest-reproducing of all animals, are under greater threat than even the amphibians (formerly thought to be the world's most threatened vertebrates) and mammals. Large sharks are more likely to be threatened than smaller species. Almost a quarter of all chondrichthyan species is threatened with extinction, and only one third is safe.

Unsustainable, unregulated target and bycatch fisheries, often driven by global trade demand for meat and fins, are the greatest threat to sharks. Habitat damage is also a problem in coastal waters and rivers, and population control or persecution of large sharks has depleted some stocks.

Sharks of shallow water habitats, on the coast and in the open ocean, are the most seriously threatened; sharks longer than 1m have a more than 50% chance of being threatened, compared with about 12% for deepwater species of a similar size. Small deepwater species, like the lanternsharks, have the lowest risk. The angelsharks and thresher sharks are the two groups with the highest level of extinction risk to their entire families.

Geographically, coastal species in the Indo-Pacific Biodiversity Triangle, the Red Sea and the Mediterranean Sea/West Africa are at greatest risk.

For more information, see *Dulvy et al.* (2014), www.iucnredlist.org, and www.iucnssg.org

	IUCN Red List category of threat		No. of shark sp.	%
CR	Critically Endangered	Threatened categories	11	2.4%
EN	Endangered		15	3.2%
VU	Vulnerable		48	10.4%
NT	Near Threatened		67	14%
LC	Least Concern		115	25%
DD	Data Deficient		209	45%

The global Red List status of sharks.