[Template:Other uses](/wiki/Template:Other_uses" \o "Template:Other uses) [Template:Pp-move-indef](/wiki/Template:Pp-move-indef) [Template:Pp-vandalism](/wiki/Template:Pp-vandalism) [Template:Taxobox](/wiki/Template:Taxobox) **Sharks** are a group of [fish](/wiki/Fish) characterized by a [cartilaginous](/wiki/Cartilaginous) [skeleton](/wiki/Skeleton), five to seven [gill slits](/wiki/Gill_slit) on the sides of the head, and [pectoral fins](/wiki/Pectoral_fin) that are not fused to the head. Modern sharks are classified within the [clade](/wiki/Clade) **Selachimorpha** (or **Selachii**) and are the [sister group](/wiki/Sister_group) to the [rays](/wiki/Batoidea). However, the term "shark" has also been used for extinct members of the subclass [Elasmobranchii](/wiki/Elasmobranchii) outside the Selachimorpha, such as [*Cladoselache*](/wiki/Cladoselache) and [*Xenacanthus*](/wiki/Xenacanthus), as well as other [Chondrichthyes](/wiki/Chondrichthyes) such as the [holocephalid](/wiki/Holocephalid) [eugenedontidans](/wiki/Eugeneodontida). Under this broader definition, the earliest known sharks date back to more than 420 million years ago.[[1]](#cite_note-1) [Acanthodians](/wiki/Acanthodians) are often referred to as "spiny sharks"; though they are not part of Chondrichthyes proper, they are a paraphyletic assemblage leading to cartilaginous fish as a whole.

Since then, sharks have diversified into [over 500 species](/wiki/List_of_sharks). They range in size from the small [dwarf lanternshark](/wiki/Dwarf_lanternshark) (*Etmopterus perryi*), a deep sea species of only [Template:Convert](/wiki/Template:Convert) in length, to the [whale shark](/wiki/Whale_shark) (*Rhincodon typus*), the largest fish in the world, which reaches approximately [Template:Convert](/wiki/Template:Convert) in length. Sharks are found in all seas and are common to depths of [Template:Convert](/wiki/Template:Convert). They generally do not live in freshwater although there are a few known exceptions, such as the [bull shark](/wiki/Bull_shark) and the [river shark](/wiki/River_shark), which can survive and be found in both seawater and freshwater.[[2]](#cite_note-2) Sharks have a covering of [dermal denticles](/wiki/Dermal_denticle) that protects their skin from damage and [parasites](/wiki/Parasite) in addition to improving their [fluid dynamics](/wiki/Fluid_dynamics). They have numerous sets of replaceable teeth.[[3]](#cite_note-3) Well-known species such as the [great white shark](/wiki/Great_white_shark), [tiger shark](/wiki/Tiger_shark), [blue shark](/wiki/Blue_shark), [mako shark](/wiki/Isurus), and the [hammerhead shark](/wiki/Hammerhead_shark) are [apex predators](/wiki/Apex_predator)—organisms at the top of their underwater [food chain](/wiki/Food_chain). Many shark populations are threatened by human activities.

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## Etymology[[edit](/index.php?title=(none)&action=edit&section=1)]

Until the 16th century,[[4]](#cite_note-4) sharks were known to mariners as "sea dogs".[[5]](#cite_note-5)The etymology of the word "shark" is uncertain. One (now largely disproved) theory is that it derives from the [Yucatec Maya](/wiki/Yucatec_Maya_language) word *xok*, pronounced 'shok'.[[6]](#cite_note-6)Evidence for this etymology came from the [Oxford English Dictionary](/wiki/Oxford_English_Dictionary), which notes *shark* first came into use after Sir [John Hawkins'](/wiki/John_Hawkins_(naval_commander)) sailors exhibited one in London in 1569 and posted "*sharke*" to refer to the large sharks of the [Caribbean Sea](/wiki/Caribbean_Sea). However, the [Middle English Dictionary](/wiki/Middle_English_Dictionary) records an isolated occurrence of the word *shark* (referring to a sea fish) in a letter written by [Thomas Beckington](/wiki/Thomas_Beckington) in 1442, which rules out a New World etymology.[[7]](#cite_note-7) Another etymology states that the original sense of the word was that of "predator, one who preys on others" from the Dutch *schurk*, meaning "villain, scoundrel" (cf. *card shark*, *loan shark*, etc.), which was later applied to the fish due to its predatory behaviour.[[8]](#cite_note-8)

## Evolution[[edit](/index.php?title=(none)&action=edit&section=2)]

[right |thumb|A collection of](/wiki/File:CretaceousSharkTeeth061812.JPG) [Cretaceous](/wiki/Cretaceous) [shark teeth](/wiki/Shark_teeth)|alt=Photo of dozens of yellowish fossilized teeth, the teeth are of various sizes and are spread out randomly on a flat black surface. [Template:See also](/wiki/Template:See_also)

Evidence for the existence of sharks dates from the [Ordovician](/wiki/Ordovician) period, 450–420 million years ago, before land vertebrates existed and before many plants had colonized the continents.[[1]](#cite_note-1) Only scales have been recovered from the first sharks and not all paleontologists agree that these are from true sharks, suspecting that these scales are actually those of [thelodont](/wiki/Thelodont) agnathans.[[9]](#cite_note-9) The oldest generally accepted shark scales are from about 420 million years ago, in the [Silurian](/wiki/Silurian) period.[[9]](#cite_note-9) The first sharks looked very different from modern sharks.[[10]](#cite_note-10) The majority of modern sharks can be traced back to around 100 million years ago.[[11]](#cite_note-11) Most fossils are of teeth, often in large numbers. Partial skeletons and even complete fossilized remains have been discovered. Estimates suggest that sharks grow tens of thousands of teeth over a lifetime, which explains the abundant fossils. The teeth consist of easily fossilized [calcium phosphate](/wiki/Calcium_phosphate), an [apatite](/wiki/Apatite). When a shark dies, the decomposing skeleton breaks up, scattering the apatite prisms. Preservation requires rapid burial in bottom sediments.

Among the most ancient and primitive sharks is [*Cladoselache*](/wiki/Cladoselache), from about 370 million years ago,[[10]](#cite_note-10) which has been found within [Paleozoic](/wiki/Paleozoic) strata in Ohio, Kentucky, and Tennessee. At that point in Earth's history these rocks made up the soft bottom sediments of a large, shallow ocean, which stretched across much of North America. *Cladoselache* was only about [Template:Convert](/wiki/Template:Convert) long with stiff triangular fins and slender jaws.[[10]](#cite_note-10) Its teeth had several pointed cusps, which wore down from use. From the small number of teeth found together, it is most likely that *Cladoselache* did not replace its teeth as regularly as modern sharks. Its caudal fins had a similar shape to the [great white sharks](/wiki/Great_white_shark) and the pelagic [shortfin](/wiki/Shortfin_mako_shark) and [longfin makos](/wiki/Longfin_mako_shark). The presence of whole fish arranged tail-first in their stomachs suggest that they were fast swimmers with great agility.

Most fossil sharks from about 300 to 150 million years ago can be assigned to one of two groups. The [Xenacanthida](/wiki/Xenacanthida) was almost exclusive to freshwater environments.[[12]](#cite_note-12)[[13]](#cite_note-13) By the time this group became extinct about 220 million years ago, they had spread worldwide. The other group, the [hybodonts](/wiki/Hybodontiformes), appeared about 320 million years ago and lived mostly in the oceans, but also in freshwater.[Template:Citation needed](/wiki/Template:Citation_needed) The results of a 2014 study of the gill structure of an unusually well-preserved 325 million year old fossil suggested that sharks are not "living fossils", but rather have evolved more extensively than previously thought over the hundreds of millions of years they have been around.[[14]](#cite_note-14) [thumb|](/wiki/File:Megalodon_scale.svg)[*Megalodon*](/wiki/Megalodon) (top two, estimated maximum and conservative sizes) with the whale shark, great white shark, and a human for scale|alt=Drawing comparing sizes of Megalodon, great white shark and a man, Megalodon is 18m long and great white 6m.

Modern sharks began to appear about 100 million years ago.[[11]](#cite_note-11) Fossil [mackerel shark](/wiki/Mackerel_shark) teeth date to the [Early Cretaceous](/wiki/Early_Cretaceous). One of the most recently evolved families is the hammerhead shark (family Sphyrnidae), which emerged in the [Eocene](/wiki/Eocene).[[15]](#cite_note-15) The oldest white shark teeth date from 60 to 66 million years ago, around the time of the [extinction of the dinosaurs](/wiki/Cretaceous–Paleogene_extinction_event). In early white shark evolution there are at least two lineages: one lineage is of white sharks with coarsely [serrated](/wiki/Shark_teeth) teeth and it probably gave rise to the modern great white shark, and another lineage is of white sharks with finely serrated teeth. These sharks attained gigantic proportions and include the extinct megatoothed shark, [*C. megalodon*](/wiki/Megalodon). Like most extinct sharks, *C. megalodon* is also primarily known from its fossil teeth and vertebrae. This giant shark reached a total length (TL) of more than [Template:Convert](/wiki/Template:Convert).[[16]](#cite_note-16)[[17]](#cite_note-17) *C. megalodon* may have approached a maxima of [Template:Convert](/wiki/Template:Convert) in total length and [Template:Convert](/wiki/Template:Convert) in mass.[[18]](#cite_note-18) Paleontological evidence suggests that this shark was an active predator of large [cetaceans](/wiki/Cetaceans).[[18]](#cite_note-18)

### Taxonomy[[edit](/index.php?title=(none)&action=edit&section=3)]

[right |350px |Identification of the 8](/wiki/File:Extant_Shark_Orders.svg) [extant](/wiki/Extant_taxon) shark [orders](/wiki/Order_(biology))|alt=Branching diagram listing distinguishing characteristics, including mouth, snout, fin spines, etc. Sharks belong to the [superorder](/wiki/Superorder_(biology)) Selachimorpha in the [subclass](/wiki/Subclass_(biology)) [Elasmobranchii](/wiki/Elasmobranchii) in the [class](/wiki/Class_(biology)) [Chondrichthyes](/wiki/Chondrichthyes). The Elasmobranchii also include [rays](/wiki/Batoidea) and [skates](/wiki/Skate_(fish)); the Chondrichthyes also include [Chimaeras](/wiki/Chimaera). It is currently thought that the sharks form a [polyphyletic](/wiki/Polyphyly) group: some sharks are more closely related to rays than they are to some other sharks.[[19]](#cite_note-19) The superorder Selachimorpha is divided into Galea (or [Galeomorphii](/wiki/Galeomorphii)), and Squalea (or [Squalomorphii](/wiki/Squalomorphii)). The Galeans are the [Heterodontiformes](/wiki/Bullhead_shark), [Orectolobiformes](/wiki/Carpet_shark), [Lamniformes](/wiki/Lamniformes), and [Carcharhiniformes](/wiki/Carcharhiniformes). Lamnoids and Carcharhinoids are usually placed in one [clade](/wiki/Clade), but recent studies show the Lamnoids and Orectoloboids are a clade. Some scientists now think that Heterodontoids may be Squalean. The Squaleans are divided into Hexanchoidei and Squalomorpha. The Hexanchoidei includes the [Hexanchiformes](/wiki/Hexanchiformes) and [Chlamydoselachiformes](/wiki/Frilled_shark). The Squalomorpha contains the [Squaliformes](/wiki/Squaliformes) and the Hypnosqualea. The Hypnosqualea may be invalid. It includes the [Squatiniformes](/wiki/Angel_shark), and the Pristorajea, which may also be invalid, but includes the [Pristiophoriformes](/wiki/Sawshark) and the [Batoidea](/wiki/Batoidea).[[19]](#cite_note-19)[[20]](#cite_note-20) There are more than 470 species of sharks split across thirteen [orders](/wiki/Order_(biology)), including four orders of sharks that have gone extinct:[[20]](#cite_note-20)

* [Carcharhiniformes](/wiki/Carcharhiniformes): Commonly known as [ground sharks](/wiki/Carcharhiniformes), the order includes the [blue](/wiki/Blue_shark), [tiger](/wiki/Tiger_shark), [bull](/wiki/Bull_shark), [grey reef](/wiki/Grey_reef_shark), [blacktip reef](/wiki/Blacktip_reef_shark), [Caribbean reef](/wiki/Caribbean_reef_shark), [blacktail reef](/wiki/Blacktail_reef_shark), [whitetip reef](/wiki/Whitetip_reef_shark), and [oceanic whitetip sharks](/wiki/Oceanic_whitetip_shark) (collectively called the [requiem sharks](/wiki/Requiem_shark)) along with the [houndsharks](/wiki/Houndshark), [catsharks](/wiki/Catshark), and [hammerhead sharks](/wiki/Hammerhead_shark). They are distinguished by an elongated snout and a [nictitating membrane](/wiki/Nictitating_membrane) which protects the eyes during an attack.
* [Heterodontiformes](/wiki/Bullhead_shark): They are generally referred to as the [bullhead](/wiki/Bullhead_shark) or [horn sharks](/wiki/Horn_shark).
* [Hexanchiformes](/wiki/Hexanchiformes): Examples from this group include the [cow sharks](/wiki/Cow_shark) and [frilled sharks](/wiki/Frilled_shark), which somewhat resembles a marine snake.
* [Lamniformes](/wiki/Lamniformes): They are commonly known as the [mackerel sharks](/wiki/Lamniformes). They include the [goblin shark](/wiki/Goblin_shark), [basking shark](/wiki/Basking_shark), [megamouth shark](/wiki/Megamouth_shark), the [thresher sharks](/wiki/Thresher_shark), [shortfin](/wiki/Shortfin_mako_shark) and [longfin mako sharks](/wiki/Longfin_mako_shark), and [great white shark](/wiki/Great_white_shark). They are distinguished by their large jaws and [ovoviviparous](/wiki/Ovoviviparity) reproduction. The Lamniformes also include the extinct [megalodon](/wiki/Megalodon), *Carcharodon megalodon*.
* [Orectolobiformes](/wiki/Carpet_shark): They are commonly referred to as the [carpet sharks](/wiki/Carpet_shark), including [zebra sharks](/wiki/Zebra_shark), [nurse sharks](/wiki/Nurse_shark), [wobbegongs](/wiki/Wobbegong), and the [whale shark](/wiki/Whale_shark).
* [Pristiophoriformes](/wiki/Sawshark): These are the [sawsharks](/wiki/Sawshark), with an elongated, toothed snout that they use for slashing their prey.
* [Squaliformes](/wiki/Squaliformes): This group includes the [dogfish sharks](/wiki/Squalidae) and [roughsharks](/wiki/Squalidae).
* [Squatiniformes](/wiki/Angel_shark): Also known as [angel sharks](/wiki/Angel_shark), they are flattened sharks with a strong resemblance to [stingrays](/wiki/Stingrays) and [skates](/wiki/Skate_(fish)).
* † [Cladoselachiformes](/wiki/Cladoselachiformes)
* † [Hybodontiformes](/wiki/Hybodontiformes)
* † [Symmoriida](/wiki/Symmoriida)
* † [Xenacanthida](/wiki/Xenacanthida) (Xenacantiformes)

## Anatomy[[edit](/index.php?title=(none)&action=edit&section=4)]

[right|thumb|475px|General anatomical features of sharks|alt=Drawing of a shark labeling major anatomical features, including mouth, snout, nostril, eye, spiracle, dorsal fin spine, caudal keel, clasper, labial furrows, gill openings, precaudal pit and fins: first and second dorsal, anal, pectoral, caudal and pelvic](/wiki/File:Parts_of_a_shark.svg)

[Template:Main](/wiki/Template:Main)

### Teeth[[edit](/index.php?title=(none)&action=edit&section=5)]

[Template:Main](/wiki/Template:Main) [thumb|The teeth of](/wiki/File:Tiger_shark_teeth.jpg) [tiger sharks](/wiki/Tiger_shark) are oblique and serrated to saw through flesh|alt=The serrated teeth of a [tiger shark](/wiki/Tiger_shark), used for sawing through flesh Shark teeth are embedded in the [gums](/wiki/Gingiva) rather than directly affixed to the jaw, and are constantly replaced throughout life. Multiple rows of replacement teeth grow in a groove on the inside of the jaw and steadily move forward in comparison to a [conveyor belt](/wiki/Conveyor_belt); some sharks lose 30,000 or more teeth in their lifetime. The rate of tooth replacement varies from once every 8 to 10 days to several months. In most species, teeth are replaced one at a time as opposed to the simultaneous replacement of an entire row, which is observed in the [cookiecutter shark](/wiki/Isistius).[[21]](#cite_note-21) Tooth shape depends on the shark's diet: those that feed on [mollusks](/wiki/Mollusk) and [crustaceans](/wiki/Crustacean) have dense and flattened teeth used for crushing, those that feed on fish have needle-like teeth for gripping, and those that feed on larger prey such as [mammals](/wiki/Mammal) have pointed lower teeth for gripping and triangular upper teeth with [serrated](/wiki/Serration) edges for cutting. The teeth of plankton-feeders such as the basking shark are small and non-functional.[[22]](#cite_note-22)

### Skeleton[[edit](/index.php?title=(none)&action=edit&section=6)]

Shark skeletons are very different from those of [bony fish](/wiki/Osteichthyes) and [terrestrial vertebrates](/wiki/Tetrapod). Sharks and other [cartilaginous fish](/wiki/Chondrichthyes) ([skates](/wiki/Skate_(fish)) and [rays](/wiki/Batoidea)) have skeletons made of [cartilage](/wiki/Cartilage) and [connective tissue](/wiki/Connective_tissue). Cartilage is flexible and durable, yet is about half the normal density of bone. This reduces the skeleton's weight, saving energy.[[23]](#cite_note-23) Because sharks do not have rib cages, they can easily be crushed under their own weight on land.<ref name=langoni>[Template:Cite web](/wiki/Template:Cite_web)</ref>

### Jaw[[edit](/index.php?title=(none)&action=edit&section=7)]

[Jaws](/wiki/Jaw) of sharks, like those of rays and skates, are not attached to the [cranium](/wiki/Cranium). The jaw's surface (in comparison to the shark's vertebrae and gill arches) needs extra support due to its heavy exposure to physical stress and its need for strength. It has a layer of tiny hexagonal plates called "[tesserae](/wiki/Tesserae)", which are crystal blocks of calcium salts arranged as a mosaic.[[24]](#cite_note-24) This gives these areas much of the same strength found in the bony tissue found in other animals.

Generally sharks have only one layer of tesserae, but the jaws of large specimens, such as the bull shark, tiger shark, and the great white shark, have two to three layers or more, depending on body size. The jaws of a large great white shark may have up to five layers.[[23]](#cite_note-23) In the [rostrum](/wiki/Rostrum_(anatomy)) (snout), the cartilage can be spongy and flexible to absorb the power of impacts.

### Fins[[edit](/index.php?title=(none)&action=edit&section=8)]

Fin skeletons are elongated and supported with soft and unsegmented rays named ceratotrichia, filaments of elastic protein resembling the horny keratin in hair and feathers.[[25]](#cite_note-25) Most sharks have eight fins. Sharks can only drift away from objects directly in front of them because their fins do not allow them to move in the tail-first direction.<ref name=langoni/>

### Dermal denticles[[edit](/index.php?title=(none)&action=edit&section=9)]

[Template:Main](/wiki/Template:Main) [thumb|The dermal denticles of a](/wiki/File:Denticules_cutanés_du_requin_citron_Negaprion_brevirostris_vus_au_microscope_électronique_à_balayage.jpg) [lemon shark](/wiki/Lemon_shark), viewed through a [scanning electron microscope](/wiki/Scanning_electron_microscope) |alt=The dermal denticles of a lemon shark

Unlike bony fish, sharks have a complex dermal corset made of flexible collagenous fibers and arranged as a helical network surrounding their body. This works as an outer skeleton, providing attachment for their swimming muscles and thus saving energy.<ref name=Cartilagious>[Template:Cite web](/wiki/Template:Cite_web)</ref> Their dermal teeth give them [hydrodynamic](/wiki/Hydrodynamic) advantages as they reduce turbulence when swimming.[[26]](#cite_note-26)

### Tails[[edit](/index.php?title=(none)&action=edit&section=10)]

[Tails](/wiki/Tail) provide thrust, making speed and acceleration dependent on tail shape. [Caudal fin](/wiki/Caudal_fin) shapes vary considerably between shark species, due to their evolution in separate environments. Sharks possess a [heterocercal](/wiki/Wiktionary:heterocercal) caudal fin in which the [dorsal](/wiki/Dorsum_(biology)) portion is usually noticeably larger than the [ventral](/wiki/Ventral) portion. This is because the shark's [vertebral column](/wiki/Vertebral_column) extends into that dorsal portion, providing a greater surface area for muscle attachment. This allows more efficient [locomotion](/wiki/Animal_locomotion) among these negatively buoyant cartilaginous fish. By contrast, most bony fish possess a [homocercal](/wiki/Wiktionary:homocercal) caudal fin.[[27]](#cite_note-27) Tiger sharks have a large upper [lobe](/wiki/Lobe_(anatomy)), which allows for slow cruising and sudden bursts of speed. The tiger shark must be able to twist and turn in the water easily when hunting to support its varied diet, whereas the [porbeagle shark](/wiki/Porbeagle), which hunts schooling fish such as [mackerel](/wiki/Mackerel) and [herring](/wiki/Herring), has a large lower lobe to help it keep pace with its fast-swimming prey.[[28]](#cite_note-28) Other tail adaptations help sharks catch prey more directly, such as the thresher shark's usage of its powerful, elongated upper lobe to stun fish and squid.

## Physiology[[edit](/index.php?title=(none)&action=edit&section=11)]

### Buoyancy[[edit](/index.php?title=(none)&action=edit&section=12)]

Unlike bony fish, sharks do not have gas-filled swim bladders for buoyancy. Instead, sharks rely on a large liver filled with oil that contains [squalene](/wiki/Squalene), and their cartilage, which is about half the normal density of bone.<ref name=Cartilagious/> Their liver constitutes up to 30% of their total body mass.[[29]](#cite_note-29) The liver's effectiveness is limited, so sharks employ [dynamic lift](/wiki/Dynamic_lift_(fish)) to maintain depth while swimming. [Sand tiger sharks](/wiki/Sand_tiger_shark) store air in their stomachs, using it as a form of swim bladder. Bottom-dwelling sharks, like the [nurse shark](/wiki/Nurse_shark), have negative buoyancy, allowing them to rest on the ocean floor.

Some sharks, if inverted or stroked on the nose, enter a natural state of [tonic immobility](/wiki/Tonic_immobility). Researchers use this condition to handle sharks safely.<ref name=ParttGruberTaniuchi>[Template:Cite book](/wiki/Template:Cite_book)</ref>

### Respiration[[edit](/index.php?title=(none)&action=edit&section=13)]

Like other fish, sharks extract oxygen from seawater as it passes over their [gills](/wiki/Gill). Unlike other fish, shark gill slits are not covered, but lie in a row behind the head. A modified slit called a [spiracle](/wiki/Spiracle) lies just behind the eye, which assists the shark with taking in water during [respiration](/wiki/Aquatic_respiration) and plays a major role in bottom–dwelling sharks. Spiracles are reduced or missing in active [pelagic](/wiki/Pelagic) sharks.[[22]](#cite_note-22) While the shark is moving, water passes through the mouth and over the gills in a process known as "ram ventilation". While at rest, most sharks pump water over their gills to ensure a constant supply of oxygenated water. A small number of species have lost the ability to pump water through their gills and must swim without rest. These species are *obligate ram ventilators* and would presumably [asphyxiate](/wiki/Asphyxiate) if unable to move. Obligate ram ventilation is also true of some pelagic bony fish species.[[30]](#cite_note-30)[[31]](#cite_note-31) The respiration and [circulation](/wiki/Circulatory_system) process begins when deoxygenated [blood](/wiki/Blood) travels to the shark's two-chambered [heart](/wiki/Heart). Here the shark pumps blood to its gills via the ventral [aorta](/wiki/Aorta) [artery](/wiki/Artery) where it branches into [afferent](/wiki/Wikt:afferent#Adjective) [brachial](/wiki/Arm) arteries. Reoxygenation takes place in the gills and the reoxygenated blood flows into the [efferent](/wiki/Wikt:efferent#Adjective) brachial arteries, which come together to form the [dorsal aorta](/wiki/Dorsal_aorta). The blood flows from the dorsal aorta throughout the body. The deoxygenated blood from the body then flows through the [posterior cardinal veins](/wiki/Posterior_cardinal_vein) and enters the posterior cardinal [sinuses](/wiki/Anal_sinuses). From there blood enters the heart [ventricle](/wiki/Ventricle_(heart)) and the cycle repeats.[[32]](#cite_note-32)

### Thermoregulation[[edit](/index.php?title=(none)&action=edit&section=14)]

Most sharks are "cold-blooded" or, more precisely, [poikilothermic](/wiki/Poikilotherm), meaning that their internal [body temperature](/wiki/Thermoregulation) matches that of their ambient environment. Members of the family [Lamnidae](/wiki/Lamnidae) (such as the [shortfin mako shark](/wiki/Shortfin_mako_shark) and the [great white shark](/wiki/Great_white_shark)) are [homeothermic](/wiki/Homeothermy) and maintain a higher body temperature than the surrounding water. In these sharks, a strip of [aerobic](/wiki/Aerobic_metabolism) red muscle located near the center of the body generates the heat, which the body retains via a [countercurrent exchange](/wiki/Countercurrent_exchange) mechanism by a system of [blood vessels](/wiki/Blood_vessel) called the [rete mirabile](/wiki/Rete_mirabile) ("miraculous net"). The [common thresher shark](/wiki/Common_thresher) has a similar mechanism for maintaining an elevated body temperature, which is thought to have evolved independently[Template:Failed verification](/wiki/Template:Failed_verification).[[33]](#cite_note-33)

### Osmoregulation[[edit](/index.php?title=(none)&action=edit&section=15)]

In contrast to bony fish, with the exception of the [coelacanth](/wiki/Coelacanth),[[34]](#cite_note-34) the blood and other tissue of sharks and [Chondrichthyes](/wiki/Chondrichthyes) is generally [isotonic](/wiki/Isotonicity) to their marine environments because of the high concentration of [urea](/wiki/Urea) (up to 2.5%[[35]](#cite_note-35)<ref name=soh>[Template:Cite book](/wiki/Template:Cite_book)</ref> In Fijian mytholog, [Dakuwaqa](/wiki/Dakuwaqa) was a shark god who was the eater of lost souls.

### In popular culture[[edit](/index.php?title=(none)&action=edit&section=42)]

[Template:Main](/wiki/Template:Main) In contrast to the complex portrayals by Hawaiians and other Pacific Islanders, the European and Western view of sharks has historically been mostly of fear and malevolence.<ref name=Dean>[Template:Cite book](/wiki/Template:Cite_book)</ref> Sharks are used in popular culture commonly as eating machines, notably in the [*Jaws*](/wiki/Jaws_(novel)) novel and the [film of the same name](/wiki/Jaws_(film)), along with its [sequels](/wiki/Jaws_(franchise)#Films).[[84]](#cite_note-84) Sharks are threats in other films such as [*Deep Blue Sea*](/wiki/Deep_Blue_Sea_(1999_film)), [*The Reef*](/wiki/The_Reef_(2010_film)), and [others](/wiki/List_of_killer_shark_films), although they are sometimes used for comedic effect such as in [*Finding Nemo*](/wiki/Finding_Nemo) and the [*Austin Powers*](/wiki/Austin_Powers_(film_series)) series. These comedic effects can sometimes be unintentional, as seen in [*Batman: The Movie*](/wiki/Batman_(1966_film)) and various [Syfy](/wiki/Syfy) channel films like [*Dinoshark*](/wiki/Dinoshark) and [*Sharktopus*](/wiki/Sharktopus).

Sharks tend to be seen quite often in cartoons whenever a scene involves the ocean. Such examples include the [*Tom and Jerry*](/wiki/Tom_and_Jerry) cartoons, [*Jabberjaw*](/wiki/Jabberjaw), and other shows produced by Hanna-Barbera. They also are used commonly as a clichéd means of killing off a character that is held up by a rope or some similar object as the sharks swim right below them, or the character may be standing on a [plank](/wiki/Walking_the_plank) above shark infested waters.

### Popular misconceptions[[edit](/index.php?title=(none)&action=edit&section=43)]

A popular myth is that sharks are immune to disease and [cancer](/wiki/Cancer), but this is not scientifically supported. Sharks have been known to get cancer.[[85]](#cite_note-85)[[86]](#cite_note-86) Both diseases and [parasites](/wiki/Parasites) affect sharks. The evidence that sharks are at least resistant to cancer and disease is mostly [anecdotal](/wiki/Anecdotal) and there have been few, if any, scientific or [statistical](/wiki/Statistical) studies that show sharks to have heightened immunity to disease.[[87]](#cite_note-87)Other apparently false claims are that fins prevent [cancer](/wiki/Cancer)[[88]](#cite_note-88) and treat [osteoarthritis](/wiki/Osteoarthritis).[[89]](#cite_note-89) No scientific proof supports these claims; at least one study has shown shark cartilage of no value in cancer treatment.[[90]](#cite_note-90)

## Conservation[[edit](/index.php?title=(none)&action=edit&section=44)]

[Template:Further](/wiki/Template:Further)

[thumb |The value of shark fins for](/wiki/File:Sharksfin.jpg) [shark fin soup](/wiki/Shark_fin_soup) has led to an increase in shark catches. Usually only the fins are taken, while the rest of the shark is discarded, usually into the sea.|alt=Photo of shark fin soup in bowl with Chinese spoon [250px|thumb|The annual shark catch has increased rapidly over the last 60 years.|alt=Graph of shark catch from 1950, linear growth from less than 200,000 tons per year in 1950 to about 500,000 in 2011](/wiki/File:Global_shark_catch.svg) [upright|thumb|A](/wiki/File:Tiger_shark,_Hawaii_Aii.jpg) [Template:Convert](/wiki/Template:Convert), [Template:Convert](/wiki/Template:Convert) [tiger shark](/wiki/Tiger_shark) caught in [Kāne'ohe Bay](/wiki/Kāne'ohe_Bay), [Oahu](/wiki/Oahu) in 1966|alt=Photo of suspended tiger shark next to four men.

### Fishery[[edit](/index.php?title=(none)&action=edit&section=45)]

It is estimated that 100 million sharks are killed by people every year, due to commercial and recreational fishing.[[91]](#cite_note-91)[[92]](#cite_note-92) Shark finning yields are estimated at 1.44 million metric tons for 2000, and 1.41 million tons for 2010. Based on an analysis of average shark weights, this translates into a total annual mortality estimate of about 100 million sharks in 2000, and about 97 million sharks in 2010, with a total range of possible values between 63 and 273 million sharks per year.[[93]](#cite_note-93)<ref name=eLife2014>[Template:Cite web](/wiki/Template:Cite_web)</ref> Sharks are a common seafood in many places, including [Japan](/wiki/Japan) and [Australia](/wiki/Australia). In the Australian state of [Victoria](/wiki/Victoria_(Australia)), shark is the most commonly used fish in [fish and chips](/wiki/Fish_and_chips), [Template:Citation needed](/wiki/Template:Citation_needed) in which fillets are battered and [deep-fried](/wiki/Deep_frying) or crumbed and grilled. In fish and chip shops, shark is called [flake](/wiki/Flake_(fish)). In [India](/wiki/India), small sharks or baby sharks (called sora in [Tamil language](/wiki/Tamil_language), [Telugu language](/wiki/Telugu_language)) are sold in local markets. Since the flesh is not developed, cooking the flesh breaks it into powder, which is then fried in oil and spices (called sora puttu/sora poratu). The soft bones can be easily chewed. They are considered a delicacy in coastal [Tamil Nadu](/wiki/Tamil_Nadu). [Icelanders](/wiki/Iceland) ferment [Greenland sharks](/wiki/Greenland_shark) to produce [hákarl](/wiki/Hákarl), which is widely regarded as a [national dish](/wiki/National_dish).[Template:Citation needed](/wiki/Template:Citation_needed) During a four-year period from 1996 to 2000, an estimated 26 to 73 million sharks were killed and traded annually in commercial markets.<ref name=Bakalar\_10\_12\_2006>[Template:Cite web](/wiki/Template:Cite_web)</ref>

Sharks are often killed for [shark fin soup](/wiki/Shark_fin_soup). Fishermen capture live sharks, fin them, and dump the finless animal back into the water. [Shark finning](/wiki/Shark_finning) involves removing the fin with a hot metal blade.[[92]](#cite_note-92) The resulting immobile shark soon dies from suffocation or predators.[[94]](#cite_note-94) Shark fin has become a major trade within black markets all over the world. Fins sell for about $300/lb in 2009.[[95]](#cite_note-95) Poachers illegally fin millions each year. Few governments enforce laws that protect them.[Template:R](/wiki/Template:R) In 2010 Hawaii became the first U.S. state to prohibit the possession, sale, trade or distribution of shark fins.[[96]](#cite_note-96) From 1996 to 2000, an estimated 38 million sharks had been killed per year for harvesting shark fins.<ref name=Bakalar\_10\_12\_2006/>

Shark fin soup is a [status symbol](/wiki/Status_symbol) in Asian countries, and is considered healthy and full of nutrients. Sharks are also killed for [meat](/wiki/Shark_meat). European diners consume [dogfishes](/wiki/Squalidae), [smoothhounds](/wiki/Smoothhound), [catsharks](/wiki/Catshark), makos, porbeagle and also skates and rays.[[97]](#cite_note-97) However, the [U.S.](/wiki/United_States) [FDA](/wiki/Food_and_Drug_Administration) lists sharks as one of four fish (with [swordfish](/wiki/Swordfish), [king mackerel](/wiki/King_mackerel), and [tilefish](/wiki/Tilefish)) whose high [mercury content](/wiki/Mercury_in_fish) is hazardous to children and pregnant women.

Sharks generally reach [sexual maturity](/wiki/Sexual_maturity) only after many years and produce few offspring in comparison to other harvested fish. Harvesting sharks before they reproduce severely impacts future populations.

The majority of shark fisheries have little monitoring or management. The rise in demand for shark products increases pressure on fisheries.<ref name=ParttGruberTaniuchi/> Major declines in shark stocks have been recorded—some species have been depleted by over 90% over the past 20–30 years with population declines of 70% not unusual.[[98]](#cite_note-98) A study by the [International Union for Conservation of Nature](/wiki/International_Union_for_Conservation_of_Nature) suggests that one quarter of all known species of sharks and rays are threatened by extinction and 25 species were classified as critically endangered.<ref name=xray>[Template:Cite web](/wiki/Template:Cite_web)</ref><ref name=Bloomberg>[Template:Cite news](/wiki/Template:Cite_news)</ref>

### Other threats[[edit](/index.php?title=(none)&action=edit&section=46)]

Other threats include habitat alteration, damage and loss from coastal development, pollution and the impact of fisheries on the seabed and prey species.[[99]](#cite_note-99) The 2007 documentary, [*Sharkwater*](/wiki/Sharkwater) exposed how sharks are being hunted to extinction.[[100]](#cite_note-100)

### Protection[[edit](/index.php?title=(none)&action=edit&section=47)]

In 1991, South Africa was the first country in the world to declare Great White sharks a legally protected species.[[101]](#cite_note-101) Intending to ban the practice of shark finning while at sea, the United States Congress passed the [Shark Finning Prohibition Act](/wiki/Shark_Finning_Prohibition_Act) in 2000.[[102]](#cite_note-102) Two years later the Act saw its first legal challenge in [*United States v. Approximately 64,695 Pounds of Shark Fins*](/wiki/United_States_v._Approximately_64,695_Pounds_of_Shark_Fins). In 2008 a [Federal Appeals Court](/wiki/Federal_Appeals_Court) ruled that a [loophole](/wiki/Loophole) in the law allowed non-fishing vessels to *purchase* shark fins from [fishing vessels](/wiki/Fishing_vessels) while on the high seas.[[103]](#cite_note-103) Seeking to close the loophole, the [Shark Conservation Act](/wiki/Shark_Conservation_Act) was passed by Congress in December 2010, and it was signed into law in January 2011.[[104]](#cite_note-104)[[105]](#cite_note-105) In 2003, the European Union introduced a general shark finning ban for all vessels of all nationalities in Union waters and for all vessels flying a flag of one of its member states.[[106]](#cite_note-106) This prohibition was amended in June 2013 to close remaining loopholes.[[107]](#cite_note-107) In 2009, the [International Union for Conservation of Nature](/wiki/International_Union_for_Conservation_of_Nature) [*IUCN Red List*](/wiki/IUCN_Red_List) *of Endangered Species* named 64 species, one-third of all oceanic shark species, as being at risk of extinction due to fishing and shark finning.[[108]](#cite_note-108)[[109]](#cite_note-109) In 2010, the Convention on International Trade in Endangered Species ([CITES](/wiki/CITES)) rejected proposals from the [United States](/wiki/United_States) and [Palau](/wiki/Palau) that would have required countries to strictly regulate trade in several species of [scalloped hammerhead](/wiki/Scalloped_hammerhead), [oceanic whitetip](/wiki/Oceanic_whitetip_shark) and [spiny dogfish sharks](/wiki/Spiny_dogfish_shark). The majority, but not the required two-thirds of voting delegates, approved the proposal. [China](/wiki/China), by far the world's largest shark market, and [Japan](/wiki/Japan), which battles all attempts to extend the convention to marine species, led the opposition.<ref name=cites>[Template:Cite news](/wiki/Template:Cite_news)</ref>[[110]](#cite_note-110) In March 2013, three endangered commercially valuable sharks, the [hammerheads](/wiki/Hammerhead_shark), the [oceanic whitetip](/wiki/Oceanic_whitetip) and [porbeagle](/wiki/Porbeagle) were added to Appendix 2 of [CITES](/wiki/CITES), bringing shark fishing and commerce of these species under licensing and regulation.[[111]](#cite_note-111) In 2010, Greenpeace International added the [school shark](/wiki/School_shark), [shortfin mako shark](/wiki/Shortfin_mako_shark), [mackerel shark](/wiki/Mackerel_shark), [tiger shark](/wiki/Tiger_shark) and [spiny dogfish](/wiki/Spiny_dogfish) to its seafood red list, a list of common [supermarket](/wiki/Supermarket) fish that are often sourced from unsustainable fisheries.[[112]](#cite_note-112) Advocacy group [Shark Trust](/wiki/Shark_Trust) campaigns to limit shark fishing. Advocacy group [Seafood Watch](/wiki/Seafood_Watch) directs American consumers to not eat sharks.[[113]](#cite_note-113) Under the auspices of the [Convention on the Conservation of Migratory Species of Wild Animals](/wiki/Convention_on_the_Conservation_of_Migratory_Species_of_Wild_Animals) (CMS), also known as the Bonn Convention, the [Memorandum of Understanding on the Conservation of Migratory Sharks](/wiki/Memorandum_of_Understanding_on_the_Conservation_of_Migratory_Sharks) was concluded and came into effect in March 2010. It was the first global instrument concluded under CMS and aims at facilitating international coordination for the protection, conservation and management of migratory sharks, through multilateral, intergovernmental discussion and scientific research.

In July 2013, New York state, a major market and entry point for shark fins, banned the shark fin trade joining seven other states of the United States and the three Pacific U.S territories in providing legal protection to sharks.[[114]](#cite_note-114)

## See also[[edit](/index.php?title=(none)&action=edit&section=48)]

[Template:Portal](/wiki/Template:Portal) [Template:Colbegin](/wiki/Template:Colbegin)

* [List of sharks](/wiki/List_of_sharks)
* [List of prehistoric cartilaginous fish genera](/wiki/List_of_prehistoric_cartilaginous_fish_genera)
* [Osteichthyes](/wiki/Osteichthyes)
* [Marine vertebrate](/wiki/Marine_vertebrate)
* [Outline of sharks](/wiki/Outline_of_sharks)
* [Shark meat](/wiki/Shark_meat)
* [Shark Week](/wiki/Shark_Week)

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## References[[edit](/index.php?title=(none)&action=edit&section=49)]

[Template:Reflist](/wiki/Template:Reflist)

General references

[Template:Refbegin](/wiki/Template:Refbegin)

* [Template:Cite book](/wiki/Template:Cite_book)
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* Moss, Jillian. 2010. "The Invention of Sharks, AKA: I Read It On the Internet". University of North Carolina Publishing, Raleigh, USA. (Publishing Pending)

[Template:Refend](/wiki/Template:Refend)

## Further reading[[edit](/index.php?title=(none)&action=edit&section=50)]

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* [Sharks Falling Prey To Humans' Appetites](http://news.nationalgeographic.com/news/2002/06/0603_020603_shark1_2.html) *National Geographic*, 28 October 2010.

## External links[[edit](/index.php?title=(none)&action=edit&section=51)]

[Template:Sister project links](/wiki/Template:Sister_project_links) [Template:Wikispecies](/wiki/Template:Wikispecies) [Template:Wikibooks](/wiki/Template:Wikibooks)

* [CMS Migratory Sharks Memorandum of Understanding](http://www.cms.int/species/sharks/sharks_bkrd.htm)
* [WikiAnswers: questions and answers about Sharks](http://wiki.answers.com/Q/FAQ/2999)
* [Oceana's International Shark Campaign](http://na.oceana.org/en/our-work/protect-marine-wildlife/sharks/overview)
* [Shark Research Institute](http://www.sharks.org/)
* [Greenland Shark and Elasmobranch Education and Research Group](http://www.geerg.ca/)
* [The International Shark Attack File](http://www.flmnh.ufl.edu/fish/Sharks/ISAF/ISAF.htm)
* [Shark Trust Organization](http://www.sharktrust.org/)
* [ReefQuest Centre for Shark Research](http://www.elasmo-research.org/)
* [ECOCEAN Whale Shark Photo-identification Library](http://www.whaleshark.org/)
* [Updated list of all known shark species](http://www.elasmo-research.org/research/checklist_res.htm)
* [Global Shark Attack File](http://www.sharkattackfile.net/)
* [Shark Research Committee](http://www.sharkresearchcommittee.com/)
* [Shark Pictures and Elasmobranch Field Guide](http://www.elasmodiver.com/)
* [Shark pictures on Morphbank](http://www.morphbank.net/Browse/ByImage/?tsn=551500)
* [Shark pictures by Wolfgang Leander](http://www.oceanicdreams.com/)
* [Scuba divers swim among the sharks](http://www.fayobserver.com/news/local/scuba-divers-swim-among-the-sharks/article_94b20704-cd3c-5872-abe0-07949320dd84.html), Fayetteville Observer
* [Sand Tigers Video](https://www.youtube.com/watch?v=9pQYcJKO-9g)
* [Shark Diversity](http://ocean.si.edu/ocean-photos/shark-diversity/) by The Smithsonian Institution: Ocean Portal
* [Sharks.org.za](http://www.sharks.org.za/) A detailed study
* [BBC Nature:](http://www.bbc.co.uk/nature/life/Shark) Shark news & video clips from BBC programmes past & present
* [South African Marine Predator Lab](http://www.sampla.org/) a research institute studying marine top predators
* [Comparison of shark size to a human](http://www.nationalgeographic.com/magazine/2016/06/shark-species-family-tree-ocean-ecosystem-predator) [National Geographic](/wiki/National_Geographic_Society)

[Template:Shark nav](/wiki/Template:Shark_nav) [Template:Selachimorpha](/wiki/Template:Selachimorpha) [Template:Diversity of fish](/wiki/Template:Diversity_of_fish)

[Template:Good article](/wiki/Template:Good_article)

[Template:Authority control](/wiki/Template:Authority_control)

[Category:Sharks](/wiki/Category:Sharks) [Category:Commercial fish](/wiki/Category:Commercial_fish) [Category:Elasmobranchii](/wiki/Category:Elasmobranchii) [Category:Electroreceptive animals](/wiki/Category:Electroreceptive_animals) [Category:Ichthyology](/wiki/Category:Ichthyology) [Category:Predators](/wiki/Category:Predators) [Category:Extant Silurian first appearances](/wiki/Category:Extant_Silurian_first_appearances)