

SHARK RESEARCH INSTITUTE NEWSLETTER

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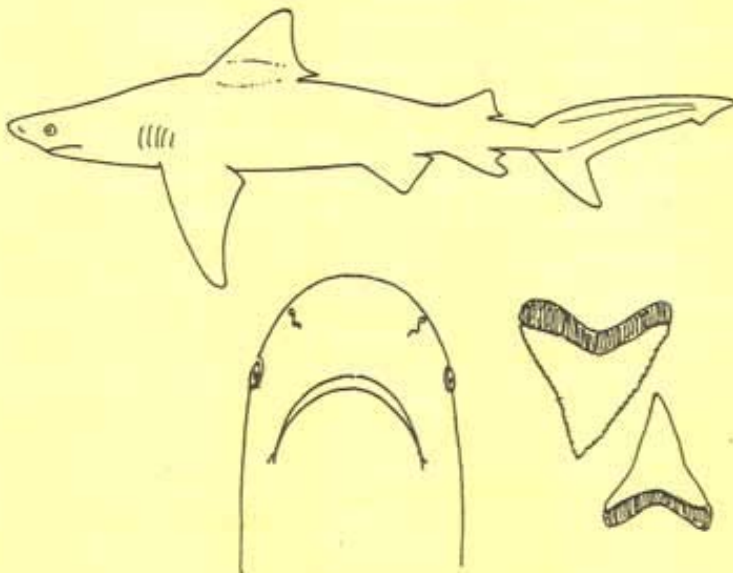


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BULL SHARK - *Carcharhinus leucas*

DISTRIBUTION AND HABITAT

An inhabitant of tropical and subtropical shallow coastal waters worldwide, the range of this shark often brings it into close proximity with humans. In North American waters it ranges from New York to Florida and the Gulf of Mexico, and from southern California to the Gulf of California. It has been found hundreds of miles upstream in large rivers; the shark has been reported in the Mississippi and Atchafalya rivers in the southern United States, the Tigris River in Iraq, and the Hoogley in India. The shark has also been found 340 miles up the Zambesi River, and 2,294 miles up the Amazon River to Peru. On August 12, 1985, a bull shark weighing about 475 lbs was caught in Chesapeake Bay, and there are populations of the sharks thriving in fresh water lakes. Known as the bull shark in the United States, it is the Lake Nicaragua shark and the Zambesi shark of African waters.



GENERAL DESCRIPTION AND FIELD MARKS

The bull shark moves like a seasoned warrior. It is a large stocky shark with a bluntly rounded snout, and its heavy jaws hold an array of large triangular serrated teeth. It is often accompanied by longnose blackfin and blacktip sharks and it frequently is host to one or more remoras.

Its body is predominantly gray with a pale to white underside and there is no distinct ridge between the dorsal fins. Juveniles have black fin tips, but these fade with age. Sometimes their backs appear grazed, but these are actually bald patches caused by fluke infections that result in loss of dermal denticles from the skin.

Compared with other similar-sized species of sharks, the eyes of the shark are small; it is thought that sight may not be as important as other senses in locating prey. Indeed, in muddied waters near river mouths they may habitually rely on other senses.

The shark is sometimes confused with the pigeye or Java shark *Carcharhinus amboinensis*, and the rare Ganges shark *Glyphis gangeticus*, however, the relative heights of the Java shark's dorsal fins differ from *C. leucas*, and the snout of the Ganges shark is longer, its eyes are smaller, and its teeth are slightly different.

SIZE/LIFE SPAN

Males mature at a length of 157 to 226 centimeters, females reach sexual maturity between 180 and 230 centimeters. The shark may reach a length of 340 centimeters and some specimens have survived 15 years in captivity. Tagging studies have yielded

considerable information about some species of sharks, but unfortunately they haven't told us much about this species; from 1963 to 1986 the National Marine Fisheries Service Cooperative Shark Tagging Program tagged 283 bull sharks, but only three were recaptured.

REPRODUCTION

Reproduction is by placental viviparous development. Litters average 10 to 12 pups, and pups are 50 to 81 centimeters in length at birth. The pups are born after a gestation period lasting nearly a year. They begin life at river mouths and in estuaries.

TEETH AND DIET

A bull shark feeds primarily on bony fishes and elasmobranchs, but it is an opportunistic feeder and will eat smaller sharks, skates, turtles, birds, mammals, crustaceans and offal.

Teeth in the upper jaw are triangular and strongly serrated, those of the lower jaw, however, are slender, pointed and edged with fine serrations.

BITE PATTERN

Teeth in the upper jaw produce a clean-cut slice. Those of the lower jaw are also serrated and may be utilized to sever flesh. Often, however, the shark uses the narrower teeth of its lower jaw to impale its prey, then it swings its head side-to-side using the heavy triangular teeth of the upper jaw to carve a mouthful of tissue from its prey.

Most of the shark attacks along the Natal coast in the early 1960s were attributed to *C. leucas* by Dr. David Davies. On December 24, 1960, a young black male, Petrus Sithole, was fatally attacked by a shark off Margate. 'Sithole's wounds were characterized by the clean-cut nature of the skin edges and muscle tissues and the characteristics of the wounds of nearly all the victims examined since 1960 have been similar,' wrote Dr. Davies (1964). The tooth fragments recovered from Sithole's body, however, were those of a great white shark.

This is not to say that bull sharks are not

responsible for many attacks on man.

Tooth fragments of *C. leucas* were recovered from the leg of a young surfer (CASE 363) who was severely bitten by a shark at Mtunzini, Zululand, in February 1988. Between 1976 and 1987 there were 35 to 36 fatal shark attacks at Mogadishu, the capital of Somalia. Attacks began shortly after the construction of a camel slaughterhouse that dumps offal directly into the sea. 1.3 miles of gill-nets were installed off Lido Beach, Mogadishu, in November 1986, but on March 15, 1987, a 14-year-old boy, standing in waist-deep water at Lido Beach, was bitten in half by a shark. Virtually all of the attacks at Mogadishu have been blamed on *C. leucas*, most just over 6'8" in length. Tim Condon, Publisher of Underwater magazine reports two attacks by *C. leucas* in Kilindini Harbour, Mombasa, in October 1990. In the first attack two Kenyan Navy divers were fatally injured. Later two scuba divers, instructor Conway Plough and Dr. Jonathan Higgs, were on a training dive 90' from shore in front of the Mombasa Yacht Club when they were attacked. The shark mauled Plough's thigh and severed Higgs' leg at the ankle. Both men survived.

FIELD OBSERVATIONS

Bull sharks have been found inshore in water less than 3' deep, and have been caught at depths of 450' and more. Divers report that the sharks are rarely seen in midwater or at the surface; most are observed cruising over the top of the reef. In one of the cases on file (Case 312) the rapid ascent of a diver may have 'released' an aggressive response (similar to when an intruder flees from a guard dog). In that particular instance, after a single bite on the diver's leg (no tissue was removed by the shark), the shark sped back to the reef.



YOUR HELP IS NEEDED

A primary goal of SRI is to increase understanding of shark behavior. Attacks are rare, but they are an aspect of shark behavior that impacts on humans. SRI maintains a large data base of shark attacks and investigates incidents throughout the world. If any members have witnessed a shark attack or know a shark attack victim, please contact SRI for data collection forms. If you spot an article about an attack, please clip it out and send it to us along with the date and name of the newspaper or magazine in which it appeared.

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SRI SHARK ATTACK FILES: CASE 312

On Wednesday March 30, 1983, 17-year-old Warren Johnson was spearfishing on Scottburgh Shoal located 1.2 miles off the town of Scottburgh, Natal, South Africa. The sky was overcast, a light rain was falling and there was a light south-westerly breeze. Air temperature was 75oF, sea temperature was 76oF. The water was clear, visibility was 65', and there was a south-to-north current.

The 5'9", 165-lb diver was wearing a black wetsuit, carried a blue speargun and towed a red float, and had no injuries before entering the water. He and two companions, Dawie de Buisson and John Girzda, were using a 13' blue-hulled ski boat with a single outboard motor. De Buisson and Girzda shot 15 fish between them and Johnson shot six fish, all of which were placed in the boat. However, in the 30 minutes preceding the attack, the divers had wounded, but not killed, a number of other fish in the area of the attack.

ATTACK: The three spearfishermen had been diving on the shoal for two hours; they spent 90 minutes in one location and then, 30 minutes before the attack, moved to another sector of the reef. At 11h15 Johnson was 25' from the boat in 65' of water when he shot a bank steenbras *Chirodactylus grandis*. He abandoned his gun and started to ascend, but 30' below the surface a shark grabbed his left calf. The shark approached from behind and to his right (i.e. from a southe-easterly direction. After shaking the diver for a second or two, the shark swam rapidly down

towards the reef. Johnson surfaced and was helped into the boat.

INJURY: The skin and superficial muscles of the diver's right calf were severely lacerated, but no tissue was removed. The width of the bite was 20 centimeters.

FIRST AID/TREATMENT: A tourniquet, applied to Johnson's right leg while he was onboard the boat, stopped blood loss. When the boat beached at Scottburgh the diver was treated by life-savers for an additional 30 minutes. Afterwards he was taken to Scottburgh Hospital and remained there 90 minutes. Then, he was airlifted - with a doctor in attendance - by a SAAF helicopter to Addington Hospital in Durban. The diver remained in the hospital for 36 days.

SPECIES RESPONSIBLE: The divers identified the attacker as a large Zambesi shark *C. leucas*. Girzda reported that immediately after Johnson speared his fish the shark approached him aggressively. He pushed the shark away with his gun and the shark swam away rapidly. Ten seconds later he heard the Johnson scream underwater.

COMMENT: It appears that the attack was directed at the diver, not his catch. A large hungry Zambesi shark could have easily bitten out Johnson's entire calf muscle, however, the attacker removed no flesh from the diver - which suggests that the attack was motivated by a reason other than hunger.

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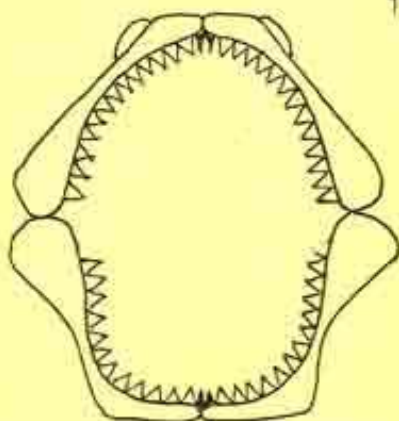
TOOTH FORMULA

The tooth formula is one of the taxonomic tools used to identify a species of shark. It tells us the number of teeth in each half of the upper and lower jaws of a shark. Although there may be some variation among individuals, the majority of sharks in a particular species will have the same tooth formula.

The upper and lower jaws of a shark are divided into two halves. The upper jaw of the bull shark has 13 teeth on the left side, 13 on the right side. The lower jaw has 12 teeth on

the left side, 12 on the right side. In addition there are two small teeth in the center of each jaw.

The tooth formula of this jaw is: 13-2-13
12-2-12



BULL SHARK VIDEO

This video, shot at the edge of the drop-off at Tongue of the Ocean near New Providence Island (Nassau), Bahamas, takes you within touching distance of feeding bull sharks.

Most attacks by bull sharks have occurred at the surface, however, at depths below fifty feet the sharks are usually less aggressive. Sequences by two cinematographers, Maurice Coutts and Bill Morgan, protected by safety divers, record feeding behavior of several pregnant 7.5-ft bull sharks. Blacktip reef sharks are also fed at close quarters. The video, edited by NJ TV Network, is the culmination of many hours of work with these two species, and is quite exciting. For more information contact M. Coutts (609) 799-9087.

"It is the best footage of bull sharks that I've ever seen."

Dr. Eugenie Clark.

CONSERVATION NEWS

GREAT WHITE SHARK

South Africa has become the first nation in the world to officially recognize the vital role of the great white shark *Carcharodon carcharias* in the marine ecosystem. In April 1991 Minister of the Environment Louis Pienaar announced that the great white shark is now a protected species; no

great white shark may be hunted within 200 miles of the South African coast, and trade in teeth, jaws, fins and other products of the species is prohibited.

MEMBER'S BOOKSHELF

GREAT WHITE SHARK by Richard Ellis and John E. McCosker. HarperCollins Publishers, 10 E. 53rd St. New York, NY, 270 p. \$50.00

The first definitive account about the great white shark, this book is a visually stunning and scientifically accurate tour de force. It contains data on size, distribution, ancestry, biology, breeding habits, feeding patterns of the species, and a careful analysis of attacks attributed to them. Beautifully illustrated with 28 original paintings by coauthor Ellis, the book contains many original photographs by Al Giddings. It is recommended to everyone (scientist and layman alike) who is fascinated by this species.

DISCOVERING SHARKS, edited by Samuel H. Gruber. American Littoral Society, Sandy Hook, Highlands, New Jersey 07732, 122p. \$10.00

This small book contains a superb collection of 28 articles written by shark biologists. Topics include shark biology, behavior and conservation. It is paperback and we've referred to it so often that our first copy looked ratty within a month; we suggest that you buy two.

REPRODUCTION IN SHARKS

On page 1 we mentioned that a bull shark has placental viviparous development and that term may cause some confusion; years ago textbooks referred to oviparous, ovoviviparous and viviparous reproduction in sharks.

One of the secrets of the sharks' evolutionary success – the reason why they have endured for millions of years despite a low birth rate – is that each newborn

shark has a good chance of survival. Most bony fishes shed vast numbers of eggs into the sea but both eggs and fry, highly vulnerable to predation and the environment, suffer heavy mortalities. Sharks on the other hand, are protected during the early stages of development; for most, birth is delayed until the pups are relatively large, fully developed predators.

In oviparous development (the most primitive reproductive strategy) the shark lays a fertilized egg. The egg capsule, or mermaid's purse as it is often called, has long tendrils by which it becomes attached to gorgonians, corals or rocks. Only the capsule of the horn shark differs; it has distinctive spiral flanges that allow it to be buried in the soft seabed or secured in rocky crevices. When the embryo matures it emerges as a free-swimming shark. Pups of species which use this form of development are small at birth and, because this mode of reproduction requires a substrate, it is primarily used by bottom-dwelling or shallow water species.

Viviparous development indicates live birth, and live birth offers pelagic sharks the greatest chance of survival; the newborn shark is comparatively large, and fully equipped to survive in the open sea. Sharks use two basic types of viviparous development: placental and aplacental.

Aplacental viviparous development (sometimes referred to as ovoviviparous development) is a combination of egg and live birth, and it is the most common reproductive strategy used by sharks. Embryos are nourished from yolk sacs attached to their digestive system and from fluids secreted by the oviducts, but at no time during pregnancy is the embryo attached to the uterine wall.

Placental viviparous development is the most complex of the reproductive strategies. The embryo remains inside the uterus throughout the pregnancy. Initially the embryo receives nourishment from its yolk sac via a yolk stalk. Near mid-term, when the supplies of the yolk sac are depleted, the sac fuses to the uterine wall and converts into a yolk sac placenta through which nutrients are received directly from the mother, and delivered to the embryo

via an umbilical cord (the former yolk stalk) until birth.

Q & A

QUESTION: Are the eyes of all sharks black, and do their pupils dilate?

ANSWER: Sharks have green eyes, golden eyes, others see their world through silvery gray eyes and a few have bold black eyes: the color varies with the species. Some sharks have round pupils, others have slits and the most highly evolved sharks have pupils which dilate. In some requiem sharks the sequence of pupillary dilation and constriction occurs much faster than it does in humans.

QUESTION: Do sharks have movable eyelids?

ANSWER: Although the upper and lower eyelids are immovable, a shark's eye can be rotated for protection when feeding. Some species possess a third eyelid called a nictitating membrane, a movable shield which completely covers the eye as the shark feeds. This anatomical feature isn't restricted to sharks; the Egyptian mongoose also has a nictitating membrane, presumably to protect it from the venom of a spitting cobra.

QUESTION: How did the great white shark get its name?

ANSWER: Although the dorsal surface of a great white shark may vary among individuals (dark blue, deep brown, gray green, steel gray or even black), its belly is always snow white. The shark may attain a 'great' size (compared to most other species of sharks with the exception of the plankton-eating giants). It may weigh as much as 4,800 lbs, and has larger teeth than any other living species of shark. The shark was so named (to the best of our knowledge) by whalers. In Australia the shark is known as a white pointer because of its long conical snout).

Shark Research Institute

• Learn more about the biology, distribution and global movements of sharks.

• Support the Institute's projects to study sharks and assist in the development of marine sanctuaries for sharks.

• Take part in shark tagging and research studies with the Institute.

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Shark Research Institute
PO Box 40
Princeton NJ 08540

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