

Shonisaurus

Shonisaurus popularis [extinct]
Ichthyosauria • Reptilia • Chordata

Shonisaurus (shone-ee-SOR-uss) was the largest of the ichthyosaurs, marine reptiles that typically had fishlike tails and tall dorsal fins. *Shonisaurus* measured at least 50 feet in length, including a 10-foot-long skull, and may have weighed up to 80,000 pounds.

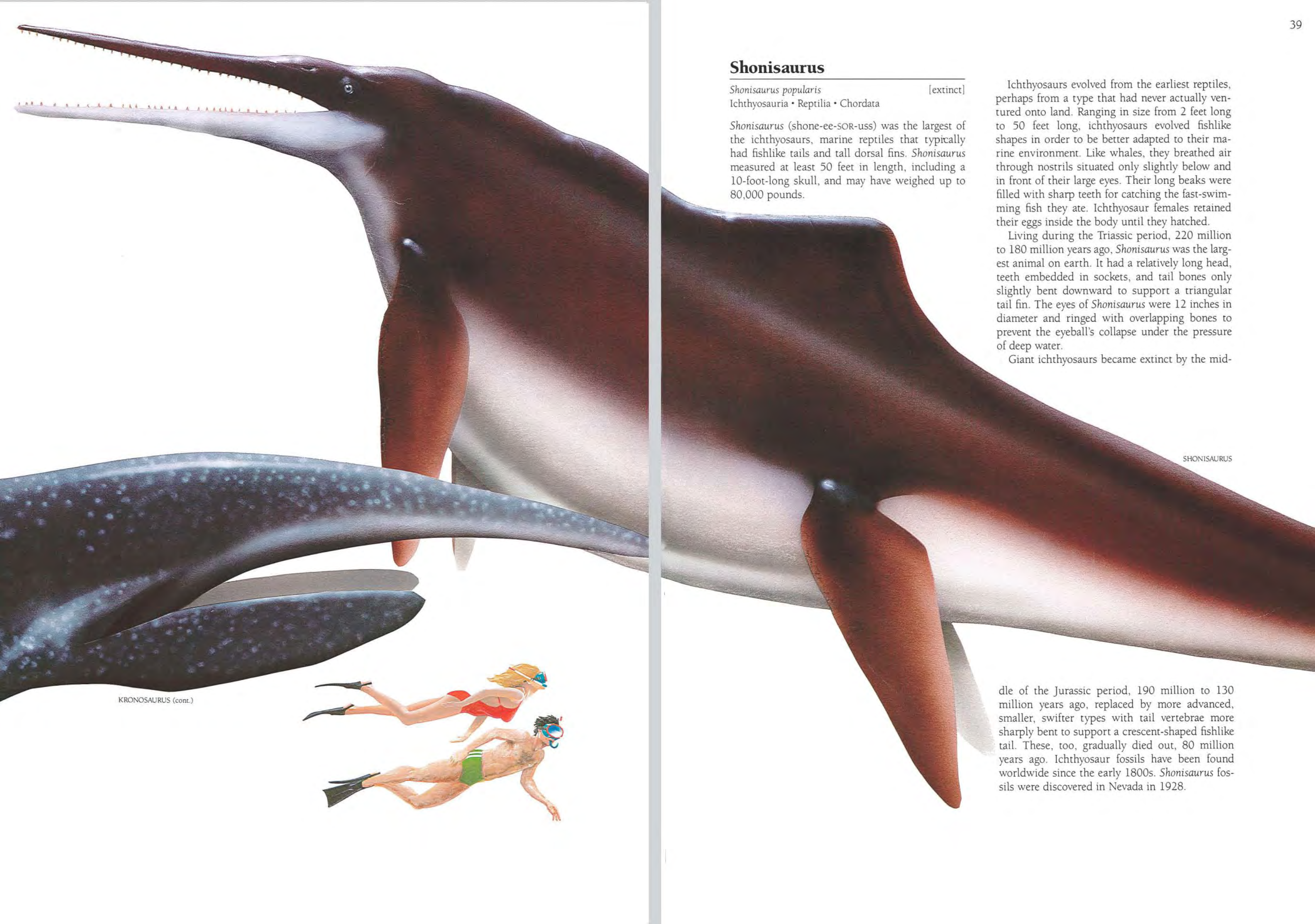
Ichthyosaurs evolved from the earliest reptiles, perhaps from a type that had never actually ventured onto land. Ranging in size from 2 feet long to 50 feet long, ichthyosaurs evolved fishlike shapes in order to be better adapted to their marine environment. Like whales, they breathed air through nostrils situated only slightly below and in front of their large eyes. Their long beaks were filled with sharp teeth for catching the fast-swimming fish they ate. Ichthyosaur females retained their eggs inside the body until they hatched.

Living during the Triassic period, 220 million to 180 million years ago, *Shonisaurus* was the largest animal on earth. It had a relatively long head, teeth embedded in sockets, and tail bones only slightly bent downward to support a triangular tail fin. The eyes of *Shonisaurus* were 12 inches in diameter and ringed with overlapping bones to prevent the eyeball's collapse under the pressure of deep water.

Giant ichthyosaurs became extinct by the mid-

SHONISAURUS

dle of the Jurassic period, 190 million to 130 million years ago, replaced by more advanced, smaller, swifter types with tail vertebrae more sharply bent to support a crescent-shaped fishlike tail. These, too, gradually died out, 80 million years ago. Ichthyosaur fossils have been found worldwide since the early 1800s. *Shonisaurus* fossils were discovered in Nevada in 1928.



KRONOSAURUS (cont.)

Oarfish

Regalecus glesne
Lampridiformes • Osteichthyes • Chordata

The oarfish, a rarely seen eel-like fish measuring 25 feet or more in length and weighing up to 600 pounds, is considered the longest bony fish in the sea. Bony fish have skeletons made of true bone, not cartilage, as is the case with sharks and rays. Oarfish 50 feet long have been seen but not captured. The oarfish's silvery, ribbonlike body may be more than 1 foot broad but edge-on is so thin and fragile as to seem nearly translucent in places.

Oarfish live in deep waters, feeding on the small fish that are found there. The crown on its head with long, arcing filaments can be raised or lowered at will. The long, thin, oarlike pelvic fins give the oarfish its name. Swimming with a wavy, side-to-side motion, the oarfish sometimes carries its head above the surface of the water. This practice may have given rise to the legend of the sea serpent.

Beluga

Huso huso
Acipenseriformes • Osteichthyes • Chordata

The beluga, or Russian sturgeon, is the largest freshwater fish in the world, measuring up to 24 feet long and weighing up to 3,250 pounds. The average is about half that size.

The beluga is a bottom feeder, pushing through the muck on the sea floor with its snout and sensitive, whiskery-looking feelers, called barbels, in search of marine worms and mollusks. Its large, tubular lips extend and suck the meal into its mouth.

Belugas show many characteristics of more primitive fish. The skin is armored with rows of bony plates. The skeleton is bone and cartilage, and the back vertebrae extend into the upper lobe of the tail fin, as do a shark's. Found only in the salty Black and Caspian seas, belugas migrate up the freshwater Volga River to mate and lay eggs, as many as 7.7 million at a time. Although their life span may be as long as 70 years, belugas are becoming rarer as their eggs continue to be eaten by humans as caviar.

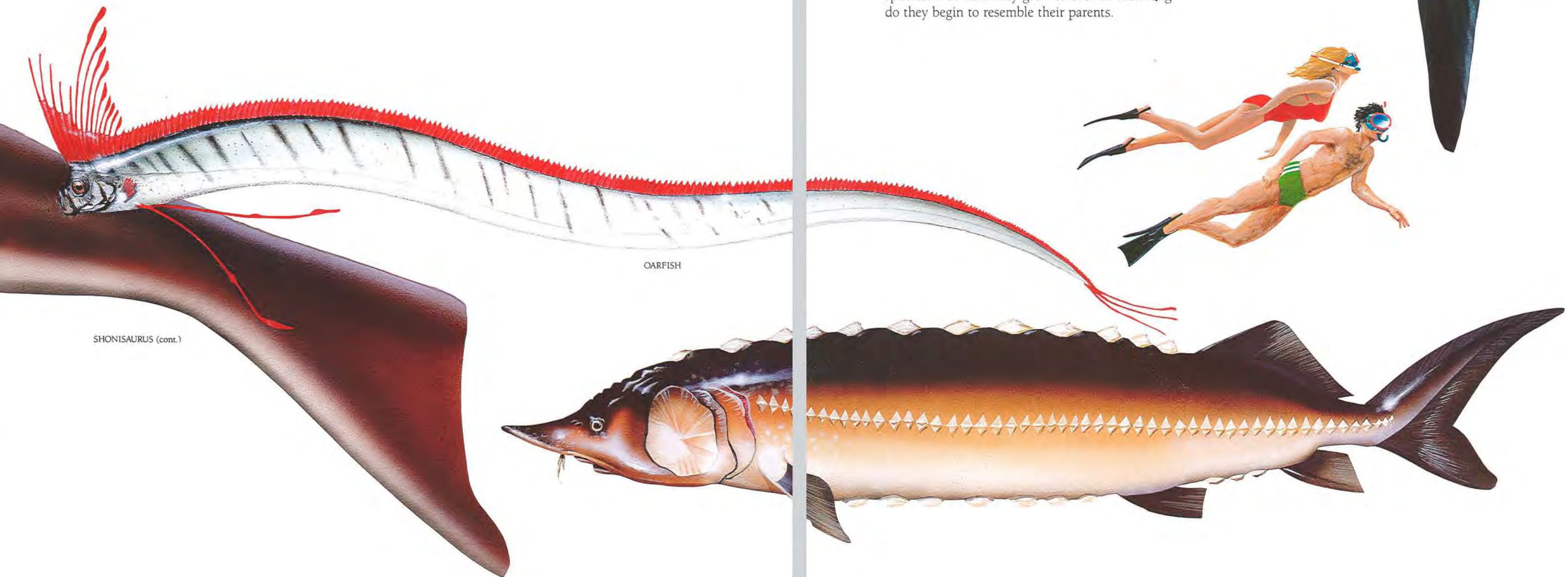
Ocean Sunfish

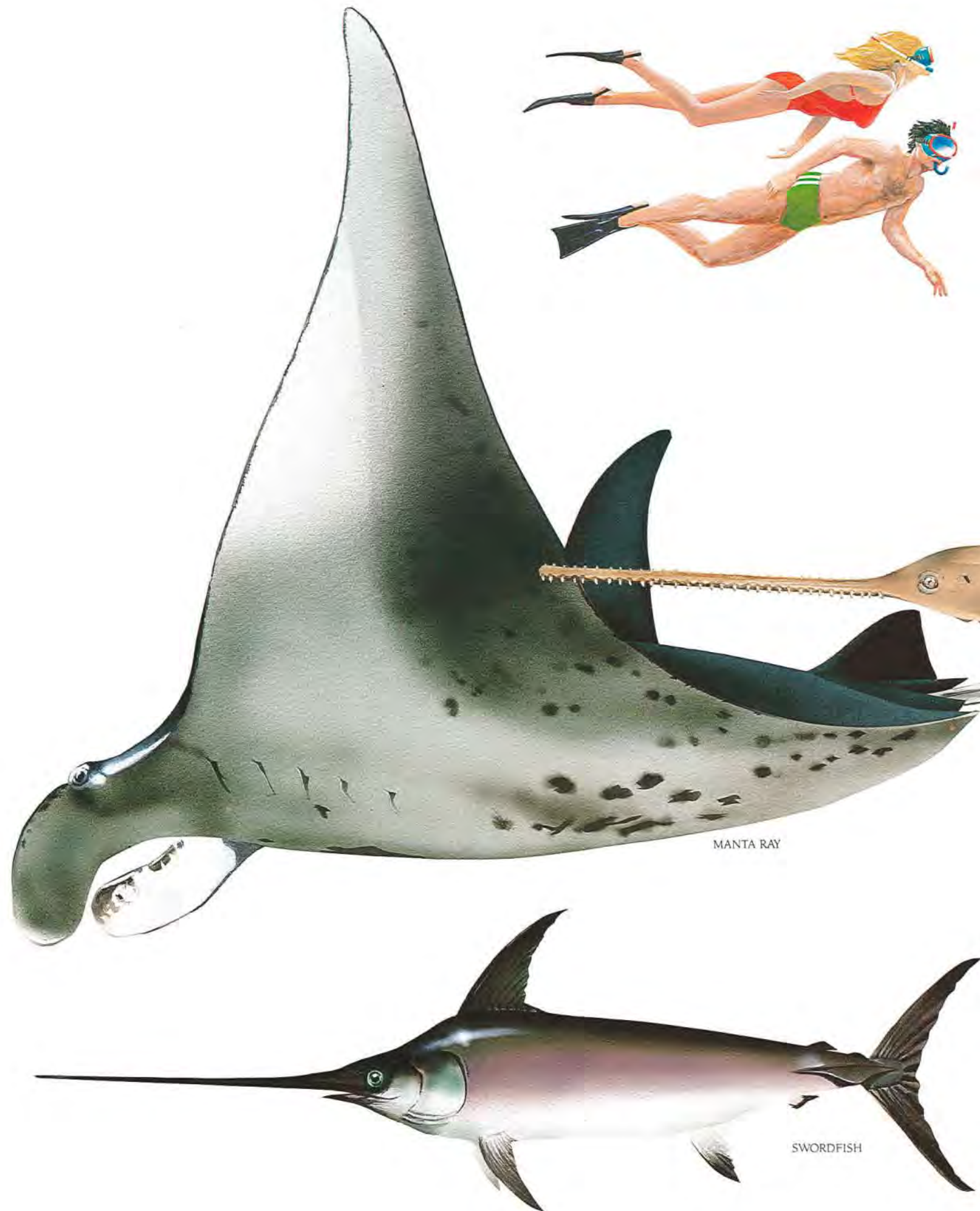
Mola mola
Tetraodontiformes • Osteichthyes • Chordata

The ocean sunfish is the heaviest bony fish. It can weigh as much as 5,017 pounds and measure 14 feet from top to bottom, between the tips of its two fins. Sunfish average 8 feet between the fin tips and 2,000 pounds in weight.

Shaped like a flattened disk, the ocean sunfish uses its huge, fleshy, supple upper and lower fins to propel it slowly through the water. The tail has almost completely disappeared. The sunfish's skeleton is useless and practically nonexistent. Under its skin is a layer of tough gristle several inches thick which supports the fish's body and serves the same purpose as the skeleton in other animals. The tough, leathery skin of the sunfish is scaleless and covered with thick mucus and flat spines. Its mouth is small but filled with teeth. It feeds on crustaceans and jellyfish.

The ocean sunfish lays 300 million eggs at a time, more than any other animal. When hatched, the young are $\frac{1}{8}$ inch long and shaped like spiny spheres. Not until they grow to over an inch long do they begin to resemble their parents.





MANTA RAY

SWORDFISH

Manta Ray

Manta birostris
Rajiformes • Chondrichthyes • Chordata

The manta, or devil, ray is the largest living ray. A ray is a flattened relative of the shark and, like the shark, has a skeleton made of cartilage and several gill openings. A manta ray can measure up to 22 feet from wing tip to wing tip (the average is 20 feet) and may weigh up to 3,500 pounds. The manta is a peaceful, nocturnal plankton eater and is not dangerous to humans.

The manta has the largest brain among fish. It swims by flapping its great wings through the water. Its top side is dark brown to black; underneath it is creamy white. The color comes off easily, so spots of white may occasionally be

seen on the backs of mantas. Flaps near the manta's mouth, called cephalic fins, are used to help direct food toward its mouth. The manta's whip-like tail carries no stinger, unlike that of its relative the stingray.

The manta is found in both the Atlantic and the Pacific oceans. Although most rays prefer to stay hidden under a layer of sand at the bottom, the manta swims and feeds near the surface and has been seen leaping completely out of the water, sometimes in unison with others, and falling back to the sea with a thunderous clap. During such leaps, females sometimes give birth to their young in midair. (As in many sharks and other fish, the eggs are retained within the body of the female until hatching.)



COMMON SAWFISH

Swordfish

Xiphias gladius
Perciformes • Osteichthyes • Chordata

The swordfish may grow up to 15 feet long and weigh as much as 1,200 pounds, but it averages 7 feet long and 250 pounds. It can often be found sunning itself at the surface in the warmer latitudes of both the Atlantic and the Pacific oceans.

The swordfish is one of the world's fastest fish, traveling at speeds of up to 40 or 50 miles per

hour. When a swordfish encounters a school of small fish or squid, it quickly flays its sword among them, returning soon after to devour the maimed prey. The sword, a flattened extension of the upper jaw, can reach a length of 5 feet. Immature swordfish have slender upper and lower jaws that are equally long and filled with teeth. But as the swordfish matures, the upper jaw continues to grow, shedding its teeth and becoming a sharp-edged sword. Adult swordfish have no teeth.

Common Sawfish

Pristis pectinata
Rajiformes • Chondrichthyes • Chordata

The common sawfish, also known as the small-tooth sawfish, is a ray that resembles a shark. Like other rays, it has its mouth and gill openings on the underside of its body. A sawfish may grow up to 25 feet long and weigh 1,200 pounds. It is found close to shore in shallow, tropical waters over sand or mud and may even ascend some rivers.

The sawfish has a long, flat snout that extends far beyond its underslung mouth and is studded with up to 32 pairs of teeth. As in sharks, the teeth grow out from the skin rather than the jaws. A young sawfish is born alive with its saw sheathed in a skinlike sack that is shed shortly after birth. The sawfish grubs for food in the sand and mud, using the saw as a probe. It may also slash schools of fish with its saw, then circle back to eat the mangled victims.

Great Shark

Carcharodon megalodon [extinct]
Squaliformes • Chondrichthyes • Chordata

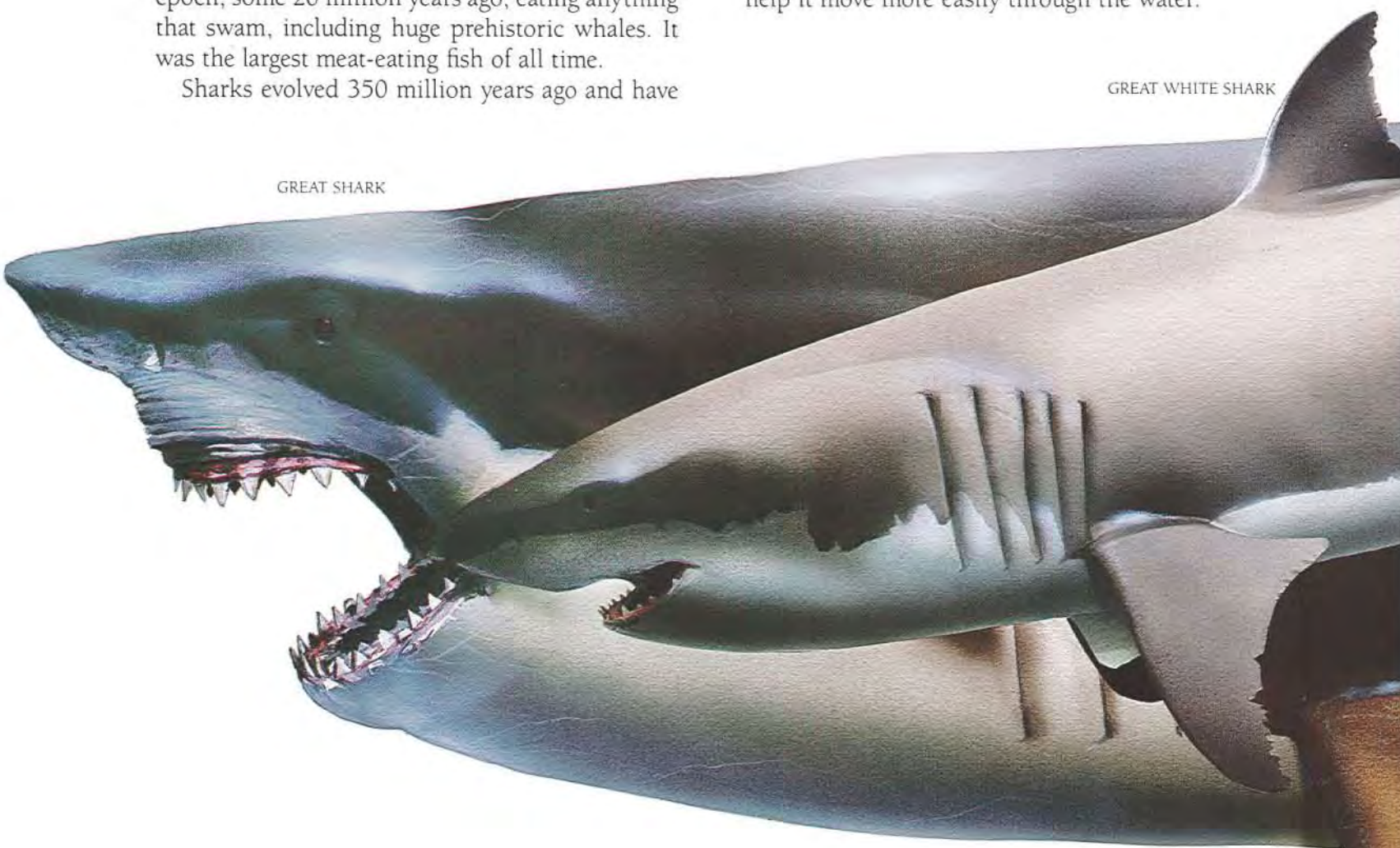
This giant prehistoric cousin of the great white shark is known only from its teeth, discovered in 1873, which are identical in shape to those of a modern great white shark but are twice as large as the largest, up to 6 inches long. Judging by the teeth alone, the great shark's length has been estimated at up to 55 feet and its weight at up to 50,000 pounds. It lived in oceans of the Miocene epoch, some 20 million years ago, eating anything that swam, including huge prehistoric whales. It was the largest meat-eating fish of all time.

Sharks evolved 350 million years ago and have

changed very little in all that time. All sharks are primitive fish with skeletons of pliable cartilage, not true bone, which evolved later.

Unlike those of most other vertebrates, a shark's teeth do not grow out from the jaws but from the skin. The teeth move forward as they increase in size, finally replacing the old, worn-out teeth at the edge of the shark's jawline. The skin itself is covered with thousands of tiny, tooth-shaped scales, called denticles, that are as rough as coarse sandpaper. The denticles protect the shark and help it move more easily through the water.

GREAT WHITE SHARK



GREAT SHARK

Great White Shark

Carcharodon carcharias
Squaliformes • Chondrichthyes • Chordata

The great white shark is the largest living meat-eating fish. One specimen measured 29 feet 6 inches long, weighed 10,000 pounds, and had 3-inch teeth. Adults average 15 feet long and 1,700 pounds. The young are born alive, 4 feet long, and hungry.

The great white shark has been found in all the warmer oceans since the Cretaceous period, 100 million years ago. It can swim at speeds of up to 25 miles per hour. It is mainly a surface feeder,

but occasionally it ventures deeper in search of prey. Because of a special organ in its circulatory system, the great white shark is one of only four fish considered to be warm-blooded. The great white has a keen sense of smell and is incredibly sensitive to vibrations in the water, especially the movements of an erratically fluttering wounded fish or a swimming human. It feeds on fish, other sharks, sea lions, sea turtles, and now and then on humans. The shark's digestive juices are strong enough to blister human skin. The great white's teeth are triangular, serrated, and so sharp they can cut a 750-pound fish in two with one bite.



WHALE SHARK

Whale Shark

Rhincodon typus

Squaliformes • Chondrichthyes • Chordata

The whale shark is the largest fish in the sea—as big as some whales, which is how it got its name. One specimen harpooned in 1919 measured 60 feet 9 inches and weighed 80,000 pounds. Whale sharks today rarely reach 41 feet and 42,000 pounds, and 20 to 30 feet is the average length.

The whale shark is the only shark with its mouth at the tip of its head instead of underslung beneath the nose. It has a distinctive checkered pattern on its back. Harpoons have bounced off its 4-inch-thick skin, thicker than that of any other animal.

The whale shark feeds on plankton while it breathes. Like all fish, it breathes by gulping water and expelling it through gill openings behind its mouth. As the oxygen-rich water passes over the gills, oxygen is exchanged for waste gases through the walls of the tiny blood vessels lining the gills. As the whale shark swims quietly through plankton-rich seawater with its 6-foot-wide mouth open, the tiny plankton are trapped by gill rakers, fingerlike projections that extend from its 10 gills back to the throat.

The whale shark lays the largest eggs of any animal, rectangular egg cases 12 inches long. When the young hatch, they are only 14 inches long. Whale sharks were first seen and recorded in 1828 and are found in all the warmer seas.

GREAT SHARK (cont.)

WHALE SHARK (cont.)

Basking Shark

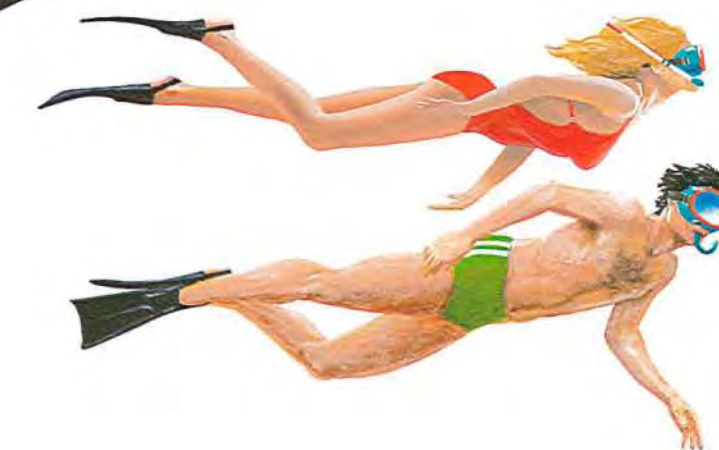
Cetorhinus maximus

Squaliformes • Chondrichthyes • Chordata

The basking shark is the second-largest living fish, reaching a length of 40 feet and a weight of 32,000 pounds, although the average is 26 feet in length and 10,250 pounds. Like the whale shark, the basking shark is a quiet, nonaggressive plankton eater, filter feeding in the same

way. It is found in cooler waters than the whale shark, often with its mouth and huge gills ballooning wide open as it gulps tremendous volumes of seawater. The enlarged gill openings on either side of the basking shark's body extend so far around they almost meet each other at the center of its back and under its throat.

BASKING SHARK



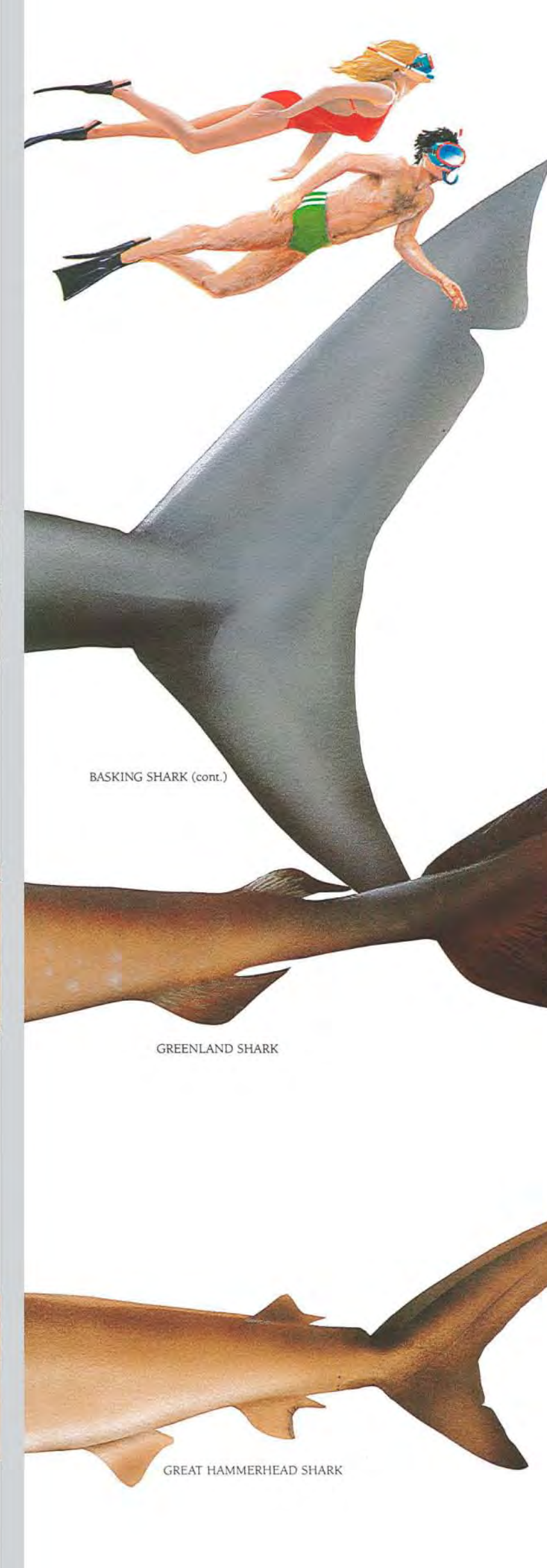


WHALE SHARK (cont.)

BASKING SHARK (cont.)

GREENLAND SHARK

GREAT HAMMERHEAD SHARK



Greenland Shark

Somniosus microcephalus
Squaliformes • Chondrichthyes • Chordata

The Greenland shark grows up to 21 feet long and may weigh as much as 2,250 pounds, but averages only 10 feet in length. It is the only shark to live year-round in the polar waters of the North Atlantic. Also known as the sleeper, it seems to be an extraordinarily sluggish shark, living near the bottom of the sea, and rising only to feed. It is a mystery how this shark captures its food, which includes fast-moving fish, seals, and whales. The Greenland shark is almost always found with one white parasitic crustacean attached to each of its eyeballs. Up to 3 inches in length, these parasites may blind the shark but they may also lure small fish near the shark's jaws. Presumably the Greenland shark scavenges the carrion of dead whales and seals. The Greenland shark bears live young.

Great Hammerhead Shark

Sphyrna mokarran
Squaliformes • Chondrichthyes • Chordata

The hammerhead is a large shark that may measure up to 18 feet 4 inches long and may weigh up to 1,860 pounds. The average size is closer to 12 feet and 1,000 pounds. The hammerhead gets its name from its unusual head. It has eyes on the ends of the flattened extensions of its skull, but sensing electrical impulses and smelling blood are more important than vision to a shark. A shark will wave its head back and forth to sense which nostril smells a trail of blood more strongly, following its nose to its prey. The hammerhead's nostrils are also positioned near the tips of its head, making this shark perhaps the one most sensitive to the smell of blood.

The hammerhead swims near the surface of warm waters, feeding on small fish and squid, but its favorite food is the stingray. It finds them buried beneath the sand by sweeping its wide head back and forth like a metal detector sensing minute electrical impulses that betray the stingray's presence. The hammerhead has been known to attack its own kind as well as humans.

Sperm Whale

Physeter macrocephalus
Cetacea • Mammalia • Chordata

The largest meat-eating animal ever was a sperm whale bull 67 feet 11 inches long, weighing more than 144,000 pounds. In the past, bulls (males) may have grown to 84 feet long. Fossils of sperm whales are known from the Miocene epoch, 23 million years ago, making them among the most ancient of modern whales. The average modern bull measures 47 feet long and weighs 74,000 pounds. Females, known as cows, are always much smaller.

The sperm whale's 20-pound brain is the heaviest in the animal kingdom. The sperm whale takes the deepest dives of any known animal: from the surface of the sea it can dive 10,000 feet or more and stay below for nearly two hours before coming up for its next breath. Making up the bulk

of the head is a huge reservoir filled with oil and a waxy substance called spermaceti, the source of the whale's name. Spermaceti may aid in buoyancy or in sonar. The sperm whale can "see" in total darkness with sonar, a process of sending out high-pitched sounds and listening for the echo as the sound bounces off objects. The skull reservoir seems to focus the sound impulses. Spermaceti also absorbs nitrogen from the bloodstream to help the whale avoid "the bends," a paralyzing disorder caused by the release of nitrogen bubbles into the blood after surfacing too quickly from a deep dive.

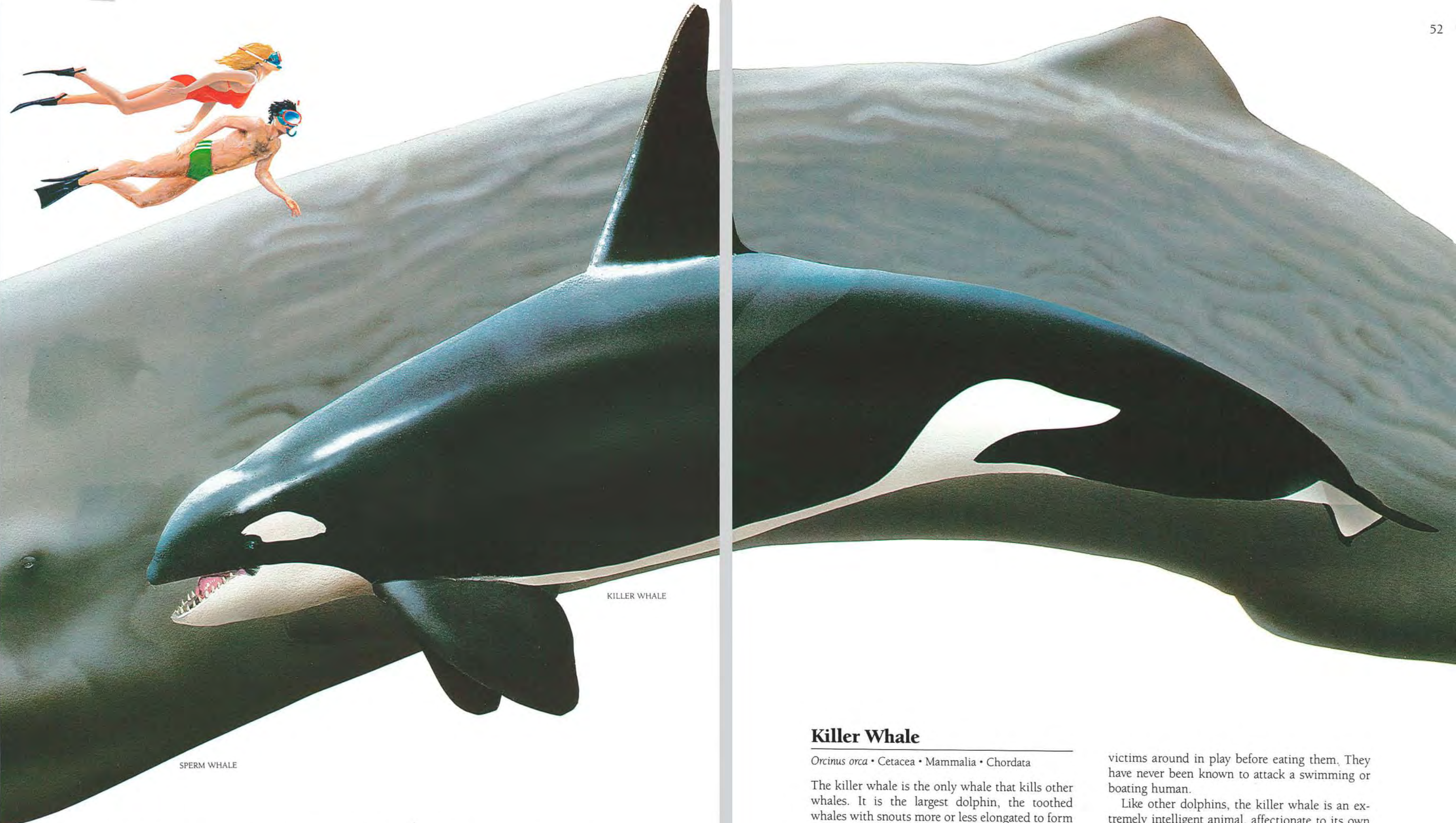
The sperm whale's long, narrow jaw has two



SPERM WHALE

rows of up to 56 nearly identical 8-inch conical teeth that fit into holes in the toothless upper jaw when the jaws close. The sperm whale eats many kinds of fish and sharks but its favorite food is the giant squid, which it finds at great depths and eats whole. Sperm whales often sport dozens of circular scars caused by the saw-toothed edges of the

squid's suckers. Sperm whales live in groups called pods which may include several hundred animals. The bull sperm whale, unlike most other whales, collects a harem of females. Gestation is 18 months. A newborn sperm whale may measure 6 feet long. Sperm whales are found today in all oceans and are protected by law.



KILLER WHALE

Killer Whale

Orcinus orca • Cetacea • Mammalia • Chordata

The killer whale is the only whale that kills other whales. It is the largest dolphin, the toothed whales with snouts more or less elongated to form beaks. A bull can measure 25 to 32 feet in length and weigh up to 20,000 pounds. The cow is smaller. The bull also has a larger and straighter dorsal fin than the cow.

Killer whales have up to 48 large, conical teeth and feed on salmon, seals, polar bears, and penguins, as well as whales. They attack in packs of from two to several dozen and often toss their

victims around in play before eating them. They have never been known to attack a swimming or boating human.

Like other dolphins, the killer whale is an extremely intelligent animal, affectionate to its own kind. Family groups, called pods, include several generations. The killer whale communicates, finds food, and avoids obstacles by means of echolocation, or sonar. Killer whales are found in all the cooler oceans. Next to humans, killer whales are the longest-living mammals, with a life span of up to 100 years. They have no natural enemies other than humans.

Blue Whale

Balaenoptera musculus
Cetacea • Mammalia • Chordata

The blue, or sulfur-bottom, whale is the largest and heaviest animal of all time. Reaching a length of up to 110 feet 2 inches, a blue whale may weigh up to an estimated 508,000 pounds, or about as much as 3,135 average men. The average blue runs 80 to 90 feet and weighs 340,000 to 480,000 pounds.

The blue whale has been around since the Pliocene epoch, 9 million years ago. It is a tremendously strong mammal; the last third of its body

is a muscular mass that drives the huge tail. A blue whale can travel at 25 miles per hour, making it the swiftest of the great whales.

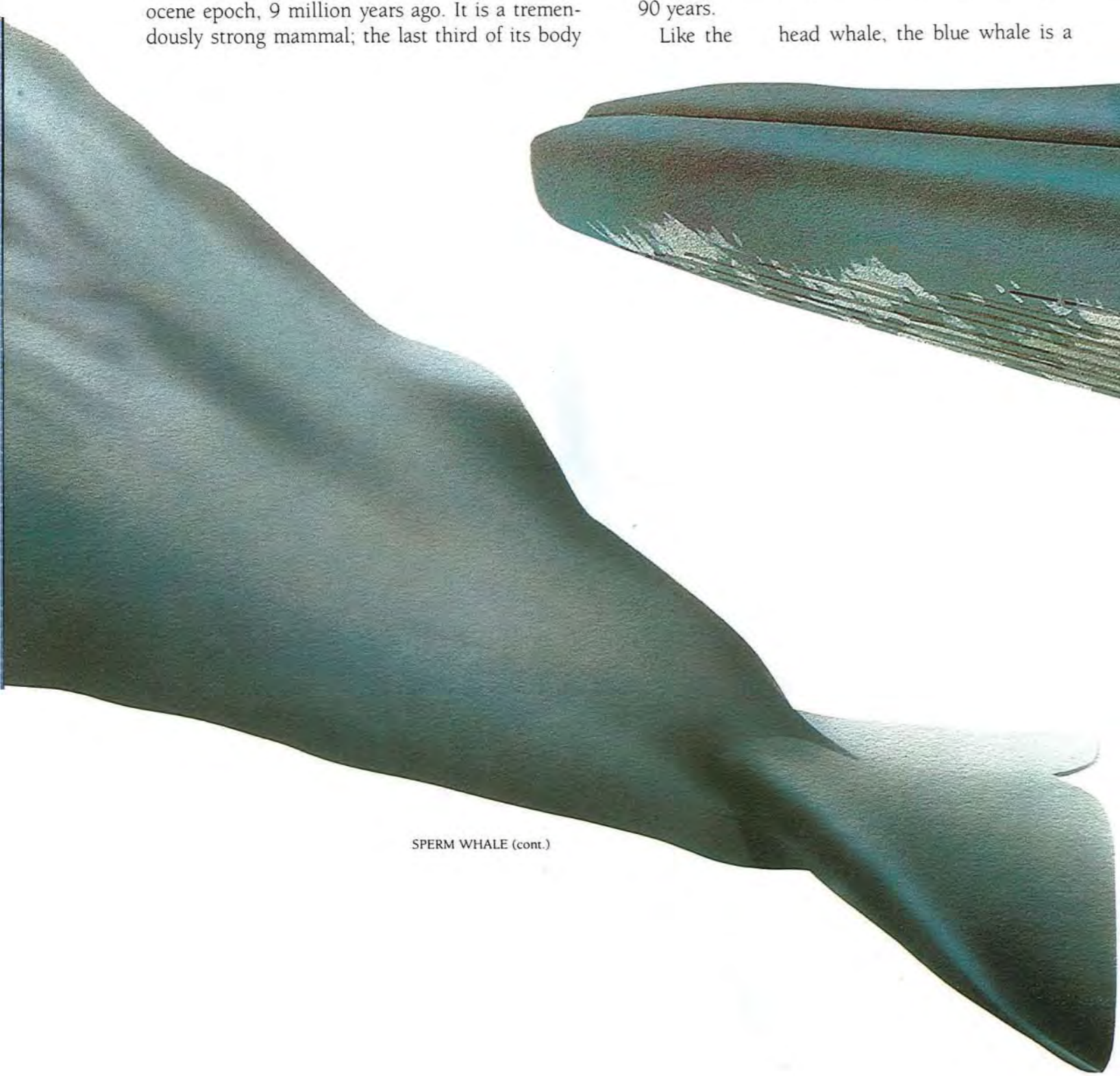
The blue whale holds the record as the fastest-growing animal. During an 11-month gestation a baby blue grows from a single cell to 25 feet long and 6,600 pounds at birth. It may put on as much as 200 pounds a day sucking its mother's milk. At 2 years old, the calf may already be 75 feet long and weigh 250,000 pounds, larger than any other whale species. The blue whale may live as long as 90 years.

Like the head whale, the blue whale is a

filter feeder. But a blue whale has an extendable "throat" with furrows that expand like an accordion to admit a tremendous quantity of seawater for filtering. The water flows through a hole below the whale's tongue to fill the throat bag. Then, plugging the hole with its tongue, the whale rises upside down to the surface to let gravity drain the accumulated seawater out of the bag and through the baleen filters in its mouth, where plankton is trapped. Emptied of seawater and streamlined, the whale may measure 12 feet deep from top to bot-

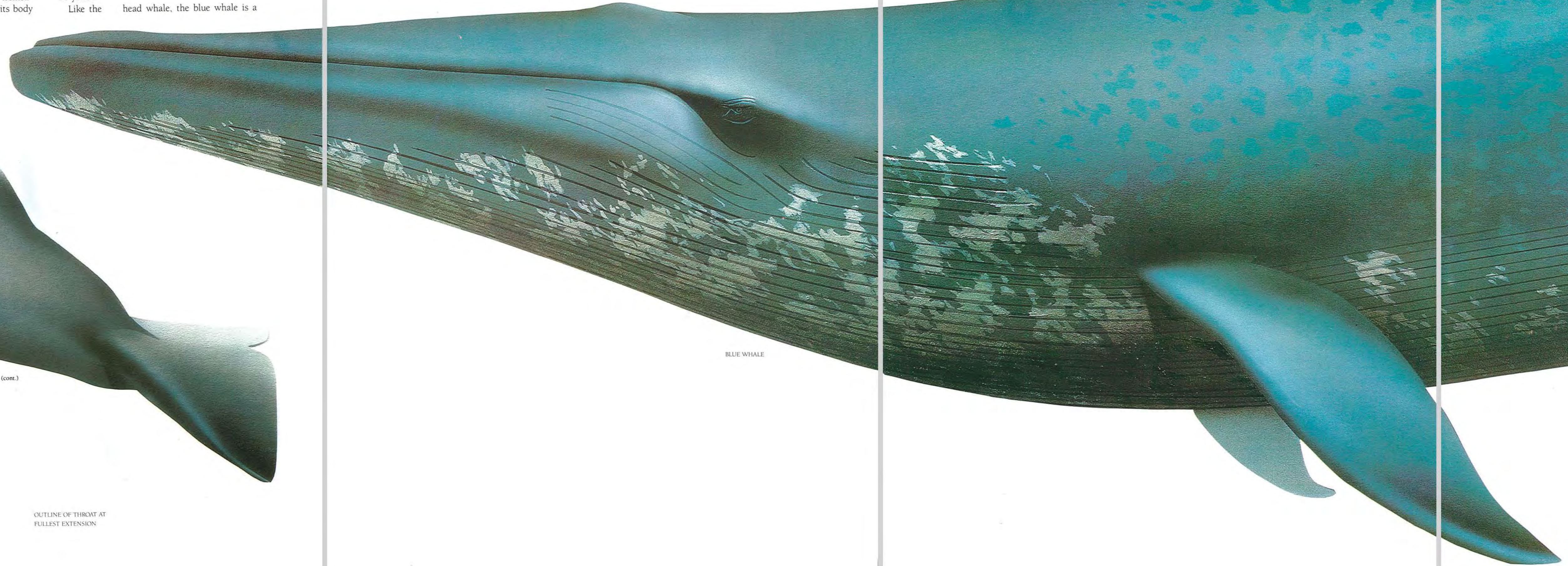
tom; filled, it can swell to an incredible 36 feet deep, with a capacity of nearly 34,000 cubic feet (a six-fold increase in the whale's total volume). An adult may consume 16,000 pounds of plankton a day.

The blue whale is found in all the oceans. Its whistle is the loudest sound any animal makes: reaching 188 decibels, louder than a jet engine at takeoff, it can be heard 530 miles away. After being hunted nearly to extinction, the blue whale is now protected by law.

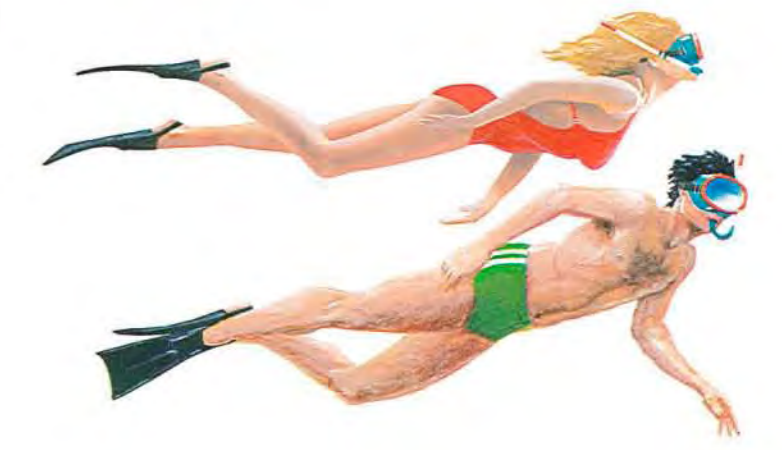


SPERM WHALE (cont.)

OUTLINE OF THROAT AT FULLEST EXTENSION



BLUE WHALE



OUTLINE OF THROAT AT FULLEST EXTENSION



NORTHERN ELEPHANT SEAL

Northern Elephant Seal

Mirounga angustirostris
Carnivora • Mammalia • Chordata

The elephant seal is the largest of the pinnipeds, marine carnivores with all four limbs evolved into flippers. The northern elephant seal is somewhat bigger than the southern. The northern male, known as a bull, may grow as large as 22½ feet long and may weigh up to 9,000 pounds. The



BLUE WHALE CALF



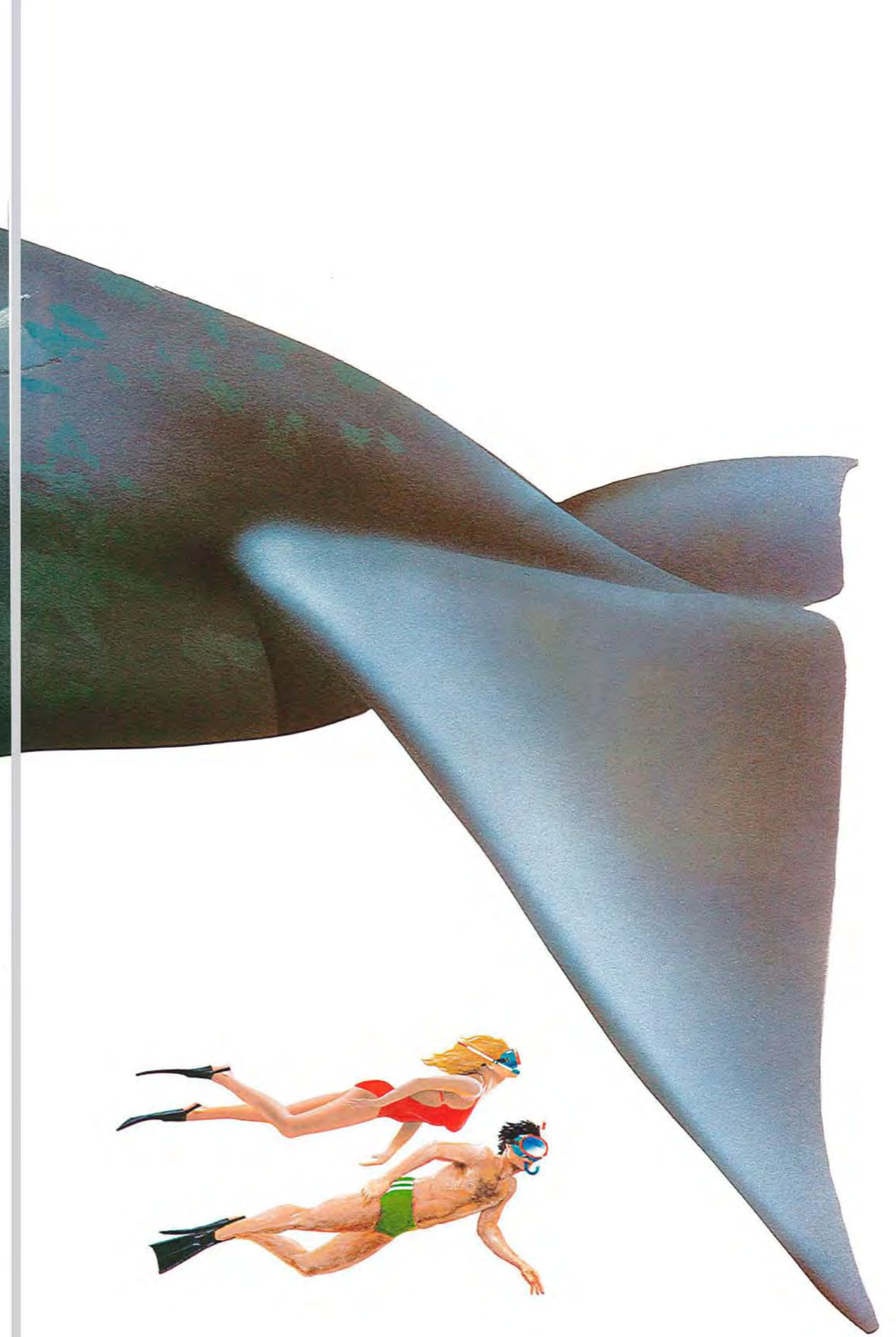
BLUE WHALE (cont.)

average bull measures 16½ feet with a weight of 5,000 pounds; females usually measure 11 feet and weigh 2,000 pounds. The bull's long nose droops many inches below its mouth and resembles an elephant's trunk. The nose inflates as the bull roars to settle territorial disputes or guard its harem of females, called cows. After an 11-month gestation, cows give birth to 4-foot-long, 80-pound pups.

The elephant seal is wrapped in a thick blanket of blubber that insulates it and streamlines its shape. Its rear flippers point straight back and propel it through the water while the front flippers steer. The elephant seal's preferred prey is the rat-

fish, a species that lives only below 300 feet. The elephant seal's large eyes are well adapted for seeing in the deep, dimly lit water in which it feeds.

Northern elephant seals live in Pacific coastal waters and congregate on sandy beaches in the summer to shed. Unlike other animals that shed a few hairs at a time, the elephant seal sheds its entire skin in large patches. On land the elephant seal is a sluggish animal, moving about by contracting its belly muscles in a rippling fashion. Hunted nearly to extinction, elephant seals are now protected by law. Its enemies are humans and the great white shark.





Bowhead Whale

Balaena mysticetus
Cetacea • Mammalia • Chordata

Also known as the Greenland right whale, the bowhead is named for the great arch of its skull, which accounts for almost a third of its length. The largest bowheads may reach up to 67 feet in length and weigh 268,000 pounds. Like all whales, the bowhead must periodically surface to breathe air.

Although some whales have teeth, the bowhead has baleen, special horny filters that hang in sheets from its upper jaws. Bowheads eat plankton, the soup of tiny floating plants and animals (especially krill, a type of shrimp) that accumulate near the ocean's surface. Swimming slowly through plankton-rich seawater with its huge mouth wide open, the bowhead periodically closes its mouth and pushes the water through the baleen filters with its 8,000-pound tongue. The plankton remains trapped on the baleen's hairy inner fringes, ready to be licked off. The bowhead has 12-foot-long baleen, the longest of any whale.

The bowhead whale is comfortably blanketed from the bone-chilling waters of its home in the Arctic Ocean with blubber 2 feet thick. The bowhead and its relative, the right whale, are slow and tend not to sink after being harpooned; hence they were the "right" whales to chase. After being hunted nearly to extinction, the bowhead is now protected by law.

Zeuglodon

Zeuglodon cetoides [extinct]
Cetacea • Mammalia • Chordata

Zeuglodon (zoo-glow-don) reached sizes of up to 80 feet and 120,000 pounds, with 50 feet as an average length. Not an ancestor of modern whales but an evolutionary offshoot, *Zeuglodon* existed only during the early Eocene period, about 54 million years ago. *Zeuglodon* had a body resembling that of a modern whale, but its disproportionately small head remained very much like those of its ancestors, the early flesh-eating mammals.

Zeuglodon had a narrow skull with 44 variously shaped teeth designed to catch and crush hard-bodied mollusks and crustaceans. Its nostrils were midway between the tip of the snout and the top of the head. Like a whale's, *Zeuglodon's* front



ZEUGLODON

limbs had evolved into flippers, but each flipper had an elbow joint that could still be pivoted, like a seal's.

Zeuglodon may have rested its long body in the sandy shallows of warm coastal waters, dipping its head below the surface to eat. Fossils, originally named *Basilosaurus* ("king of the reptiles"), were discovered in Louisiana in 1832.