theNAT
SAN DIEGO NATURAL HISTORY MUSEUM

Whales

GIANTS OF THE DEEP

VOLUNTEER GUIDE

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Welcome

Thank you for participating in *Whales: Giants of the Deep*, an immersive, exciting exhibition on some of the world's most fascinating animals. The exhibition was created by the Museum of New Zealand Te Papa Tongarewa. Featuring two fully-articulated sperm whale skeletons, including an impressive 58-foot male, *Whales* showcases amazing and rare specimens from Te Papa's whale collection, one of the largest in the world. Visitors will see life-size and scale models of whales common to the South Pacific as well as contemporary whalebone treasures such as weapons and chiefly adornments. They'll also learn about whale biology, the extraordinary evolutionary journey of whales from land to sea, and the history of whaling in New Zealand. Children can even crawl through a life-size replica of the heart of a blue whale, the Earth's largest living creature. This is an exciting opportunity to learn more about whales from other parts of the world and explore the Maori people's relationship with whales which parallels the indigenous peoples of the Arctic.

We do not expect you to become whale experts. The following information is just basic background on these amazing animals. Let the exhibition be your main source of information. If you read every panel you will know more than any visitor. Enjoy!

Volunteer Logistics

Reporting for Service

- Please wear dark pants, white shirt and your photo ID, and your "Ask Me" button. After working three shifts, you'll be eligible for a free whales t-shirt and you can wear that for the remainder of the exhibition.
- Sign in the log at the north visitor desk and say hi to the VSAs.
- Come to the volunteer room and leave your personal items in a locker. There are locks for your use. The keys are located on the wall near the door. Take the key with you.
- Please log your volunteer hours in Volgistics at the beginning of your shift. You may include travel time to and from the Museum.
- On your first day, plan on coming a little early or staying a little late so that you can thoroughly explore the exhibition. This guide doesn't cover everything that is in the exhibition.

Scheduling

- You may add yourself to any opening in the Whales schedule on Volgistics.
- Shifts are 10 AM–12:30 or 12:30–3 PM.
- Three shifts per month is the desired commitment.

Logistics for Interpretative Cart

- The cart will be stored in a secure location once the exhibition opens. Security will be in the exhibition and can let you into the storage area.
- Please use care when moving the cart.
- You may the station cart in the lobby area outside the exhibition or inside the exhibition near the sperm whale skeletons.

- Unless you are relieved by another volunteer, please return the cart to the storage area.
- Please be gentle with the biofacts (whale louse, barnacle, baleen) and keep them in your control at all times. You can allow the visitor to handle the objects but keep a watchful eye. Do not allow visitors to touch the baleen. This is a dried brittle specimen and, honestly, feels nothing like fresh baleen which is more like hair. All specimens are irreplaceable.

Representing the Museum

Volunteers working the exhibition help us provide extra customer service for our visitors. Please follow these guidelines:

- Share your enthusiasm for *Whales: Giants of the Deep* with our visitors.
- Respect personal space and read their body language when approaching.
- If a visitor is agitated or complains, please find the security officer in the exhibition. But, please don't leave the cart unattended. Take it with you.
- Give them clear directions when explaining where things are located in the Museum.
- Tell them about other exhibitions in the Museum:
    - *Birds as Art: The Avian Photography of Arthur Morris (4th floor)* features 67 of Arthur's all-time favorite images. Visitors will enjoy his clean, graphic style while simultaneously building a deep appreciation for our feathered friends.
    - *Skul*ls (3rd floor) Rarely on display, the skulls featured are research specimens of animals from around the world mammals, birds, reptiles, and amphibians, ranging from the big and spectacular (a rhinoceros, a big-horned sheep, a giraffe) to the miniature (California's own tiny Western Black-headed Snake). Point them toward the dolphin-human/skull comparison.
    - *Fossil Mysteries* (2nd floor) highlights fossils found in San Diego County and the Baja peninsula, and recreates the animals and environment at different points in time (Jurassic through Pleistocene). Tell them there is a complete baleen whale fossil in the exhibition that was collected right here in San Diego.
    - *Coast to Cactus in Southern California* (2nd floor) Not only is it one of the nicest places to live, it's one of the most interesting places in the world for its amazing diversity of plant and animal life. The coastline, mountains, deserts and more—it's all here, ready to be explored. Point them towards the gray whale skull near the back of the exhibition.
    - *Water: A California Story* (1st floor) Developed by Museum staff, this exhibition explores the water issues facing southern California. Live animals, including a rattlesnake, are on display. Encourage them to see the fin whale skull on display. The fin whale is the second largest whale.
- Encourage them to visit other museums and gardens in Balboa Park

Logging Your Volunteer Hours

Recording the number of hours you work as a volunteer is an important part of your service. These volunteer hours play a critical role when the Museum applies for grants and submits proposals to donors. Each year 750 volunteers contribute over 58,000 hours. The only way we can know how many hours is by asking you to log them.

There is a computer in the volunteer room you can use each time you work your shift. If you forget to log your hours, you can log them from home. Here are the instructions:

- Go to the Museum's website www.sdnhm.org.
- Choose the **Support** Menu and click on **Volunteer**.
- Click on the link that says "Already a Volunteer? Click here for Volgisitcs."
- Sign in using the email address you listed on your application. Your temporary password is welcome. You will be asked to change it the first time you log in.
- Choose Whales as your assignment.
- You may include your travel time in your hours.
- You may record your mileage for tax purposes (You may deduct mileage to and from your volunteer work).

Adding Yourself to the Schedule

- Log into Volgistics as above.
- Choose **Check Your Schedule**.
- Choose show openings in Whales
- You may select any day with the Help Wanted sign.
- Choose **Schedule Me** and then click continue to confirm.

Introduction to Marine Mammals

Three groups, or orders, of marine mammals evolved independently for life in the ocean.

Order	Cetacea (Cetaceans) whales, dolphins, porpoises
Order	Sirenia (Sirenians) dugongs and manatees, or sea cows (not in our region)
Order	Carnivora (Carnivores) Suborder: Pinnipedia (Pinnipeds) seals, sea lions, and walrus

Examples of other mammal orders are carnivores (cats and dogs, bears, weasels, and seals and sea lions); rodents (rats and mice), rabbits and hares; monkeys and apes; even-toed ungulates (antelopes, camels, and goats); or odd-toed ungulates (rhinoceros, horse, wild ass).

Introduction to Cetaceans

In scientific classification, whales and dolphins, and a third, lesser known group, Porpoises, make up the order of Cetaceans (from the Latin word "cetus", a large sea animal).

Cetaceans are divided into two groups, baleen whales (Mysticeti) and toothed whales (Odontoceti). Baleen whales include most of the larger whales (blue whales, fin whales, humpbacks, gray whales, minke whales, right whales). They have baleen plates instead of teeth that help them capture small

prey. Their large jaws allow them to catch thousands of small prey at a time. Toothed whales include the Narwhal and the Beluga, all of the dolphins, sperm whales, and beaked whales. They feed mostly on squid, and in a few cases, marine mammals, one at a time. (Source: *Whales, Dolphins, and Porpoises*, Mark Carwardine).

Suborder	Mysticeti (Mysticetes, baleen whales)
Family	Balaenidae: Bowhead whale, Northern and Southern Right whales
Family	Balaenopteridae: the Rorquals (Blue, Fin, Minke, Humpback and other whales)
Family	Eschrichtiidae: Gray whale, only member of the family
Family	Neobalaenidae: Pigmy Right whale, in southern hemisphere only

Suborder	Odontoceti (Odontocetes, toothed whales)
Family	Physeteridae: Sperm whale
Family	Monodontidae: Narwhale and Beluga whale
Family	Ziphiidae: Beaked whales
Family	Delphinidae: Ocean dolphins, Orca, Pilot whaleS
Family	Phocoenidae: Porpoises

There are six more families of lesser known whales and dolphins.

Whether an animal is called a whale or a dolphin is a matter of size: All members of the baleen whale family are "whales." The sperm whale is the largest member of the toothed whales, comparable in size to a humpback whale. Next in size is the orca, which is also called killer whale, but belongs to the dolphin family (Delphinidae).

Porpoises are small members of the toothed whales that look much like dolphins. The only real difference between dolphins and porpoises is their teeth. Dolphins have cone-shaped teeth, and porpoises have spade-shaped teeth.

Some confusion exists as to the use of the word "porpoise." Fishermen and animal trainers call dolphins, especially the bottlenose dolphin "porpoise." These dolphins often leap out of the water when moving around, a form of locomotion called "porpoising." The "real" porpoises do not do this.

Adaptations

Marine mammals are united more by their shared use of a similar environment than by common evolutionary descent. While cetaceans, sirenians and pinnipeds have different evolutionary origins, they

have evolved similar physical and physiological adaptations to life in the ocean. All have well-developed paddle shaped limbs, a streamlined body and the ability to dive underwater for extended periods of time. Physiologically, marine mammals differ from land mammals in that they can conserve oxygen and withstand increased water pressure during a deep dive. But like all mammals they must breathe air.

Challenges of the Marine Environment

PHYSICAL PROPERTIES WATER VS. AIR		ADAPTATIONS
High heat capacity of water means colder environment	⇨	Insulation: blubber, fur, large body size
High density and viscosity—more energy needed to move	⇨	Streamlined body shape reduces drag
High water pressure	⇨	Special diving adaptations, e.g. collapsible lungs
Visibility low, decreasing with greater depth	⇨	Cetaceans: hearing is dominant sense Odontocetes: echolocation Pinnipeds: Special adaptations in eyes
Sound travels much faster and farther underwater	⇨	All Cetaceans: sound production for communication Odontocetes: echolocation DANGER: man made loud noises interfere with marine mammal's communication & orientation

Baleen

A suborder of cetaceans, with the scientific name, Mysticeti, from the Greek word for "moustache" use baleen for feeding. Baleen is a strong, yet flexible material made out of keratin, a protein that is the same material that makes up human hair and fingernails. Baleen allows baleen whales to take advantage of the most abundant food sources in the ocean: small schooling fish, krill and even smaller zooplankton. Baleen consists of several hundred individual plates that hang down from the upper jaw in two racks, one on each side of the mouth.

A whale's baleen plates play the most important role in its filter-feeding process. In order to feed, a baleen whale opens its mouth widely and takes in large volumes of water (or ocean sediment in the case of the gray whale), together with dense shoals of prey. It then partly shuts its mouth and presses its tongue against its upper jaw, forcing the water (or sediment) to pass out sideways through the baleen, thus straining out the prey that it can then swallow.

Information on Selected Whales

Sperm Whales

Hal Whitehead, one of the foremost sperm whale researchers of our time, calls this whale "an Animal of Extremes." It is the largest of the toothed whales with extreme sexual dimorphisms, with females up to 36' long and 15 tons; while males are 60' and weigh up to 45 tons. It has the largest brain of any animal, weighing in at 16 lbs. It is one of the deepest and longest divers—more than 3000' for 90 minutes. It has the most sophisticated echolocation organ and a very highly developed social structure.

Sperm whales have a cosmopolitan distribution. Females form "matrilineal" social units consisting of several generations, which together travel widely within their home range in tropical and subtropical waters far from land. They raise their calves communally, babysitting each other's offspring, while a mother goes off for a deep dive to feed—something the young ones cannot do yet—and in some cases even nursing each other's calves. They communicate with each other by special clicks called "codas", which are typical for each group.

Young males in their teens—or before—will leave their mother's unit, forming bachelor's groups, which gradually move to higher latitudes, eventually getting to the ice edges of both hemispheres. Over the years groups become smaller, and only when they reach their late twenties do these males return to the warm-water habitat of the females to mate.

The sperm whale's appearance is dominated by its gigantic head, containing the spermaceti organ, which takes up a quarter of total body length in females and a third in males.

"Spermaceti", so called because to the early whalers it looked like sperm—hence the whale's name—is a waxy substance, which provided the finest grade oil for lubricants, candles and other purposes until the 1960s and 70s. For this highly prized product thousands of sperm whales were killed every year, until they were finally protected.

But what does the sperm whale use it for?

It is an oversized nasal complex, used for echolocation. Unlike in baleen whales and other toothed whales, the sperm whale's blowhole and nasal sacs (the "monkey lips") are situated at the front end of the head on the left side, not on top of the head. (See illustration for dolphin echolocation on page 18.) Clicks for echolocation produced by the nasal sacs are first sent back through the mass of spermaceti, reflected on an air sac in front of the skull and only then directed outward into the water through another waxy substance called the "junk". This complex structure, which has been fully investigated only in the last 15 years, allows the sperm whale to create the most powerful and most directional clicks, reaching over ranges of hundreds of meters to tens of kilometers.

Sperm whales are known as champion divers, reaching depths of 3000' for as long as 90 minutes. In these totally dark waters they hunt for squid, using their superior echolocation abilities. They actively pursue their prey, but the rows of teeth in their very narrow lower jaw do not seem to play a role in

capturing prey. Females mostly eat squid in the 2-20 pound range; males take larger ones, but not exclusively the giant squid, as popular literature would make you believe!

Sources:

Marine Mammal Encyclopedia, “Whalewatcher” Journal of the American Cetacean Society, spring 2012: Sperm Whale, Hal Whitehead “Sperm Whales,” 2003

Gray’s Beaked Whale

One of the more easily distinguished beaked whales, the Gray’s beaked whale, has a particularly long, slender snout, or ‘beak,’ which is white in adults with a straight mouthline. The beak is often raised up out of the water when the whale surfaces.

Mature male Gray’s beaked whales possess a single pair of functional teeth, which are triangular in shape and located midway along the lower jaw. These teeth project up, outside of the mouth, and can be seen when the mouth is closed. Both sexes have a regularly spaced row of teeth on the upper jaw.

The elusive nature of Gray’s beaked whale, together with its far offshore habitat and apparent rarity, mean that little is known about the biology and behavior of this marine species. Like other members of the genus, it is likely to feed mainly on cephalopods such as squid, with most prey caught in deep water, below depths of 200 meters, and believed to be swallowed whole.

Gray’s beaked whale is found throughout cool, temperate waters of the Southern Hemisphere, with records from Antarctic and sub-Antarctic waters, as well as around New Zealand, southern Australia, South Africa, Argentina, Chile and Peru. Information on their distribution has come mostly from mass strandings. Gray’s beaked whales are included in the exhibition.

Pygmy Right Whale

The smallest of the baleen whales, the pygmy right whale is usually described as “rarely seen at sea,” “known mostly from strandings,” and therefore a whale about whose life history we have very little information. It is found only in the southern hemisphere between 30 and 55 degrees south

We have some facts we do know from strandings (as individuals, no mass strandings). Their average length is 20’ with females slightly larger than males, as in all baleen whales. Their estimated weigh is about 3.5 tons. The pygmy right whales is “countershaded,” as in many marine mammals, dark above, light below, with lighter colored chevrons across the back in front of the flippers. They have 212–260 baleen plates on each side, same as in the much larger right whales! Pymgy right whales feed on small plankton, especially copepods and krill (found as stomach content).

Where to place this elusive whale in the taxonomic system has long been a question of debate. Initially, because its arched mouthline resembles that of the right whale, it was given its name, pygmy right whale, and was placed in the right whale family. However, it differs from the right whale by having a dorsal fin and a much slimmer overall body shape, and closer inspection of stranded individuals showed that the skull and skeleton of the pygmy right whale are unlike those of any other Cetacean.

Since the pygmy right whale did not fit into any of the three other baleen whale families, a new family was created just for this species, the Neobalaenide. Most books still list it in this way.

New research, published in 2012 by Felix Marx of the University of Otago, New Zealand throws light on the true ancestry of the pigmy right whale. Marx compared the unusual skull and other bones of the pygmy right whale to bones from fossil whales, and found them to be most closely related to a group called Cetotheres, which lived in oceans across the globe from 15 to 2 million years ago. This makes our pigmy right whale a "Living Fossil", the sole survivor of an ancient group extinct long ago.

In the open ocean, pigmy right whales have been spotted in groups of as many as 80 individuals, sometimes associated with pilot and minke whales. They may be confused with minke whales, but can be distinguished from minke whales by their strongly curved jaw and their peculiar way of moving with whole body motions (rather than just the fluke), throwing their head out of the water while swimming.

Closer to shore pygmy right whales are mostly seen singly or as mother-calf pairs. They like to frequent shallow bays, and that is where strandings sometimes happen. A National Geographic article from March 2008 tells of a mother–calf pair, who were hopelessly trapped in an area with sandbanks off New Zealand. Rescue workers almost considered euthanasia, because the whales had stranded themselves four times, when a bottlenose dolphin appeared, seemingly saying: "follow me!" and safely led the pair out to the open ocean.

Southern Right Whale

The southern right whale is confined to the Southern Hemisphere but is almost identical to its northern counterparts the northern right whale and the north Atlantic right whales. Recent genetic testing indicates it is a separate species.

Known as the "right" whale by the whaling industry because it is large, slow moving and floats when dead, this whale is easy to identify as it has a uniformly dark color with callosities, outgrowths of skin where hair would appear on a human male. These callosities are black but appear white because of the large number of whale lice that congregate around them. The body is rotund and the head is very large, making up one third of the total length. The southern right whale does not have a dorsal fin or a grooved throat.

Southern right whales produce short, low-frequency moans, groans, belches and pulses. Typical feeding dives last between 10 and 20 meters and southern right whales are also frequently seen at or above the surface of the water, slapping the water with its tail and flippers, rolling, and breaching (launching out of the water and landing on the side or back). The function of these behaviors is not known.

The southern right whale is only found in the southern hemisphere in all waters between 30° and 60° south. A migratory species, the southern right whale is found in the open ocean of the most southern region of its range during the summer months where prey populations are more abundant, but migrates up to the coastal regions of more northerly regions of its range during the winter and spring.

Southern right whales appear to congregate in small, unstable groups and occasional large feeding aggregations. They have been observed “sailing,” a behavior in which they raise their flukes in the air at a 90 degree angle to the wind and “sail” downwind and then repeat the behavior.

Following serious over-exploitation from the 1600s until the 1930s, the southern right whale population became dangerously low. International protection in 1935 allowed a slow increase, but illegal whaling continued into the 1960s. Since then, the population has been increasing but disturbance from vessels, divers, coastal industrial activity, entanglement in fishing gear and pollution are all concerns.

Blue Whale

The blue whale is the largest animal ever to live on this planet. On land, an animal the size of a blue whale would be crushed by its own weight without the support of large heavy bones. Because its body is supported by water, as a sea animal, the need for heavy bones to support its weight disappeared. This, plus the availability of a large food supply, has made it possible for the blue whale to reach such an enormous size. The blue whale makes deep and rumbling sounds that can be felt as much as heard. These low-frequency sounds travel long distances through water, allowing blue whales to communicate with each other over hundreds of miles of ocean.

The blue whale has a huge body, long, somewhat tapered, and streamlined, with the head making up less than one-fourth of its total body length. Its rostrum (upper part of the head) is very broad and flat and almost U-shaped. Its blowholes are contained in a large, raised "splash guard," and the blow is tall and straight and over 20 feet high. Its body is smooth and relatively free of parasites, but a few barnacles attach themselves to the edge of the fluke and occasionally to the tips of the flippers and to the dorsal fin. In the Southern Hemisphere blue whales can reach 100 feet in length and up to 150 tons. Their heart is the size of a VW beetle and a small child can crawl through its aorta. Females are larger than males of the same age.

Blue whales are thought to feed almost exclusively on krill, a small shrimp-like crustacean. During the summer feeding season blue whales probably consume 4 tons or more each day. They feed by lunging into prey schools. There are 55-68 ventral grooves, or pleats, extending from the lower jaw to near the navel. These grooves or pleats expand when the whale feeds allowing it to take in huge gulps of water and prey. It is interesting to note that the largest animal on earth eats some of the smallest prey.

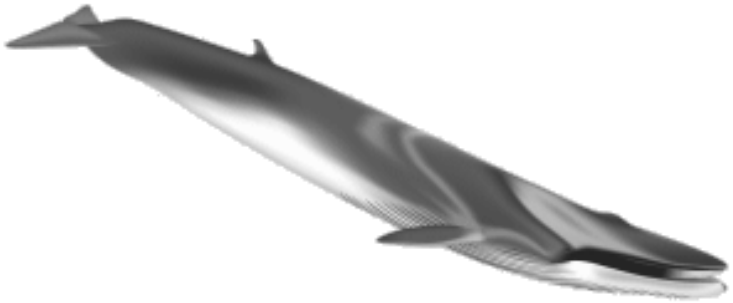
Recent research indicates that blue whales reach sexual maturity between the ages of 6–10 years. Calves are born at intervals of 2 to 3 years, and gestation takes approximately 11-12 months. Calves are 23–27 feet long at birth and weigh 3 tons. During the nursing period (7–8 months), calves consume 100 gallons of the fat-rich mother's milk each day and gain 200 pounds a day, or 8 pounds an hour. They grow 1.5 inches in the length of a day.

Blue whales may be found in all oceans of the world. They migrate to tropical-to-temperate waters during winter months to mate and give birth to calves. They can feed throughout their range, in polar, temperate, or even tropical waters. During the summer months, blue whales can feed off the coast of California. Though they may be found singly or in small groups, it is more common to see blue whales in pairs. They are sometimes seen in larger groups and loosely defined concentrations of 50–60 have been observed. They are fast, strong swimmers, capable of reaching 30 mph when alarmed, but they usually cruise along at about 12 mph.

Because of their enormous size and speed, blue whales were safe from early whalers, who could not pursue them in open boats with hand harpoons. But in 1868 a Norwegian, Sven Foyn, revolutionized the whaling industry with the invention of the exploding harpoon gun, and by using steam and diesel powered factory ships and catcher boats. The whaling industry began to focus on blue whales after 1900. In the Southern Hemisphere alone, 360,000 were killed in the 20th century. The International Whaling Commission (IWC) banned all hunting of blue whales in 1966 and gave them worldwide protection. Recovery has been extremely slow, and presently, there are an estimated 5–10,000 blue whales in the Southern Hemisphere, and only around 3–4,000 in the Northern Hemisphere. A population around 2,000 individuals that summer off the coast of California may be the only population that is truly thriving.

Fin Whale

The fin, or finback whale is second only to the blue whale in size and weight. Among the fastest of the great whales, it is capable of bursts of speed of up to 23 mph leading to its description as the "greyhound of the oceans." Its most unusual characteristic is the asymmetrical coloring of the lower jaw, which is white or creamy yellow on the right side, and mottled black on the left side. Fin whales are found in all oceans of the world, though they seem to prefer temperate and polar waters to tropical seas. Adults measure up to 79 feet in the northern hemisphere, and 89 feet in the southern hemisphere. Females are slightly larger than males. Weight for both sexes is between 50–70 tons.



Fin whales feed mainly on krill and schooling fish. They have been observed circling schools of fish at high speed, rolling the fish into compact balls then turning on their right side to engulf the fish. Their color pattern, including their asymmetrical jaw color, may somehow aid in the capture of such prey. They can consume up to 2 tons of food a day.

Fin whales are found in all oceans of the world. They sometimes associate with blue whales and sometimes interbreeding occurs. They may migrate to subtropical waters for mating and calving during the winter months and to the colder areas of the Arctic and Antarctic for feeding during the summer months; although recent evidence suggests that during winter, fin whales may be dispersed in deep ocean waters. During the summer months, fin whales can be seen off the coast of California. Fin whales are found most often alone, but groups of 3–7 individuals are common, and associations of larger numbers or concentrations may occur in some areas at times. Because their powerful sounds can carry vast distances, fin whales may stay in touch with each other over long distances. The fin whale's blow is tall and shaped like an inverted cone, and the dive sequence is 5–8 blows, approximately 70 seconds

apart before a long dive. They rarely raise their flukes as they begin their dive, which can be as deep as 1,800 feet.

Note: A cast of a fin whale skull can be seen in *Water: A California Story* at theNAT.

Minke Whale

The minke (pronounced mink-ey) whale, like all the rorquals, is a fast swimmer, capable of reaching speeds of 16–21 mph. Dubbed the “elusive minke” by our Museum Whalers, they spend relatively little time at the surface. It may be hard to see a minke at sea because its blow is rarely visible and it tends to disappear quickly after exhaling. Since it is relatively small, it may be hidden in a choppy sea. Minke distribution is widespread, ranging from sub-tropical to polar waters.

The minke whale is the smallest member of the rorqual family. One of its most distinctive features is the narrow, triangular rostrum (upper jaw), which is proportionally shorter than in other rorquals. Some minkes have a light-colored chevron on the back behind the head. The dorsal fin of the minke is tall and curved. Adult males average about 26 feet, while adult females average 27 feet. Both males and females weigh about 10 tons. Both sexes are slightly larger in the southern hemisphere.

Minke whales feed primarily on krill in the southern hemisphere and on small schooling fish (capelin, cod, herring, pollock) or krill in the northern hemisphere. They will also eat copepods (small crustaceans) in certain areas.

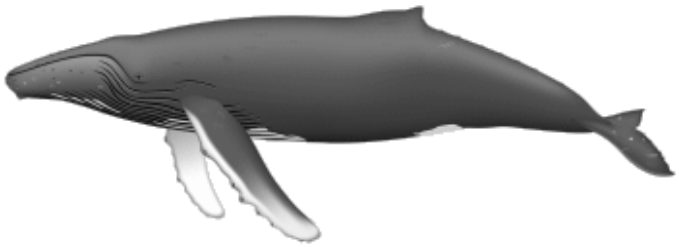
Minkes are among the most widely distributed of all the baleen whales. They occur in the North Atlantic and North Pacific, from tropical to polar waters. Generally, they inhabit warmer waters during winter and travel north to colder regions in summer, with some animals migrating as far as the ice edge. Minkes can sometimes be spotted off the coast of California. Scientists are still examining the populations of minke whales in areas where they are harvested, and have discovered that the largest numbers of minke whales are found in the Southern Hemisphere. It is thought that minke populations have increased as they started to eat the food that was previously eaten by the now-depleted large whale species. The present population worldwide is believed to be over a million animals.

Note: We have a sample of minke whale baleen on the interpretative cart.

Humpback Whale

Perhaps the most familiar of the great whales, the humpback whale is best known for its acrobatic displays and its haunting songs, which are produced only by the males. The shape and color pattern on the humpback whale's dorsal fin and flukes are as individual in each animal as are fingerprints in humans. The discovery of this interesting fact changed the course of cetacean research forever, and the new form of research known as "photo-identification," in which individuals are identified, catalogued, and monitored, has led to valuable information on population sizes, migration, sexual maturity, and behavior patterns.

The head of a humpback whale is broad and rounded when viewed from above, but slim in profile. The body is not as streamlined as other rorquals, but is quite round, narrowing to a slender peduncle (tail stock). The top of the head and lower jaw has rounded, bump-like knobs, each containing at least one stiff hair. The purpose of these hairs is not known, though they may allow the whale to detect movement in nearby waters. There are between 20–50 ventral (throat) grooves that extend slightly beyond the navel.



The body is black on the dorsal (upper) side, and mottled black and white on the ventral (under) side. This color pattern extends to the flukes. When the humpback whale "sounds" (goes into a long or deep dive) it usually throws its flukes upward, exposing the black and white patterned underside. This pattern is distinctive to each whale. Its flippers are very long, between 1/4 and 1/3 the length of its body, and have large knobs on the leading edge. The flukes (tail), which can be 18 feet wide, is serrated and pointed at the tips. Adults may reach 50 feet and weigh 25 to 40 tons.

Humpback whales feed on krill and various kinds of small fish. Each whale eats up to 1.5 tons of food a day. Some humpback whales cooperatively feed using a bubble-feeding technique. One whale dives and exhales bubbles in a spiral pattern around a school of fish, driving them into a tight ball toward the surface where other whales then take large gulps of their prey. If you see large congregations of birds and lots of splashing, it could be humpbacks exhibiting this behavior.

Found in all of the world's oceans, most populations of humpback whales follow a regular migration route, summering in the temperate and polar waters for feeding, and wintering in tropical waters for mating and calving. In the Arabian Sea, a year round non-migratory population of humpbacks appears not to follow this general rule. Humpbacks can be seen off the coast of California.

Gray Whale

The only member of the family Eschrichtiidae, the gray whale is a mysticete, or baleen whale. It is a "coastal" whale that undertakes one of the longest migrations of any mammal on earth, traveling along the North American Pacific Coast between arctic seas and the lagoons of Baja California, Mexico. Frequently visible from shore, gray whales provide a unique opportunity for land and boat observation, and commercial whale watching has become a major industry along its migration route. Visitors to the calving and breeding lagoons sometimes encounter the phenomenon of the "friendlies," gray whales that closely approach small boats and allow themselves to be touched by humans. Ray Gilmore, Research Associate at the San Diego Natural History Museum, started some of the first whale watching excursions in 1959 and became an expert on the species.

Gray whales have a streamlined body, with a narrow, tapered head. The upper jaw is arched in profile, and slightly overlaps the lower jaw. The rostrum (upper jaw) is dimpled and each of the little depressions contains one stiff hair. About 2/3 of the way back on its body is a prominent dorsal hump followed by a series of 6–12 knuckles along the dorsal ridge that extend to the flukes (tail lobes). Its flippers are paddle shaped and pointed at the tips. Adult males measure 45-46 feet and adult females measure slightly more. Both sexes weigh 30-40 tons.

Among the baleen whales, the gray whale has a unique feeding pattern. They feed on small crustaceans such as amphipods, and tube worms found in bottom sediments. They dive to the bottom of the ocean, turn on their side (mostly their right side) and scoop large amounts of sediment from the ocean floor. As it closes its mouth, water and sediments are expelled through the baleen plates, which trap the food on the inside and are then swiped by the tongue to be swallowed. They feed mainly in the cold Arctic waters in the summer and rarely eat on their journey to and from the lagoons of Baja since their preferred diet is not available in the warmer waters.

Mating and calving both occur primarily in the lagoons of Baja California, Mexico, although both have been observed during the migration. Females bear a single calf, at intervals of 2 or more years. Courtship and mating behavior are complex, and frequently involve 3 or more whales of mixed sexes.

Gray whales occur most frequently in coastal shallow waters. Today two distinct populations occur in the eastern and western North Pacific. The western Pacific population numbers as few as 150 individuals while those on the eastern side are estimated at 20,000 individuals. There are some individual gray whales that are found year round in the Straits of Juan de Fuca between the State of Washington and Vancouver Island, Canada, and some that are seen during the summer months off the northern California coast. Recent research by the National Oceanic and Atmospheric Administration (NOAA) has tracked some individuals from the Western Pacific stock to the lagoons of Baja, an amazingly long migration. It is not clear if there is interbreeding between the two stocks.

Information on Selected Dolphins

Basic Anatomy and Behavior

All Delphinidae (ocean dolphins) have undifferentiated conical teeth (porpoises have spade-like teeth), though the number and size differ among species. The dolphins off San Diego have a curved dorsal fin near the center of the back, and the flukes are cleaved on the rear margin by a notch. The length of the beak is variable; the bottlenose and the two species of common dolphins have distinctive beaks, while the Pacific white-sided and Risso's dolphins have little to no beak at all.

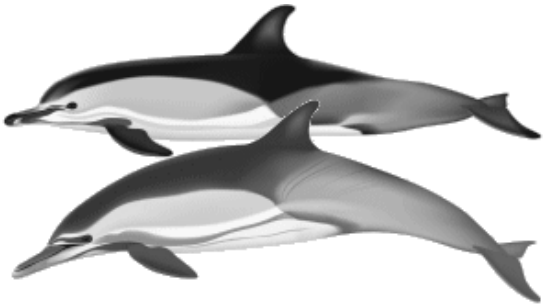
The ocean dolphins in our area primarily eat fish, along with a smaller number of squid and small crustaceans, and some species specialize in eating squid. Ocean dolphins travel in pods, which may number from just a few, to hundreds of individuals in some species. Pods can have a loose social structure, with individuals frequently joining or leaving, and sometimes culminate in megapods of thousands of dolphins traveling and foraging together.

Individuals communicate by sound, producing low-frequency whistles, and they also produce high-frequency broadband clicks of 80-220 kHz, which are primarily used for echolocation. Gestation lasts from 10 to 12 months, and results in the birth of a single calf.

Traditionally, hundreds of thousands of dolphins have been taken in fishing operations, caught in fishing nets.

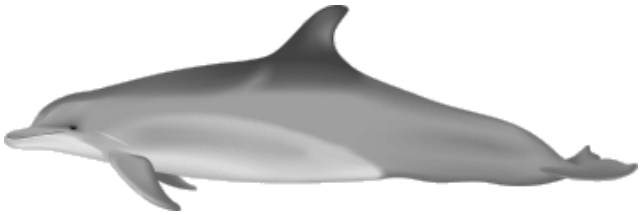
Common Dolphin

Common dolphins are colorful, with a complex crisscross or hourglass color pattern on the side. Common dolphins are often found in large pods of hundreds or even thousands. They are extremely active, fast moving, and engage in spectacular aerial behavior. They are noted for riding bow and stern waves of boats, often changing course to bow ride the pressure waves of fast-moving vessels and even large whales. Common dolphins can be frequently seen in association with other marine mammal species. Common dolphins are found worldwide.



Bottlenose Dolphin

The bottlenose dolphin is perhaps one of the most well-known cetaceans, because of its widespread use in marine parks and research facilities. This is the dolphin most frequently seen along the shores of the United States.



Bottlenose dolphins are found worldwide in temperate and tropical waters, absent only from 45 degrees poleward in either hemisphere. They are frequently seen in harbors, bays, lagoons, estuaries, and river mouths. There appear to be two ecotypes: a coastal form and an offshore form. Population density appears to be higher nearshore.

Based on a number of studies of nearshore populations, bottlenose dolphins seem to live in relatively open societies. Mother and calf bonds and some other associations may be strong, but individuals may be seen from day-to-day with a variety of different associates. Group size is often less than 20 nearshore; offshore groups of several hundred have been seen. Much of what we know of the general biology of dolphins comes from studies of bottlenose dolphins, both in captivity and in the wild.

Pacific White-sided Dolphin

Pacific White-sided dolphins come in two forms: the Atlantic white-sided and the Pacific white-sided. Somewhat similar in appearance, the Atlantic species is larger and more robust than its Pacific counterpart. Both species are avid bow-riders and acrobatic jumpers.

The Pacific white-sided dolphin inhabits temperate, coastal waters in the North Pacific, avoiding both tropical and Arctic waters. Its range extends from Amchitka Island in the Aleutians, to the Gulf of Alaska south along the coast of North America to the tip of Baja California. It is also found off the coast of Asia from the Kuril Islands to Japan. It is abundant in Japanese waters with estimates of 30,000 to 50,000 in that area.

Pacific white-sided dolphins are often found in large pods of 90 to 100. The pods are made up of animals of both sexes and all ages. They are often seen accompanying other dolphins and large whales. They are considered residents in some parts of their range, notably Monterey Bay and off southern California and northwestern Baja California, and may be joined by transient groups from other areas.

Risso's Dolphin

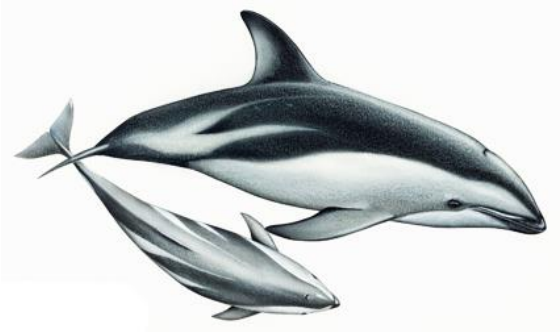
Sometimes seen off the coast of California (and rarely off the San Diego coast), Risso's dolphins, also known as Grampus, are one of the larger members of the dolphin family. They are usually an offshore dolphin whose inshore appearance is uncommon. In numerous instances though, groups have moved into inshore areas where they have been seen repeatedly over a fixed period of time. Despite this, they are seen with some regularity in Monterey Bay, California, and off British Columbia.

Typical groups of Risso's dolphins are 3-30 animals, although "super-pods" of up to several thousand together have been noted. However, recent studies indicate that groups may be stable, and may consist of related individuals (especially females), although this has yet to be confirmed. They typically travel side by side, and are fairly active. Observations of leaping, spy hopping, fluke slapping, and flipper slapping are common.

While formerly thought to be rare; this impression probably resulted from the typically offshore distribution. In fact, the species is probably abundant throughout its range, although no exact numbers are known. 13,000–30,000 animals are estimated to occur off of central and northern California.

Dusky Dolphin

Dusky dolphins, *Lagenorhynchus obscurus* (Gray, 1828), are small cetaceans that reach about 6 ½ feet in length, and 220 lbs or less. Dusky dolphins are dark blue-black in color on their tails and dorsal (upper) sides. There are three subspecies of dusky dolphins, living near South American, the Indian Ocean, and New Zealand.



Dusky dolphins are a curious species; they favor bow riding and seem to enjoy contact with boats and people. They are extremely agile swimmers and are known for their acrobatics. They are also known to associate with other cetaceans. Their own group sizes vary according to the time of year, with larger numbers living together during the summer and in winter, small groups of about 20 individuals are common.

School size of dusky dolphins in New Zealand varies. Generally, they are known to form large, widespread schools consisting of scattered, smaller, more intimate groups of about 10 individuals. The dolphins search for food as one widespread unit and rest near shore in small groups during the day. School sizes in New Zealand vary seasonally, forming larger groups during the warmer winter months.

Hector's Dolphin

Hector's dolphin, one of the rarest and smallest of marine dolphins, has a short, stocky torpedo-shaped body, which becomes narrow towards the tail. Males and females are similar in appearance, but females tend to be slightly longer than males. The common name of this dolphin refers to the

New Zealand scientist Sir James Hector, who first examined the species. It is called the “Mickey Mouse” dolphin because of its rounded dorsal fin which resembles mickey mouse ears.

This dolphin tends to occur in small groups of two to ten individuals. These groups sometimes join together forming larger temporary aggregations. Hector’s dolphins undertake short dives for about 90 seconds and feed on a variety of small fish and squid. Hector’s dolphins reproduce slowly and without human impacts have a maximum population growth rate of about 2 percent per year. Each female has one calf every 2-4 years which tends to be born between late spring and summer. A maximum age of about 20-25 years has been observed. Hector’s dolphins are unusual in that they only produce short, high frequency clicks, not whistles like many other species of dolphin.

Endemic to New Zealand waters, this species is found around the majority of the South Island. The North Island subspecies’ population is much smaller than the South Island population, with approximately 100 individuals remaining.

Orca (Killer Whale)

Though seldom found off the coast of San Diego, Orcas or killer whales are so iconic, they are included in this guide.

The orca, or killer whale, with its striking black and white coloring, is one of the best known of all the cetaceans. It has been extensively studied in the wild and is often the main attraction at many sea parks and aquaria. An odontocete, or toothed whale, the orca is known for being a carnivorous, fast and skillful hunter, with a complex social structure. Sometimes called "the wolf of the sea," the orca can be a fierce hunter with well-organized hunting techniques, although there are no documented cases of killer whales attacking a human in the wild.

The orca has a striking color pattern made up of well-defined areas of shiny black and cream or white. The dorsal (top) part of its body is black, with a pale white to gray "saddle" behind the dorsal fin. It has an oval, white eyepatch behind and above each eye. The chin, throat, central length of the ventral (underside) area, and undersides of the tail flukes are white. Each whale can be individually identified by its markings and by the shape of its saddle patch and dorsal fin. Males can grow as large as 32 feet long and weigh 8 to 9 tons. Females can reach 23 feet in length and weigh up to 4 tons.

The orca is found in all the oceans of the world, though they are more abundant in cooler waters. Unlike some other species of whales, which follow a regular migration route each year, the orca seems to travel according to the availability of food. They are one of the few species of whales that move freely from hemisphere to hemisphere.

Orcas generally live in pods (groups) consisting of several females, calves, one or more males, and/or juveniles. Some pods consist of a mother and her offspring who stay with her for life. This type of matrilineal family structure has been observed in the U.S. Pacific Northwest where resident pods have been documented as stable, consistent matriarchal family groups with several generations traveling

together. Transient pods appear to be more fluid; individuals come and go, groups often contain unrelated females with offspring, offspring do not stay with their mother and pods may form solely as a temporary foraging pack. The social structure of other populations, including offshore orcas, is being studied to document whether certain family groups always stay together or return to each other after periods of time. Mothers are very protective of their calves, and orcas are known to protect and care for sick and injured companions. Sparked by the increase in live capture for aquaria and public concern, scientists have been studying resident pods along the northern Pacific coast of the United States and Canada since 1970. By 1973, photographs were being used to identify individuals based on differences in saddle color pattern, dorsal fin shapes and other identifying marks and scars. Identified orcas have all been numbered and careful records are kept of their re-sightings. Recordings of the sounds made by these orcas have revealed that each pod has its own "dialect." Each pod has some sounds in common with other pods, and other sounds that are unique to its own pod. Through these scientific studies, much has been learned about population, travel patterns, reproduction, behavior and social habits of orcas.

Although orcas are widely distributed, total world population is still unknown. They have no natural enemies and have not been hunted as much as other whales. Recent studies suggest that a significant threat to orcas, and other marine mammals, may come from man-made chemicals. Yet, toxins are not the only threats facing orcas. Many fish populations around the world are decreasing. This may be having a direct effect on the populations of fish-eating resident whales. Loss of fish may also cause a decline in seals and sea lions, often the primary prey of transient orcas.

Dolphins and Echolocation

Hearing and echolocation from: The Dolphin Institute (http://www.dolphin-institute.org/)

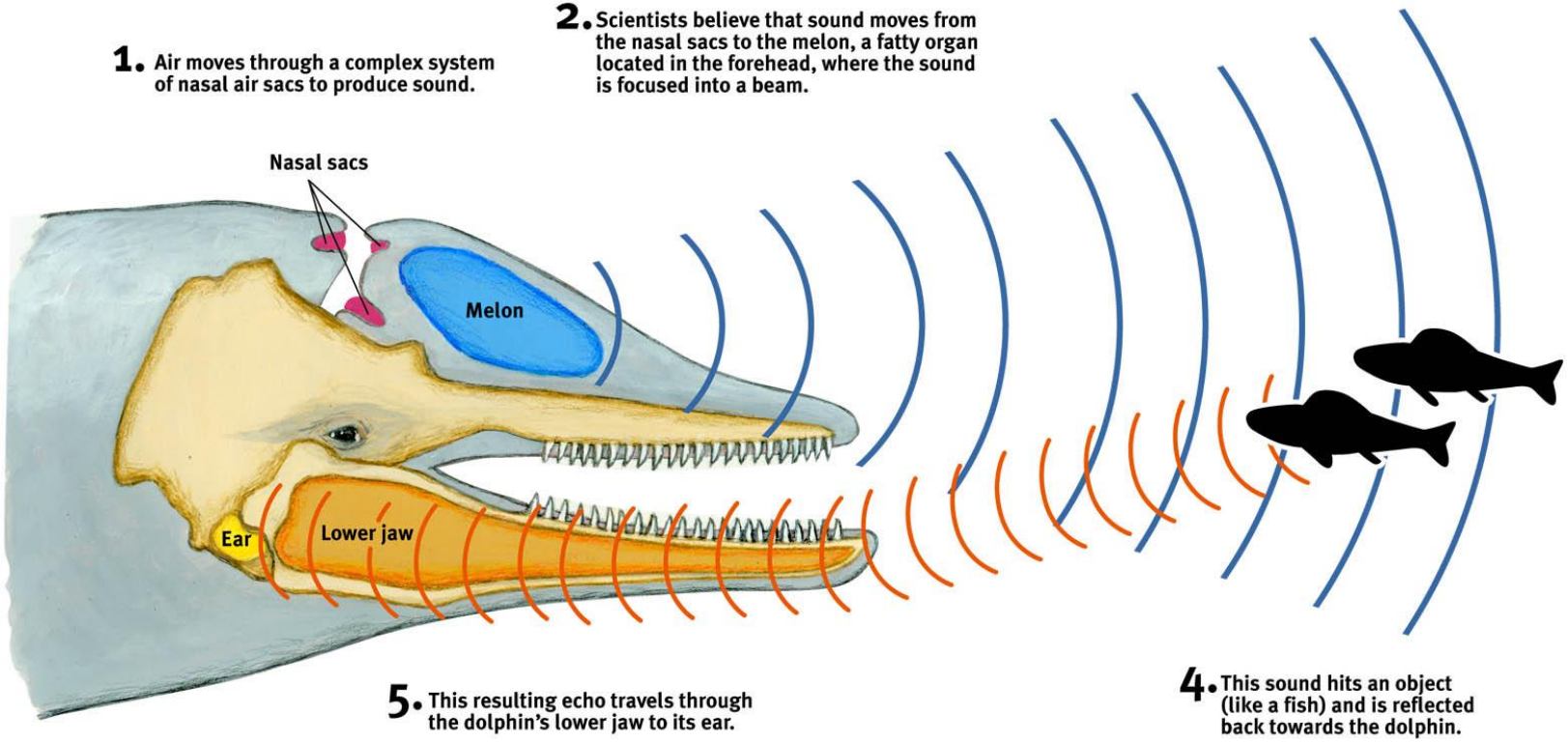
The underwater world is filled with sound, providing information on such diverse things as vocalizing schoolmates, shoaling water, and prey locations. In response to the advantages of perceiving and interpreting underwater sounds, the dolphin’s hearing and sound production systems have undergone extensive modifications. The external ears have disappeared, resulting in a more streamlined body shape better suited to rapid swimming. New sound pathways to the inner ear have evolved, including the broad area around the sides of the dolphin’s head and the fat-filled spaces of the lower jaw.

Each of the two inner ears is isolated acoustically from the other, enabling the dolphin to precisely locate the sources of underwater sound. Hearing is remarkably acute throughout a broad range of frequencies, and the dolphin is capable of distinguishing small differences in the frequency (pitch) of sounds. One of the types of sounds produced by dolphins is the whistle, a narrow-band continuous sound that varies in its frequency. Individual dolphins tend to have unique whistle sounds, called “signatures,” and can be easily recognized by other members of its group.

Additionally, the inner ear has been modified to allow for the perception of high-frequency sounds, reaching some ten times or more above the upper limit of adult human hearing. The ability to sense these high-frequency sounds is vital for the dolphin’s echolocation sense and allows the dolphin to detect very small objects. A series of very short duration, high-intensity, broad-band clicks containing frequencies as high as 120-kHz are projected in a narrow beam from the region of the dolphin’s melon and broadcast in front of the dolphin into the adjoining waters. When the clicks strike an object, echoes are returned and sensed by the dolphin through its special pathways for hearing.

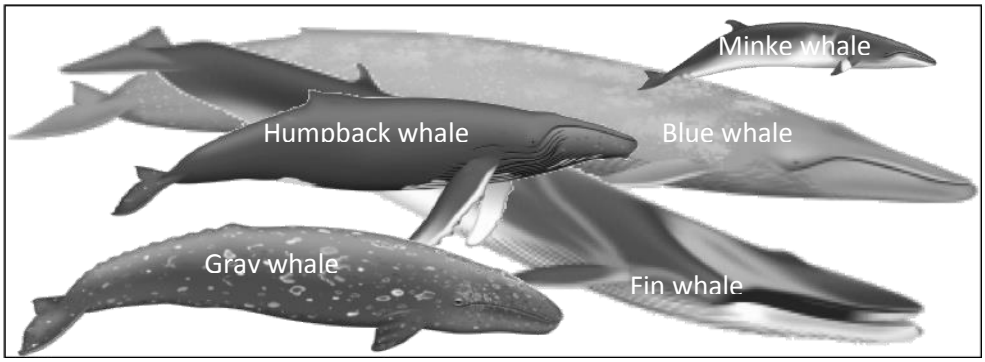
Recent research suggests that these echoes may preserve the spatial structure or shape of the reflecting object and be interpreted by higher center of the dolphin's brain as an image of the object. This echolocation sense seems to be closely integrated with the dolphin's visual sense, allowing it to easily relate things heard to things seen.

Echolocation in dolphins



Whales in the San Diego Area

The baleen whales in San Diego area can include: blue whales, fin whales, humpbacks, gray whales, and minke whales. This collage shows the relative differences in size.



Size comparison of the mysticetes in our area. The gray whale averages 45 feet long. Unlike the other whales in this picture, the gray whale is not a rorqual.

Dolphins in the San Diego area include: common dolphins, bottlenose dolphins, Risso's dolphins (not so often in recent years), and Pacific white-sided dolphins. There have been rare sightings of orcas on occasion.

Whale Evolution

This is by no means a complete explanation of the evolution of whales. For detailed information refer to the *Whales: Giants of the Deep* exhibition and come to the lecture on the Evolutionary History of Baleen Whales with Tom Deméré, Curator of Paleontology on Thursday, April 21; 7 PM in Kaplan Theater at theNAT. For information on tickets, visit the Museum's website. http://sdnhm.org/calendar/public-programs/lectures-and-films/

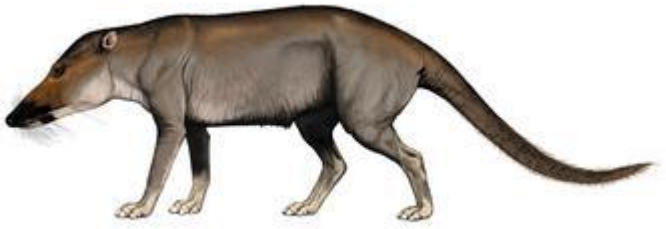
The following is taken from the American Museum of Natural History for *Whales: Giants of the Deep*:

The evolutionary transition came shortly after the rise of modern mammal groups, around 55 million years ago, during a hot period in the Earth's history. Dinosaurs, other than birds, and large marine reptiles had disappeared some millions of years previously.

One group of hoofed mammals spent more and more time in the water, living on the abundant food there. Eventually they left land altogether—evolving into the fully aquatic whales. A few of these early extinct whales are shown on the following pages.

Pakicetus attocki

Pakicetus attocki (R) lived on the margins of a large shallow ocean around 50 million years ago. Chemical information from some of these wolf-sized meat-eaters show that they ate fish.



Ear bones from Pakicetus show a feature that is unique to whales, placing it as the earliest known member of the modern whale lineage.

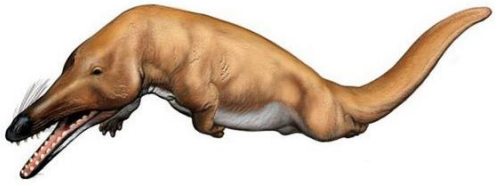
Ambulocetus natans

Ambulocetus natans (below) means “walking whale that swims,” referring to its lifestyle both in water and on land. It probably swam by paddling with its legs and dived by tucking in its forelimbs and giving powerful kicks with its hind limbs, a distinctive way of moving in the water.

It seems Ambulocetus heard sound through its lower jaw bone. Sound passed from the jaw through soft tissues leading to the ear. This small adaptation foreshadows the sound-receiving system used by modern toothed whales.

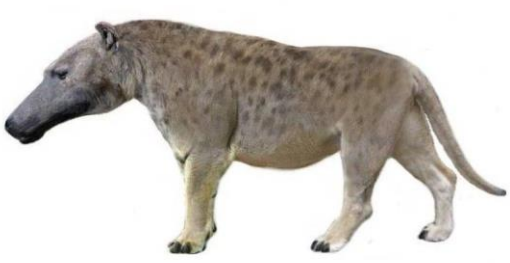
Kutchicetus minimus

Kutchicetus minimus (R), with its small, otterlike skeleton, lived between 43 and 46 million years ago. Like other early whales,Kutchicetus lived in tropical seas. Its fossils are found in sediment that formed in shallow seas sheltered by barrier islands.



How did Kutchicetus swim? Its hind legs are smaller than those of earlier whales and probably had little to do with propulsion. Perhaps that long tail helped, although there is no evidence of tail flukes as seen in living whales.

Kutchinecetus probably spent more time diving than Pakicetus. Hair was no longer needed in its aquatic environment. Blubber provided insulation and helped with body streamlining, which in turn aided swimming.



Andrewsarchus mongoliensis (L)

This close whale relative, a member of the hoofed mammal group that includes hippos and whales, is known from a single skull discovered in 1923 during a Museum expedition to Mongolia and China. The rarely displayed specimen is on exhibit in *Whales: Giants of the Deep*.

Dorudon atrox (Below)
The exhibition (*Whales: Giants of the Deep*) features a cast of a Dorudon atrox skeleton and skull that represents a group of early fossil whales called basilosaurids. These whales were fully aquatic and lived between 34 and 40 million years ago. From a distance, living basilosaurids probably looked very much like modern species.

The nostrils, or blowhole, had moved toward the top of the head. The structure of the ear bones suggests that basilosaurids could hear well under water. Forelimbs became paddlelike flippers, while the hindlimbs were rudimentary. The pelvis had detached from the spinal column, freeing up the lower spine to power greater tail movement. Squared-off vertebrae at the tip of the tail would have supported flukes.

This group of whales came to inhabit all the oceans of the world.

The Maori

The Maori are the tangata whenua—"the people of the land." They are the indigenous people of New Zealand. The Maori name for New Zealand is *Aotearoa*, meaning "land of the long white cloud." They are Polynesian and make up fifteen percent of the country's population. Te Reo Maori is their native language.

Tukaroto Matutaera Potatau Te Wherowhero Tawhiao, the second Maori king (1860–94).

Frank and Frances Carpenter Collection/Library of Congress, Washington, D.C. (LC-USZ62-109768)

Maori Origins

There are several theories regarding the origin of the Maori. It is believed they arrived before 1300 A.D. Their own legends say they came from "*Hawaiki,*" their legendary homeland, a place believed to be somewhere in Southern Polynesia. They arrived in large ocean going canoes (*waka*): the Aotea, Arawa, Tainui, Kurahaupo, Takitimu, Horouata, Tokomaru and Mataatua.

A more accepted theory suggests the Maori migrated to New Zealand over an extended period time. Beginning in China, they traveled to Taiwan, the Philippines, Indonesia, Melanesia, Fiji, Samoa, the Marquesas, then southwest to Tahiti, the Cook Islands and finally arriving in New Zealand. Although recognized as one of the greatest navigating peoples of all time, it is unknown if they discovered New Zealand by chance of if they had sophisticated ancient knowledge of the stars and ocean currents.

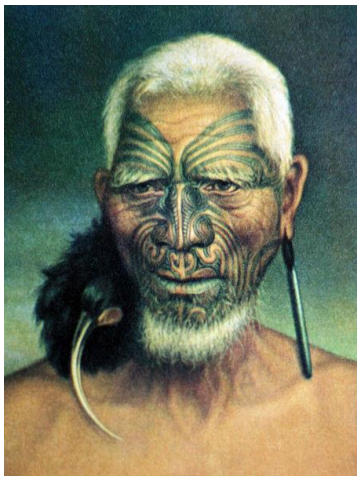
Upon arrival, the Maori settled along the coast, hunting seals and moas (a flightless bird now extinct, possible due to overhunting by the Maori). Later, they grew their food and some even moved into the forests. Although a stone-age culture, they were highly evolved, using mainly bird bones, whale bones, ivory teeth, dog bones, human bones and stone as tools. They lived in small tribal groups, rich in oral culture.

Maori Traditions

Before the arrival of the *Pakeha* (white man), all literature was passed orally through succeeding generations. This includes many legends and songs. In addition to oral telling, some stories were told as carvings in their homes.

One oral story is the creation of Earth. The Maori story describes the world as being formed by the violent separation of *Ranginu*i, the Sky Father, and *Papatuanuku*, the Earth Mother, by their children. Many Maori carvings and artworks graphically depict this struggle.

The Maori also had a rich traditional in performing arts, some of which are still performed today. They include the *haka* (a posture dance), the *poi* (dance accompanied by song and rhythmic movements of the poi, a light ball on a string), the *waiata-ā-ringa* (action songs) and the *waiata koroua* (traditional chants).



Tukukino, old chief

Lindauer painted this portrait in 1878 J.C. Graham, editor, *Maori Paintings: Pictures from the Partridge Collection of Paintings by Gottfried Lindauer*. A.H. & A.W. Reed, Wellington, 1965, p54-55.

Another prominent tradition in the Maori culture was, and still is, *ta moko*, a permanent tattooing of the face and body. The full faced tattoo was predominantly a male activity. The females restricted their tattoos to the chin area, the upper lip and the nostrils. *Ta moko* is distinct from other forms of tattooing because it uses a chisel to carve the skin rather than using needles to puncture it, as in traditional tattooing. This leaves the skin with textured groves, rather than a smooth surface. *Ta moko* is a core component of Maori culture and an outward expression of commitment and respect.

Legend states that the art of *ta moko* came from the underworld. The legend goes that a young warrior, named Mataora, fell in love with Niwareka, the princess of the underworld. She agreed to stay above ground and marry Mataora. But Mataora mistreated her, and she returned to the underworld. Hoping to win her back, Mataora followed her below, enduring many trials and obstacles on his way. When he finally found her, the paint on his face was smudged from his sweat and the Niwareka's people, with chiseled faces and permanent designs, laughed at him. Ashamed, Mataora asked his father-in-law to teach him the art of *ta moko*, which he did. Niwareka eventually forgave her husband and returned with him to the world above, along with the knowledge of *ta moko* and other skills.

Carvings are another important part of the Maori culture. Carvings could be found in their homes, boats, statues and jewelry and were made out of jade, bone, silver, and wood. Each design tells a story, which can be read by those who know how. The shape of the heads, position of the body and the surface patterns work together to record and remember events. A representation of the most common can be found below.

Maori Weapons

Fighting amongst tribes was common, usually a dispute over territory. Maori warriors were fierce in battle and the fate of their enemies, when captured, usually involved being eaten or having their heads shrunk as trophies.

The *mere* (L) was a short, flat club usually made out of wood, bone or greenstone. It was used in hand-to-hand combat, striking the opponent's temple, jaw and ribs. A greenstone mere was particularly prized because it required an incredible amount of work to make one. Warriors with greenstone mere were considered to possess great strength and honor.

The *wahaika (R)* was a short club used where thrusting jabs were needed. A warrior would hold it by its thong of dog skin through a hole in the handle, then wrap it around his wrist and thumb. The indent on the right was for catching the opponent's weapon. With a quick flick and twist of the wrist, one could disarm his enemy.

The kotiate (L) was the prized weapon on the battlefield and many chielfs held one during speech making. The notches on the sides are for catching the opponent's weapon. Like the *wahaika*, a quick flick did the job.

The taiaha (R) is one the most known weapon. It is a long club, typically five feet in length or longer.

The *toki pou tangata* (L) was for ceremonial occasions. It was characterized by a greenstone blade and a carved handle.

First Contact and War

1642—First European contact by Abel Tansman, a European. He fought with a group of Maori on South Island. He left, leaving the island virtually unexplored.

1769-70—Capt. James Cook arrived and claimed the land for Britain. He wrote about the intelligence of Maori & opportunity for colonization.

1830's—Many Europeans live amongst the Maori. Diseases brought by the Europeans killed many Maori.

1840—Queen Victoria annexes New Zealand. The Treaty of Waitangi was signed by 500 tribal chiefs and a small number of Europeans. It gave the Maori the rights of British subjects plus Maori property rights and tribal autonomy.

1845—Alarmed by the Europeans, some Maori chieftains wage war (First Maori War).

1847—Uprising defeated.

1857—Te Wherowhero elected as king. Also established were a council of state, a judicial system, and a police organization in an attempt to retain their land and to stop the intertribal warfare over the issue.

1859—Te Teira, a Maori of the Taranaki area, sold his Waitara River land to the colonial government without the consent of his tribe.

1860-61—First Taranaki War

1863—Second Taranaki War—both wars ended in the British taking large amounts of Maori land in punishment for what they considered an uprising.

1862 & 1865—Native Land Acts. These acts resulted in the Maori losing almost all of their land. After this, the Maori population dropped drastically and by the late 19th century it seemed like the Maori people and culture would disappear, assimilating into the European population.

Maori Today

The 2013 census showed 598,602 Maori living in New Zealand. They live throughout New Zealand, and many are actively involved with keeping their culture and language alive. For them, being Maori means recognizing and venerating their Maori ancestors, having claims to family land and having a right to be received as *taangata whenua* ("people of the land") in the village of their ancestors. It means the acceptance of group membership and the shared recognition, with members of the group, of distinctly Maori ways of thinking and behaving. They define themselves by their *iwi* (tribe), *hapu* (sub-tribe), *maunga* (mountain) and *awa* (river). Whanau is the name given to family—the term embraces immediate family, in-laws and all those connected by blood ties.

Picture of Maori family, circa 1880 and 1889
Photothèque du Musée de l'Homme
via French National Library URL]
Reference No Cote: 1998-1361-139

To preserve the Maori culture, there are *kōhanga reo* (preschool language nests) set up where preschool children are encouraged to use the Maori language. Primary and secondary schools include the Maori language in their curriculum. There is a Maori television station and 20 radio stations. Sixteen Maori members represent their people in Parliament.

Sources:

virtualoceania.net/newzealand/culture/maori/; britannica.com/topic/Maori;
history-nz.org/maori; Te Ahukaramū Charles Royal.
'Māori', Te Ara - the Encyclopedia of New Zealand, updated 7-Sep-15
2013 New Zealand Census **Source:** Statistics New Zealand
maorisource.com/Maori-Tribe

Interpretative Cart

Objects on Cart

The exhibition is focused on whales of the South Pacific. The objects on the cart are meant to help educate the visitors about our local whales. Please refer to the cards on the cart that explain more about each item. This is a list of what you will find:

- Minke Whale baleen (used in place of teeth) and picture of minke whale skeleton with baleen
- Gray whale barnacle (live on skin of whale)
- Gray whale louse (live on skin of whale)
- Common dolphin skull model
- Bottlenose dolphin skull model – for comparison
- Sperm whale and orca teeth
- Sperm whale tooth and killer whale tooth
- Dolphin fin
- Gray whale migration map – the gray whale makes the longest migration of any mammal
- Chart showing relative sizes of whales
- Rack cards for information on whale watching

Inquiry Based Learning

Inquiry-based learning starts by a facilitator posing questions, problems or scenarios, rather than simply presenting established facts or portraying a smooth path to knowledge. It is a process of asking questions of the visitor, and finding answers together by looking, touching, and investigating an object. At theNAT we encourage using this model for engaging visitors. We want to spark their interest not overload them with facts. If the visitor asks a questions you don't know the answer to, it's a perfect opportunity to say, "Let's explore that answer together."

Sample Questions for Inquiry Based Learning

Minke Whale Baleen

- What is this?
- What animal do you think this is from?
- What makes you think that?
- Where would you find this?
- (Assuming they say "mouth") where do you think it would be in the mouth?
- What do you think it's made out of?
- What do they use it for?
- What kind of food do you think they eat?
- (2 finger touch) What does it feel like?
- How do think a whale uses it's baleen to catch food?
- How do they get the food down their throat?
- If a whale has baleen, do you think they also have teeth?
- This is baleen from a minke whale. Do you know of some other whales that have baleen?
- Do you know of any whales that have teeth?

Gray Whale Lice

- What is it?
- What does it look like?
- Where would you find this?
- What do you think it does? OR What do they eat?
- Do you think it's harmful to a whale?
- How do you think they get on the whale?
- How do think they stay on the whale?

Gary Whale Barnacle

- What is it?
- What does it look like?
- Where would you find this?
- What do you think it does?
- What do they eat?
- How do you think they eat?
- Do you think it's harmful to a whale?
- How do you think they get on the whale?
- How do think they stay on the whale?
- Have you seen these anywhere else?

Sample Story

Gray whales undertake one the longest migration of any mammal on earth. Do you wonder why? In fact several species of whales are long distance migrators.

As we've said, the gray whales spend the summer feeding in the rich, productive waters of the arctic. Why not just stay there all year? These areas in winter have little food and are cold and dark for many months. And they also ice completely over, cutting the whales off from the surface where they must breathe. So the whales swim southward to the lagoons of Baja California, where the days are sunny and the water is 30 degrees warmer than in the arctic. But you might ask why do they swim so far? Nobody knows for sure, but it's interesting to note that the whales must constantly swim to stay afloat. So if their summer home freezes over in winter and they have to swim constantly anyway, they might as well swim to a place such as the lagoons where it is an ideal location to mate and give birth.

That leads us to one last question. If the lagoons are such great places, why not stay there year round? The answer, quite simply, is that there is not enough food in the lagoons to sustain the whales. They consume about 6%–8% of their body weight per day.

Fun Facts to Share

- During the feeding season a gray whale typically consumes about 6% of its body weight daily
- The fat content of gray whale milk is 40–50%. Cow's milk is about 4–5% fat. Beluga milk has 736 calories/cup (92 calories/ounce).

- A gray whale pregnancy lasts about 2 months longer than a human pregnancy, but by the time it's born, a calf weighs about 187 times as much as a typical human baby (1,500 lbs. versus 8 lbs.).
- During its lifetime of 50–60 years, the total distance covered during migration by a gray whale may be 600,000 miles. This is greater than a trip to the moon and back or equal to 24 trips around the world (at the equator). Or 170 trips from San Diego to Boston.
- Blue whales are believed to be the largest animal ever to have inhabited the earth.
- A blue whale's heart is as large as a Volkswagen beetle and a child can call through the blue whale's aorta (hence the full scale replica in the exhibition).
- Blue whales can consume up to 4 tons of food per day.
- During the nursing period, blue whale calves consume 100 gallons (379 liters) of the fat-rich mother's milk each day, gain 200 pounds a day, or 8 pounds an hour, and grow 1.5 inches in length a day.
- Orcas are called the wolves of the sea because they are a top predator feeding on fish and other marine mammals including seals and gray whales. They can hunt in packs.

Resources

Books

Marine Mammal Field Guides

Carwardine, Mark. 2002. *Smithsonian Handbook: Whales, Dolphins, and Porpoises*. Dorling Kindersley.

Clapham, Phil. 2001. *Whales of the World.* Minnesota: Voyageur Press.

Eder, Tamara, 2002. *Whales and Other Marine Mammals of California and Baja*, Lone Pine.

Folkens, Peter, 2002. *Guide to Marine Mammals*. Alfred A. Knopf, Inc.

Jefferson, Thomas A. et al. 2007. *Guide to Marine Mammals of the World—A Comprehensive Guide to their Identification*, Academic Press.

Leatherwood, Stephen and Randall R. Reeves. 1983. *Sierra Club Handbook of Whales, Dolphins, & Porpoises*. Sierra Club Books.

Orr, Robert and Roger Helm. 1989. *Marine Mammals of California*. University of California Press.

Movies

Available on Netflix streaming:
BBC Earth Series—Planet Earth—episode on whales
BBC Series—Life of Mammals—episode on whales
BBC Series—Ocean Giants
BBC Series—Blue Planet: The Natural History of the Oceans

Whales 3D—playing at theNAT

Web Resources

This is by no means an exhaustive list. Many of these sites have links to others.

American Cetacean Society—www.acsonline.org/

MarineBio—http://marinebio.org/

Marine Mammal Center—www.marinemammalcenter.org/

Monterey Bay Aquarium—www.montereybayaquarium.org

National Oceanic and Atmospheric Administration—www.noaa.gov

Whale and Dolphin Conservation Society—www.whales.org/

Sources Used for This Guide

Arkive.org

American Cetacean Society

Carwardine, Mark. 2002. *Smithsonian Handbook: Whales, Dolphins, and Porpoises*. Dorling Kindersley.

Eder, Tamara, 2002. *Whales and Other Marine Mammals of California and Baja*, Lone Pine.

Marinebio.ord

Reeves, Randall, Et al., 2002. National Audubon Society *Guide to Marine Mammals of the World; Chanticleer Press.*