

= Whale =

Whale is the common name for a widely distributed and diverse group of fully aquatic placental marine mammals . They are an informal grouping within the infraorder Cetacea , usually excluding dolphins and porpoises . Whales , dolphins and porpoises belong to the order Cetartiodactyla with even @-@ toed ungulates and their closest living relatives are the hippopotamuses , having diverged about 40 million years ago . The two parvorders of whales , baleen whales (Mysticeti) and toothed whales (Odontoceti) , are thought to have split apart around 34 million years ago . The whales comprise eight extant families : Balaenopteridae (the rorquals) , Balaenidae (right whales) , Cetotheriidae (the pygmy right whale) , Eschrichtiidae (the gray whale) , Monodontidae (belugas and narwhals) , Physeteridae (the sperm whale) , Kogiidae (the dwarf and pygmy sperm whale) , and Ziphiidae (the beaked whales) .

Whales are creatures of the open ocean ; they feed , mate , give birth , suckle and raise their young at sea . So extreme is their adaptation to life underwater that they are unable to survive on land . Whales range in size from the 2 @.@ 6 metres (8 @.@ 5 ft) and 135 kilograms (298 lb) dwarf sperm whale to the 34 metres (112 ft) and 190 metric tons (210 short tons) blue whale , which is the largest creature that has ever lived . The sperm whale is the largest toothed predator on earth . Several species exhibit sexual dimorphism , in that the females are larger than males . Baleen whales have no teeth ; instead they have plates of baleen , a fringe @-@ like structure used to expel water while retaining the krill and plankton which they feed on . They use their throat pleats to expand the mouth to take in huge gulps of water . Balaenids have heads that can make up 40 % of their body mass to take in water . Toothed whales , on the other hand , have conical teeth designed for catching fish or squid . Baleen whales have a well developed sense of " smell " , whereas toothed whales have well @-@ developed hearing ? their hearing , that is adapted for both air and water , is so well developed that some can survive even if they are blind . Some species , such as sperm whales , are well adapted for diving to great depths to catch squid and other favoured prey .

Whales have evolved from land @-@ living mammals . As such they must breathe air regularly , though they can remain submerged for long periods . They have blowholes (modified nostrils) located on top of their heads , through which air is taken in and expelled in the form of vapour . They are warm @-@ blooded , and have a layer of fat , or blubber , under the skin . With streamlined fusiform bodies and two limbs that are modified into flippers , whales can travel at up to 20 knots , though they are not as flexible or agile as seals . Whales produce a great variety of vocalizations , notably the extended songs of the humpback whale . Although whales are widespread , most species prefer the colder waters of the Northern and Southern Hemispheres , and migrate to the equator to give birth . Species such as humpbacks and blue whales are capable of travelling thousands of miles without feeding . Males typically mate with multiple females every year , but females only mate every two to three years . Calves are typically born in the spring and summer months and females bear all the responsibility for raising them . Mothers of some species fast and nurse their young for a relatively long period of time .

Once relentlessly hunted for their products , whales are now protected by international law . The North Atlantic right whales nearly became extinct in the twentieth century , with a population low of 450 , and the North Pacific gray whale population is ranked Critically Endangered by the IUCN . Besides whaling , they also face threats from bycatch and marine pollution . The meat , blubber and baleen of whales have traditionally been used by indigenous peoples of the Arctic . Whales have been depicted in various cultures worldwide , notably by the Inuit and the coastal peoples of Vietnam and Ghana , who sometimes hold whale funerals . Whales occasionally feature in literature and film , as in the great white whale of Herman Melville 's Moby Dick . Small whales , such as belugas , are sometimes kept in captivity and trained to perform tricks , but breeding success has been poor and the animals often die within a few months of capture . Whale watching has become a form of tourism around the world .

= = Etymology and definitions = =

The word " whale " comes from the Old English whæl , related to the High German wal . Related forms are the Old Norse hvalr and the Swedish / Danish hval . The obsolete " whalefish " has a similar derivation , indicating a time when whales were thought to be fish . Other archaic English forms include wal , wale , whal , whalle , whaille , wheal , etc .

The term " whale " is sometimes used interchangeably with dolphins and porpoises , acting as a synonym for Cetacea . Six species of dolphins have the word " whale " in their name , collectively known as blackfish : the killer whale , the melon @-@ headed whale , the pygmy killer whale , the false killer whale , and the two species of pilot whales , all of which are classified under the family Delphinidae (oceanic dolphins) . Each species has a different reason for it , for example , the killer whale was named " Ballena asesina " by Spanish sailors , which translates directly to " whale assassin " or " whale killer " , but is more often translated to " killer whale " .

= = Taxonomy and evolution = =

The whales are part of the largely terrestrial mammalian clade Laurasiatheria . Whales do not form a clade or order ; the infraorder Cetacea includes dolphins and porpoises , which are not considered whales .

Whales in green

A = Artiodactyla

C = Cetartiodactyla

W = Whippomorpha

Cetaceans are divided into two parvorders : the largest parvorder , Mysticeti (baleen whales) , is characterized by the presence of baleen , a sieve @-@ like structure in the upper jaw made of keratin , which it uses to filter plankton , among others , from the water ; Odontocetes (toothed whales) are characterized by bearing sharp teeth for hunting , as opposed to their counterparts ' baleen .

Cetaceans and artiodactyls now are classified under the order Cetartiodactyla , often still referred to as Artiodactyla , which includes both whales and hippopotamuses . The hippopotamus and pygmy hippopotamus are the whale 's closest terrestrial living relatives .

= = = Mysticetes = = =

Mysticetes are also known as baleen whales . They have a pair of blowholes side @-@ by @-@ side and lack teeth , which renders them incapable of catching larger prey ; they instead have baleen plates which is a sieve @-@ like structure in the upper jaw made of keratin , which it uses to filter plankton and other food from the water ; this forces them to follow krill or plankton migrations . Some whales , such as the humpback , reside in the polar regions where they feed on a reliable source of schooling fish and krill . These animals rely on their well @-@ developed flippers and tail fin to propel themselves through the water ; they swim by moving their fore @-@ flippers and tail fin up and down . Whale ribs loosely articulate with their thoracic vertebrae at the proximal end , but do not form a rigid rib cage . This adaptation allows their chest to compress during deep dives as the pressure increases with depth . Mysticetes consist of four families : rorquals (balaenopterids) , cetotheriids , right whales (balaenids) , and gray whales (eschrichtiids) .

The main difference between each family of mysticete is in their feeding adaptations and subsequent behaviour . Balaenopterids are the rorquals . These animals , along with the cetotheriids , rely on their throat pleats to gulp large amounts of water while feeding . The throat pleats extend from the mouth to the navel and allow the mouth to expand to a large volume for more efficient capture of the small animals they feed on . Balaenopterids consist of two genera and eight species . Balaenids are the right whales . These animals have very large heads , which can make up as much as 40 % of their body mass , and much of the head is the mouth . This allows them to take in large amounts of water into their mouths , letting them feed more effectively . Eschrichtiids have one living member : the gray whale . They are bottom feeders , mainly eating crustaceans and benthic invertebrates . They feed by turning on their sides and taking in water mixed with sediment , which is

then expelled through the baleen , leaving their prey trapped inside . This is an efficient method of hunting , in which the whale has no major competitors .

= = = Odontocetes = = =

Odontocetes are known as toothed whales ; they have teeth and only one blowhole . They rely on their well @-@ developed sonar to find their way in the water . Toothed whales send out ultrasonic clicks using the melon . Sound waves travel through the water . Upon striking an object in the water , the sound waves bounce back at the whale . These vibrations are received through fatty tissues in the jaw , which is then rerouted into the ear @-@ bone and into the brain where the vibrations are interpreted . All toothed whales are opportunistic , meaning they will eat anything they can fit in their throat because they are unable to chew . These animals rely on their well @-@ developed flippers and tail fin to propel themselves through the water ; they swim by moving their fore @-@ flippers and tail fin up and down . Whale ribs loosely articulate with their thoracic vertebrae at the proximal end , but they do not form a rigid rib cage . This adaptation allows the chest to compress during deep dives as opposed to resisting the force of water pressure . Excluding dolphins and porpoises , odontocetes consist of four families : belugas and narwhals (monodontids) , sperm whales (physeterids) , dwarf and pygmy sperm whales (kogiids) , and beaked whales (ziphiids) . There are six species , sometimes referred to as " blackfish " , that are dolphins commonly misconceived as whales : the killer whale , the melon @-@ headed whale , the pygmy killer whale , the false killer whale , and the two species of pilot whales , all of which are classified under the family Delphinidae (oceanic dolphins) .

The differences between families of odontocetes include size , feeding adaptations and distribution . Monodontids consist of two species : the beluga and the narwhal . They both reside in the frigid arctic and both have large amounts of blubber . Belugas , being white , hunt in large pods near the surface and around pack ice , their coloration acting as camouflage . Narwhals , being black , hunt in large pods in the aphotic zone , but their underbelly still remains white to remain camouflaged when something is looking directly up or down at them . They have no dorsal fin to prevent collision with pack ice . Physeterids and Kogiids consist of sperm whales . Sperm whales consist the largest and smallest odontocetes , and spend a large portion of their life hunting squid . *P. macrocephalus* spends most of its life in search of squid in the depths ; these animals do not require any degree of light at all , in fact , blind sperm whales have been caught in perfect health . The behaviour of Kogiids remains largely unknown , but , due to their small lungs , they are thought to hunt in the photic zone . Ziphiids consist of 22 species of beaked whale . These vary from size , to coloration , to distribution , but they all share a similar hunting style . They use a suction technique , aided by a pair of grooves on the underside of their head , not unlike the throat pleats on the rorquals , to feed .

= = = Evolution = = =

Whales are descendants of land @-@ dwelling mammals of the artiodactyl order (even @-@ toed ungulates) . They are related to the Indohyus , an extinct chevrotain @-@ like ungulate , from which they split approximately 48 million years ago . Primitive cetaceans , or archaeocetes , first took to the sea approximately 49 million years ago and became fully aquatic 5 ? 10 million years later . What defines an archaeocete is the presence of anatomical features exclusive to cetaceans , alongside other primitive features not found in modern cetaceans , such as visible legs or asymmetrical teeth . Their features became adapted for living in the marine environment . Major anatomical changes included their hearing set @-@ up that channeled vibrations from the jaw to the earbone (*Ambulocetus* 49 mya) , a streamlined body and the growth of flukes on the tail (*Protocetus* 43 mya) , the migration of the nostrils toward the top of the cranium (blowholes) , and the modification of the forelimbs into flippers (*Basilosaurus* 35 mya) , and the shrinking and eventual disappearance of the hind limbs (the first odontocetes and mysticetes 34 mya) .

Today , the closest living relatives of cetaceans are the hippopotamuses ; these share a semi @-@

aquatic ancestor that branched off from other artiodactyls some 60 mya . Around 40 mya , a common ancestor between the two branched off into cetacea and anthracotheres ; nearly all anthracotheres became extinct at the end of the Pleistocene 2 @. @ 5 mya , eventually leaving only one surviving lineage - the hippo .

Whales split into two separate parvorders around 34 mya - the baleen whales (Mysticetes) and the toothed whales (Odontocetes) .

= = Biology = =

= = = Anatomy = = =

Whales have torpedo shaped bodies with non @-@ flexible necks , limbs modified into flippers , non @-@ existent external ear flaps , a large tail fin , and flat heads (with the exception of monodontids and ziphiids) . Whale skulls have small eye orbits , long snouts (with the exception of monodontids and ziphiids) and eyes placed on the sides of its head . Whales range in size from the 2 @. @ 6 @-@ metre (8 @. @ 5 ft) and 135 @-@ kilogram (298 lb) dwarf sperm whale to the 34 @-@ metre (112 ft) and 190 @-@ metric @-@ ton (210 @-@ short @-@ ton) blue whale . Overall , they tend to dwarf other cetartiodactyls ; the blue whale is the largest creature on earth . Several species have female @-@ biased sexual dimorphism , with the females being larger than the males . One exception is with the sperm whale , which has males larger than the females .

Odontocetes , such as the sperm whale , possess teeth with cementum cells overlying dentine cells . Unlike human teeth , which are composed mostly of enamel on the portion of the tooth outside of the gum , whale teeth have cementum outside the gum . Only in larger whales , where the cementum is worn away on the tip of the tooth , does enamel show . Mysticetes have large whalebone , as opposed to teeth , made of keratin . Mysticetes have two blowholes , whereas Odontocetes contain only one .

Breathing involves expelling stale air from the blowhole , forming an upward , steamy spout , followed by inhaling fresh air into the lungs ; a humpback whale 's lungs can hold about 5 @, @ 000 litres of air . Spout shapes differ among species , which facilitates identification .

All whales have a thick layer of blubber . In species that live near the poles , the blubber can be as thick as 11 inches . This blubber can help with buoyancy (which is helpful for a 100 @-@ ton whale) , protection to some extent as predators would have a hard time getting through a thick layer of fat , and energy for fasting when migrating to the equator ; the primary usage for blubber is insulation from the harsh climate . It can constitute as much as 50 % of a whales body weight . Calves are born with only a thin layer of blubber , but some species compensate for this with thick lanugos .

Whales have a two- to three @-@ chambered stomach that is similar in structure to terrestrial carnivores . Mysticetes contain a proventriculus as an extension of the oesophagus ; this contains stones that grind up food . They also have fundic and pyloric chambers .

= = = Locomotion = = =

Whales have two flippers on the front , and a tail fin . These flippers contain four digits . Although whales do not possess fully developed hind limbs , some , such as the sperm whale and bowhead whale , possess discrete rudimentary appendages , which may contain feet and digits . Whales are fast swimmers in comparison to seals , which typically cruise at 5 ? 15 kn , or 9 ? 28 kilometres per hour (5 @. @ 6 ? 17 @. @ 4 mph) ; the fin whale , in comparison , can travel at speeds up to 47 kilometres per hour (29 mph) and the sperm whale can reach speeds of 35 kilometres per hour (22 mph) . The fusing of the neck vertebrae , while increasing stability when swimming at high speeds , decreases flexibility ; whales are unable to turn their heads . When swimming , whales rely on their tail fin propel them through the water . Flipper movement is continuous . Whales swim by moving their tail fin and lower body up and down , propelling themselves through vertical movement , while their flippers are mainly used for steering . Some species log out of the water , which may

allow them to travel faster . Their skeletal anatomy allows them to be fast swimmers . Most species have a dorsal fin .

Whales are adapted for diving to great depths . In addition to their streamlined bodies , they can slow their heart rate to conserve oxygen ; blood is rerouted from tissue tolerant of water pressure to the heart and brain among other organs ; haemoglobin and myoglobin store oxygen in body tissue ; and they have twice the concentration of myoglobin than haemoglobin . Before going on long dives , many whales exhibit a behaviour known as sounding ; they stay close to the surface for a series of short , shallow dives while building their oxygen reserves , and then make a sounding dive .

= = = Senses = = =

The whale ear has specific adaptations to the marine environment . In humans , the middle ear works as an impedance equalizer between the outside air 's low impedance and the cochlear fluid 's high impedance . In whales , and other marine mammals , there is no great difference between the outer and inner environments . Instead of sound passing through the outer ear to the middle ear , whales receive sound through the throat , from which it passes through a low @-@ impedance fat @-@ filled cavity to the inner ear . The whale ear is acoustically isolated from the skull by air @-@ filled sinus pockets , which allow for greater directional hearing underwater . Odontocetes send out high frequency clicks from an organ known as a melon . This melon consists of fat , and the skull of any such creature containing a melon will have a large depression . The melon size varies between species , the bigger the more dependent they are of it . A beaked whale for example has a small bulge sitting on top of its skull , whereas a sperm whale 's head is filled up mainly with the melon .

The whale eye is relatively small for its size , yet they do retain a good degree of eyesight . As well as this , the eyes of a whale are placed on the sides of its head , so their vision consists of two fields , rather than a binocular view like humans have . When belugas surface , their lens and cornea correct the nearsightedness that results from the refraction of light ; they contain both rod and cone cells , meaning they can see in both dim and bright light , but they have far more rod cells than they do cone cells . Whales do , however , lack short wavelength sensitive visual pigments in their cone cells indicating a more limited capacity for colour vision than most mammals . Most whales have slightly flattened eyeballs , enlarged pupils (which shrink as they surface to prevent damage) , slightly flattened corneas and a tapetum lucidum ; these adaptations allow for large amounts of light to pass through the eye and , therefore , a very clear image of the surrounding area . In water , a whale can see around 10 @.@ 7 metres (35 ft) ahead of itself , but , of course , they have a smaller range above water . They also have glands on the eyelids and outer corneal layer that act as protection for the cornea .

The olfactory lobes are absent in toothed whales , suggesting that they have no sense of smell . Some whales , such as the bowhead whale , possess a vomeronasal organ , which does mean that they can " sniff out " krill .

Whales are not thought to have a good sense of taste , as their taste buds are atrophied or missing altogether . However , some toothed whales have preferences between different kinds of fish , indicating some sort of attachment to taste . The presence of the Jacobson 's organ indicates that whales can smell food once inside their mouth , which might be similar to the sensation of taste .

= = = Communication = = =

Whale vocalization is likely to serve several purposes . Some species , such as the humpback whale , communicate using melodic sounds , known as whale song . These sounds may be extremely loud , depending on the species . Humpback whales only have been heard making clicks , while toothed whales use sonar that may generate up to 20 @,@ 000 watts of sound (+ 73 dBm or + 43 dBw) and be heard for many miles .

Captive whales have occasionally been known to mimic human speech . Scientists have suggested this indicates a strong desire on behalf of the whales to communicate with humans , as whales have a very different vocal mechanism , so imitate human speech likely takes considerable effort .

Whales emit two distinct kinds of acoustic signals , which are called whistles and clicks : Clicks are quick broadband burst pulses , used for sonar , although some lower @-@ frequency broadband vocalizations may serve a non @-@ echolocative purpose such as communication ; for example , the pulsed calls of belugas . Pulses in a click train are emitted at intervals of ~ 35 ? 50 milliseconds , and in general these inter @-@ click intervals are slightly greater than the round @-@ trip time of sound to the target . Whistles are narrow @-@ band frequency modulated (FM) signals , used for communicative purposes , such as contact calls .

= = = Intelligence = = =

Whales are known to teach , learn , cooperate , scheme , and grieve . The neocortex of many species of whale is home to elongated spindle neurons that , prior to 2007 , were known only in hominids . In humans , these cells are involved in social conduct , emotions , judgement , and theory of mind . Whale spindle neurons are found in areas of the brain that are homologous to where they are found in humans , suggesting that they perform a similar function .

Brain size was previously considered a major indicator of the intelligence of an animal . Since most of the brain is used for maintaining bodily functions , greater ratios of brain to body mass may increase the amount of brain mass available for more complex cognitive tasks . Allometric analysis indicates that mammalian brain size scales at approximately the $\frac{2}{3}$ or $\frac{3}{4}$ exponent of the body mass . Comparison of a particular animal 's brain size with the expected brain size based on such allometric analysis provides an encephalisation quotient that can be used as another indication of animal intelligence . Sperm whales have the largest brain mass of any animal on earth , averaging 8 @,@ 000 cubic centimetres (490 in³) and 7 @.@ 8 kilograms (17 lb) in mature males , in comparison to the average human brain which averages 1 @,@ 450 cubic centimetres (88 in³) in mature males . The brain to body mass ratio in some odontocetes , such as belugas and narwhals , is second only to humans .

Small whales are known to engage in complex play behaviour , which includes such things as producing stable underwater toroidal air @-@ core vortex rings or " bubble rings " . There are two main methods of bubble ring production : rapid puffing of a burst of air into the water and allowing it to rise to the surface , forming a ring , or swimming repeatedly in a circle and then stopping to inject air into the helical vortex currents thus formed . They also appear to enjoy biting the vortex @-@ rings , so that they burst into many separate bubbles and then rise quickly to the surface . Some believe this is a means of communication . Whales are also known to produce bubble @-@ nets for the purpose of foraging .

Larger whales are also thought , to some degree , to engage in play . The southern right whale , for example , elevates their tail fluke above the water , remaining in the same position for a considerable amount of time . This is known as " sailing " . It appears to be a form of play and is most commonly seen off the coast of Argentina and South Africa . Humpback whales , among others , are also known to display this behaviour .

= = = Life cycle = = =

Whales are fully aquatic creatures , which means that birth and courtship behaviours are very different from terrestrial and semi @-@ aquatic creatures . Since they are unable to go onto land to calve , they deliver the baby with the fetus positioned for tail @-@ first delivery . This prevents the baby from drowning either upon or during delivery . To feed the new @-@ born , whales , being aquatic , must squirt the milk into the mouth of the calf . Being mammals , they , of course , have mammary glands used for nursing calves ; they are weaned off at about 11 months of age . This milk contains high amounts of fat which is meant to hasten the development of blubber ; it contains so much fat that it has the consistency of toothpaste . Females deliver a single calf with gestation lasting about a year , dependency until one to two years , and maturity around seven to ten years , all varying between the species . This mode of reproduction produces few offspring , but increases the survival probability of each one . Females , referred to as " cows " , carry the responsibility of

childcare as males , referred to as " bulls " , play no part in raising calves .

Most mysticetes reside at the poles . So , to prevent the unborn calf from dying of frostbite , they migrate to calving / mating grounds . They will then stay there for a matter of months until the calf has developed enough blubber to survive the bitter temperatures of the poles . Until then , the calves will feed on the mother 's fatty milk . With the exception of the humpback whale , it is largely unknown when whales migrate . Most will travel from the Arctic or Antarctic into the tropics to mate , calve , and raise during the winter and spring ; they will migrate back to the poles in the warmer summer months so the calf can continue growing while the mother can continue eating , as they fast in the breeding grounds . One exception to this is the southern right whale , which migrates to Patagonia and western New Zealand to calve ; both are well out of the tropic zone .

= = = Sleep = = =

Unlike most animals , whales are conscious breathers . All mammals sleep , but whales cannot afford to become unconscious for long because they may drown . While knowledge of sleep in wild cetaceans is limited , toothed cetaceans in captivity have been recorded to sleep with one side of their brain at a time , so that they may swim , breathe consciously , and avoid both predators and social contact during their period of rest .

A 2008 study found that sperm whales sleep in vertical postures just under the surface in passive shallow ' drift @-@ dives ' , generally during the day , during which whales do not respond to passing vessels unless they are in contact , leading to the suggestion that whales possibly sleep during such dives .

= = Ecology = =

= = = Foraging and predation = = =

All whales are carnivorous and predatory . Odontocetes , as a whole , mostly feed on fish and cephalopods , and then followed by crustaceans and bivalves . All species are generalist and opportunistic feeders . Mysticetes , as a whole , mostly feed on krill and plankton , followed by crustaceans and other invertebrates . A few are specialists . Examples include the blue whale , which eats almost exclusively krill , the minke whale , which eats mainly schooling fish , the sperm whale , which specialize on squid , and the gray whale which feed on bottom @-@ dwelling invertebrates . The elaborate baleen " teeth " of filter @-@ feeding species , mysticetes , allow them to remove water before they swallow their planktonic food by using the teeth as a sieve . Usually whales hunt solitarily , but they do sometimes hunt cooperatively in small groups . The former behaviour is typical when hunting non @-@ schooling fish , slow @-@ moving or immobile invertebrates or endothermic prey . When large amounts of prey are available , whales such as certain mysticetes hunt cooperatively in small groups . Some cetaceans may forage with other kinds of animals , such as other species of whales or certain species of pinnipeds .

Large whales , such as mysticetes , are not usually subject to predation , but smaller whales , such as monodontids or ziphiids , are . These species are preyed on by the killer whale or orca . To subdue and kill whales , orcas continuously ram them with their heads ; this can sometimes kill bowhead whales , or severely injure them . Other times they corral the narwhals or belugas before striking . They are typically hunted by groups of 10 or fewer orcas , but they are seldom attacked by an individual . Calves are more commonly taken by orcas , but adults can be targeted as well .

These small whales are also targeted by terrestrial and pagophilic predators . The polar bear is well adapted for hunting Arctic whales and calves . Bears are known to use sit @-@ and @-@ wait tactics as well as active stalking and pursuit of prey on ice or water . Whales lessen the chance of predation by gathering in groups . This however means less room around the breathing hole as the ice slowly closes the gap . When out at sea , whales dive out of the reach of surface @-@ hunting orcas . Polar bear attacks on belugas and narwhals are usually successful in winter , but rarely inflict

any damage in summer .

== = Whale pump == =

A 2010 study considered whales to be a positive influence to the productivity of ocean fisheries , in what has been termed a " whale pump . " Whales carry nutrients such as nitrogen from the depths back to the surface . This functions as an upward biological pump , reversing an earlier presumption that whales accelerate the loss of nutrients to the bottom . This nitrogen input in the Gulf of Maine is " more than the input of all rivers combined " emptying into the gulf , some 23 @,@ 000 metric tons (25 @,@ 000 short tons) each year . Whales defecate at the ocean 's surface ; their excrement is important for fisheries because it is rich in iron and nitrogen . The whale faeces are liquid and instead of sinking , they stay at the surface where phytoplankton feed off it .

== = Whale fall == =

Upon death , whale carcasses fall to the deep ocean and provide a substantial habitat for marine life . Evidence of whale falls in present @-@ day and fossil records shows that deep sea whale falls support a rich assemblage of creatures , with a global diversity of 407 species , comparable to other neritic biodiversity hotspots , such as cold seeps and hydrothermal vents .

Deterioration of whale carcasses happens through a series of three stages . Initially , moving organisms such as sharks and hagfish , scavenge the soft tissues at a rapid rate over a period of months , and as long as two years . This is followed by the colonization of bones and surrounding sediments (which contain organic matter) by enrichment opportunists , such as crustaceans and polychaetes , throughout a period of years . Finally , sulfophilic bacteria reduce the bones releasing hydrogen sulphide enabling the growth of chemoautotrophic organisms , which in turn , support other organisms such as mussels , clams , limpets , and sea snails . This stage may last for decades and supports a rich assemblage of species , averaging 185 species per site .

== = Interaction with humans == =

== = Whaling == =

Whaling by humans has existed since the Stone Age . Ancient whalers used harpoons to spear the bigger animals from boats out at sea . People from Norway started hunting whales around 2000 B.C. , and people from Japan began hunting whales in the Pacific at least as early . Whales are typically hunted for their meat and blubber by aboriginal groups ; they used baleen for baskets or roofing , and made tools and masks out of bones . The Inuit hunted whales in the Arctic Ocean . The Basques started whaling as early as the 11th century , sailing as far as Newfoundland in the 16th century in search of right whales . 18th and 19th century whalers hunted down whales mainly for their oil , which was used as lamp fuel and a lubricant , baleen or whalebone , which was used for items such as corsets and skirt hoops , and ambergris , which was used as a fixative for perfumes . The most successful whaling nations at this time were Holland , Japan , and the United States .

Commercial whaling was historically important as an industry well throughout the 17th , 18th and 19th centuries . Whaling was at that time a sizeable European industry with ships from Britain , France , Spain , Denmark , the Netherlands and Germany , sometimes collaborating to hunt whales in the Arctic , sometimes in competition leading even to war . By the early 1790s , whalers , namely the Americans and Australians , mainly focused efforts in the South Pacific where they mainly hunted sperm whales and right whales , with catches of up to 39 @,@ 000 right whales by Americans alone . By 1853 , U.S. profits turned to US \$ 11 @,@ 000 @,@ 000 (UK £ 6.5m) , equivalent to US \$ 348 @,@ 000 @,@ 000 (UK £ 230m) today , the most profitable year for the American whaling industry . Commonly exploited species included North Atlantic right whales , sperm whales , which were mainly hunted by Americans , bowhead whales , which were mainly

hunted by the Dutch , common minke whales , blue whales , and gray whales . The scale of whale harvesting decreased substantially after 1982 when the International Whaling Commission (IWC) placed a moratorium which set a catch limit for each country , excluding aboriginal groups until 2004 .

Current whaling nations are Norway , Iceland , and Japan , despite their joining to the IWC , as well as the aboriginal communities of Siberia , Alaska , and northern Canada . Subsistence hunters typically use whale products for themselves and depend on them for survival . National and international authorities have given special treatment to aboriginal hunters since their methods of hunting are seen as less destructive and wasteful . This distinction is being questioned as these aboriginal groups are using more modern weaponry and mechanized transport to hunt with , and are selling whale products in the marketplace . Some anthropologists argue that the term " subsistence " should also apply to these cash @-@ based exchanges as long as they take place within local production and consumption . In 1946 , the IWC placed a moratorium , limiting the annual whale catch . Since then , yearly profits for these " subsistence " hunters have been close to US \$ 31 million (UK £ 20m) per year .

= = = Other threats = = =

Whales can also be threatened by humans more indirectly . They are unintentionally caught in fishing nets by commercial fisheries as bycatch and accidentally swallow fishing hooks . Gillnetting and Seine netting is a significant cause of mortality in whales and other marine mammals . Species commonly entangled include beaked whales . Whales are also affected by marine pollution . High levels of organic chemicals accumulate in these animals since they are high in the food chain . They have large reserves of blubber , more so for toothed whales as they are higher up the food chain than baleen whales . Lactating mothers can pass the toxins on to their young . These pollutants can cause gastrointestinal cancers and greater vulnerability to infectious diseases . They can also be poisoned by swallowing litter , such as plastic bags . Environmentalists speculate that advanced naval sonar endangers some whales . Some scientists suggest that sonar may trigger whale beachings , and they point to signs that such whales have experienced decompression sickness .

= = = Conservation = = =

The scale of whale harvesting decreased substantially after 1946 when , in response to the steep decline in whale populations , the International Whaling Commission placed a moratorium which set a catch limit for each country ; this excluded aboriginal groups up until 2004 . As of 2015 , aboriginal communities are allowed to take 280 bowhead whales off of Alaska and two from the western coast of Greenland , 620 gray whales off of Washington state , three common minke whales off of the eastern coast of Greenland and 178 on their western coast , 10 fin whales from the west coast of Greenland , nine humpback whales from the west coast of Greenland and 20 off of St. Vincent and the Grenadines each year . Several species that were commercially exploited have rebounded in numbers ; for example , Grey whales may be as numerous as they were prior to harvesting , but the North Atlantic population is functionally extinct . Conversely , the North Atlantic right whale was extirpated from much of its former range , which stretched across the North Atlantic , and only remains in small fragments along the coast of Canada , Greenland , and is considered functionally extinct along the European coastline .

The IWC has designated two whale sanctuaries : the Southern Ocean Whale Sanctuary , and the Indian Ocean Whale Sanctuary . The Southern Ocean whale sanctuary spans 30 @,@ 560 @,@ 860 square kilometres (11 @,@ 799 @,@ 610 sq mi) and envelopes Antarctica . The Indian Ocean whale sanctuary takes up all of the Indian Ocean south of 55 ° S. The IWC is a voluntary organization , with no treaty . Any nation may leave as they wish ; the IWC cannot enforce any law it makes .

As of 2013 , the International Union for Conservation of Nature (IUCN) recognized 86 cetacean species , 40 of which are considered whales . Six are considered at risk , as they are ranked

Critically Endangered (the North Atlantic right whale) , " Endangered " (blue whale , fin whale , North Pacific right whale , and sei whale) , and " Vulnerable " (sperm whale) . Twenty @-@ one species have a " Data Deficient " ranking . Species that live in polar habitats are vulnerable to the effects of recent and ongoing climate change , particularly the time when pack ice forms and melts .

= = = Whale watching = = =

An estimated 13 million people went whale watching globally in 2008 , in all oceans except the Arctic . Rules and codes of conduct have been created to minimize harassment of the whales . Iceland , Japan and Norway have both whaling and whale watching industries . Whale watching lobbyists are concerned that the most inquisitive whales , which approach boats closely and provide much of the entertainment on whale @-@ watching trips , will be the first to be taken if whaling is resumed in the same areas . Whale watching generated US \$ 2 @. @ 1 billion (UK £ 1 @. @ 4 billion) per annum in tourism revenue worldwide , employing around 13 @, @ 000 workers . In contrast , the whaling industry , with the moratorium in place , generates US \$ 31 million (UK £ 20 million) per year . The size and rapid growth of the industry has led to complex and continuing debates with the whaling industry about the best use of whales as a natural resource .

= = = In myth , literature and art = = =

As marine creatures that reside in either the depths or the poles , humans knew very little about whales over the course of history ; many feared or revered them . The Nords and various arctic tribes revered the whale as they were important pieces of their lives . In Inuit creation myths , when ' Big Raven ' , a deity in human form , found a stranded whale , he was told by the Great Spirit where to find special mushrooms that would give him the strength to drag the whale back to the sea and thus , return order to the world . In an Icelandic legend , a man threw a stone at a fin whale and hit the blowhole , causing the whale to burst . The man was told not to go to sea for twenty years , but during the nineteenth year he went fishing and a whale came and killed him .

Whales played a major part in shaping the art forms of many coastal civilizations , such as the Norse , with some dating to the Stone Age . Petroglyphs off a cliff face in Bangudae , South Korea show 300 depictions of various animals , a third of which are whales . Some show particular detail in which there are throat pleats , typical of rorquals . These petroglyphs show these people , of around 7 @, @ 000 to 3 @, @ 500 B.C.E. in South Korea , had a very high dependency on whales .

The Pacific Islanders and Australian Aborigines viewed whales as bringers of good and joy . One exception is French Polynesia , where in many parts , cetaceans are met with great brutality .

In Vietnam and Ghana , among other places , whales hold a sense of divinity . They are so respected in their cultures that they occasionally hold funerals for beached whales , a throwback to Vietnam 's ancient sea @-@ based Austro @-@ Asiatic culture . The god of the seas , according to Chinese folklore , was a large whale with human limbs .

Whales have also played a role in sacred texts such as the Bible . It mentions whales in Genesis 1 : 21 , Job 7 : 12 , and Ezekiel 32 : 2 . The " leviathan " described at length in Job 41 : 1 @-@ 34 is generally understood to refer to a whale . The " sea monsters " in Lamentations 4 : 3 have been taken by some to refer to marine mammals , in particular whales , although most modern versions use the word " jackals " instead . The story of Jonah being swallowed by a great fish is told both in the Qur 'an and in the Bible . A medieval column capital sculpture depicting this was made in the 12th century in the abbey church in Mozac , France . The Old Testament contains the Book of Jonah and in the New Testament , Jesus mentions this story in Matthew 12 : 40 .

In 1585 , Alessandro Farnese , 1585 , and Francois , Duke of Anjou , 1582 , were greeted on his ceremonial entry into the port city of Antwerp by floats including " Neptune and the Whale " , indicating at least the city 's dependence on the sea for its wealth .

Whales continue to be prevalent in modern literature . For example , Herman Melville 's Moby Dick features a " great white whale " as the main antagonist for Ahab , who eventually is killed by it . The whale is an albino sperm whale , considered by Melville to be the largest type of whale , and is partly

based on the historically attested bull whale Mocha Dick . Rudyard Kipling 's Just So Stories includes the story of " How the Whale got in his Throat " . Niki Caro 's film the Whale Rider has a M?ori girl ride a whale in her journey to be a suitable heir to the chieftain @-@ ship . Walt Disney 's film Pinocchio features a giant whale named Monstro as the final antagonist . Alan Hovhaness ' orchestra And God Created Great Whales including the recorded sounds of humpback and bowhead whales . Léo Ferré 's song " Il n 'y a plus rien " is an example of biomusic that begins and ends with recorded whale songs mixed with a symphonic orchestra and his voice .

= = = In captivity = = =

Belugas were the first whales to be kept in captivity . Other species were too rare , too shy , or too big . The first beluga was shown at Barnum 's Museum in New York City in 1861 . For most of the 20th century , Canada was the predominant source of wild belugas . They were taken from the St. Lawrence River estuary until the late 1960s , after which they were predominantly taken from the Churchill River estuary until capture was banned in 1992 . Russia has become the largest provider since it had been banned in Canada . Belugas are caught in the Amur River delta and their eastern coast , and then are either transported domestically to aquariums or dolphinariums in Moscow , St. Petersburg , and Sochi , or exported to other countries , such as Canada . Most captive belugas are caught in the wild , since captive @-@ breeding programs are not very successful .

As of 2006 , 30 belugas were in Canada and 28 in the United States , and 42 deaths in captivity had been reported up to that time . A single specimen can reportedly fetch up to US \$ 100 @,@ 000 (UK £ 64 @,@ 160) on the market . The beluga 's popularity is due to its unique colour and its facial expressions . The latter is possible because while most cetacean " smiles " are fixed , the extra movement afforded by the beluga 's unfused cervical vertebrae allows a greater range of apparent expression .

Between 1960 and 1992 , the Navy carried out a program that included the study of marine mammals ' abilities with sonar , with the objective of improving the detection of underwater objects . A large number of belugas were used from 1975 on , the first being dolphins . The program also included training them to carry equipment and material to divers working underwater by holding cameras in their mouths to locate lost objects , survey ships and submarines , and underwater monitoring . A similar program was used by the Russian Navy during the Cold War , in which belugas were also trained for antimining operations in the Arctic .

Aquariums have tried housing other species of whales in captivity . The success of belugas turned attention to maintaining their relative , the narwhal , in captivity . However , in repeated attempts in the 1960s and 1970s , all narwhals kept in captivity died within months . A pair of pygmy right whales were retained in an enclosed area (with nets) ; they were eventually released in South Africa . There was one attempt to keep a stranded Sowerby 's beaked whale calf in captivity ; the calf rammed into the tank wall , breaking its rostrum , which resulted in death . It was thought that Sowerby 's beaked whale evolved to swim fast in a straight line , and a 30 metres (98 ft) was not big enough . There have been attempts to keep baleen whales in captivity . There were three attempts to keep gray whales in captivity . Gigi was a gray whale calf that died in transport . Gigi II was another gray whale calf that was captured in the Ojo de Liebre Lagoon , and was transported to SeaWorld . The 680 kilograms (1 @,@ 500 lb) calf was a popular attraction , and behaved normally , despite being separated from his mother . A year later , the 8 @,@ 000 @-@ kilogram (18 @,@ 000 lb) whale grew too big to keep in captivity and was released ; it was the first of two gray whales , the other being another gray whale calf named JJ , to successfully be kept in captivity . There were three attempts to keep minke whales in captivity in Japan . They were kept in a tidal pool with a sea @-@ gate at the Izu Mito Sea Paradise . Another , unsuccessful , attempt was made by the U.S. One stranded humpback whale calf was kept in captivity for rehabilitation , but died days later .

= = = Cryptid whales = = =

Over the last few hundred years sailors and whalers have reported seeing whales they cannot identify . Giglioli 's whale is a purported species of baleen whale observed by Enrico Hillyer Giglioli . Trunko is the nickname for a whale @-@ like creature reportedly sighted in Margate , South Africa in 1924 . The high @-@ finned sperm whale , or *Physeter tursio* , is a supposed variant or relative of the known sperm whale , *Physeter macrocephalus* , said to live in the seas around the Shetland Islands , the Southern Ocean , and Nova Scotia .

= = = Books = = =