Scientific Classification

**Bottlenose Dolphins**

### Scientific Classification

#### Order - Cetacea

1. Cetacea is a scientific order of large aquatic mammals that have forelimbs modified into flippers, a horizontally flattened tail, one or two nostrils at the top of the head for breathing, and no hind limbs. Cetaceans include all whales, dolphins and porpoises.

2. The word "cetacean" is derived from the Greek word for whale, kētos.

3. Living cetaceans are further divided into two suborders: the Odontoceti (toothed whales) and the Mysticeti (baleen whales).

#### Suborder - Odontoceti

1. Odontoceti is a scientific suborder of whales characterized by having teeth and a single blowhole. The word “Odontoceti” comes from the Greek word for tooth, odontos.

#### Family - Delphinidae

1. Scientists group most dolphins in the scientific family Delphinidae, part of the suborder Odontoceti. Delphinids (at least 36 species of ocean dolphins) include such well known dolphins as bottlenose dolphins and common dolphins as well as pilot whales and killer whales.
false killer whales, *Pseudorca crassidens*

driver whales, *Orcinus orca*

**Genus - *Tursiops***

1. *Tursiops*, which translates as "dolphinlike," is derived from the Latin word *Tursio* for "dolphin" and the Greek suffix –*ops* for "appearance".


With the advent of advanced molecular biology screening techniques, two species within the genus *Tursiops* are now widely recognized.

**Fossil Record**

1. Scientists believe that early whales arose 50 million years ago from (now extinct) primitive mammals that ventured back into the sea. Two small rod-shaped pelvic bones, buried deep in the body muscle of toothed whales, may be remnants of the hind limbs of these primitive mammals.

2. Modern forms of both odontocetes and mysticetes appear in the fossil record five to seven million years ago.

3. The genus *Tursiops* first appears in the fossil record about five million years ago.

4. Biochemical and genetic studies suggest that even-toed ungulates, especially hippopotamuses (Family *Hippopotamidae*), are cetaceans’ closest living terrestrial relatives.
### Bottlenose Dolphins

#### Habitat & Distribution

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#### Distribution

1. Bottlenose dolphins live in temperate and tropical waters worldwide. Distribution is generally limited to surface water temperatures of 10° to 32°C (50°-90° F).

   - Documented sightings of bottlenose dolphins are indicated in dark blue.

2. In the Pacific Ocean, bottlenose dolphins are found from northern Japan to Australia and from Southern California to Chile. They are also found offshore in the eastern tropical Pacific as far west as the Hawaiian Islands. Off the California coast bottlenose dolphins have been observed as far north as Monterey, particularly during years of unusual warmth.

3. In the Atlantic Ocean, bottlenose dolphins are found from Nova Scotia to Patagonia and from Norway to the tip of South Africa. They are the most abundant dolphin species along the United States coast from Cape Cod through the Gulf of Mexico.

4. Bottlenose dolphins are also found in the Mediterranean and Black Seas.

5. Indo-Pacific bottlenose dolphins are found in the Indian Ocean from Indonesia to Australia to South Africa, the Red Sea, and in the tropical and subtropical waters of the western Pacific.

#### Habitat

1. Bottlenose dolphins live in a variety of habitats, from coastal waters to the open ocean.

2. Scientists recognize two bottlenose dolphin ecotypes (forms): coastal and offshore. In the northwest Atlantic, bottlenose dolphin coastal and offshore ecotypes can be differentiated by skull and body measurements as well as by characteristics of their blood.

   - In general, the coastal ecotype seems to be adapted for warm, shallow waters. Its smaller body and larger flippers suggest increased maneuverability and heat dissipation. These dolphins frequent harbors, bays, lagoons, and estuaries.

   - In general, the offshore ecotype seems to be adapted for cooler, deeper waters. Certain characteristics of its blood indicate that this form may be better suited for deep diving. Its larger body helps to conserve heat and defend itself against predators.

   - In northwest Atlantic bottlenose dolphin studies, researchers determined that dolphins within 7.5
km (4.65 mi) of shore were coastal ecotypes. Dolphins beyond 34 km (21 mi) from shore were offshore ecotypes.

**Migration**

1. Variations in water temperature, movements of food fish, and feeding habits may account for the seasonal movements of some dolphins to and from certain areas.

2. Some coastal dolphins in higher latitudes show a clear tendency toward seasonal migrations, traveling farther south in the winter. For example, coastal bottlenose dolphins on the Atlantic side of the U.S. migrate seasonally between New Jersey and North Carolina.

3. Coastal dolphins in warmer waters show less extensive, localized seasonal movements.

4. Some coastal animals stay within a limited home range: an area in which individuals or groups regularly move about during day-to-day activities.

   Individual dolphins that live within a home range are called "local residents." Resident dolphins have been identified along the coasts of Georgia, Florida, Texas, southern California, Gulf of California, and South Africa.

   Groups of dolphins that reside within a home range make up "resident communities." The Sarasota, Florida resident dolphin community home range is an area of about 125 km2 (48.3 mi2).

   Home ranges may overlap.

**Population**

1. Bottlenose dolphins are not endangered.

2. The worldwide population of bottlenose dolphins is unknown. Specific bottlenose dolphin populations in a few areas have been estimated.

   U.S. National Marine Fisheries Service (NMFS) surveys estimate 243,500 bottlenose dolphins in the eastern tropical Pacific.

   Japanese surveys estimate 316,935 dolphins in the northwest Pacific.

   NMFS surveys in the northern Gulf of Mexico estimate as many as 45,000 bottlenose dolphins from the coast to about 250 km (155 mi.) offshore. This area includes the Gulf's bays and sounds, coastal waters (about 17,600 individuals), and continental shelf waters (about 25,320 individuals).

   In U.S. waters of the western North Atlantic, average abundance estimates for the coastal population are 9,206 from the summer survey and 19,459 from the winter survey. The western North Atlantic average abundance estimate for the offshore population is 29,774 individuals.

   The Mediterranean population is estimated at less than 10,000.

   Average abundance estimates for the U.S. west coast include the California coastal population of 206 individuals and the California-Oregon-Washington offshore population of 5,065 individuals.

   Chromosome banding techniques have proven useful in bottlenose dolphin population studies. In some areas, scientists can identify individuals and determine relationships among dolphins in a group.
Physical Characteristics

Bottlenose Dolphins

Physical Characteristics

Size

1. In general, bottlenose dolphins are 2 to 3.9 m (6.6-12.8 ft.). Their average weight is 150 to 200 kg (331.5-442 lb.).
2. Differences in size may be related to coastal and offshore ecotype variances, and geographical locations. Offshore ecotypes, adapted for cooler waters, tend to be larger than inshore ecotypes.

The sizes and skull shapes of bottlenose dolphins vary greatly by region.

3. On average, full-grown males are slightly longer than females, and considerably heavier.

Although male and female bottlenose dolphins are close in size, full grown males are generally slightly longer than females.

4. Coastal bottlenose dolphins measured off Sarasota, Florida average 2.5 to 2.7 m (8.2-8.9 ft.) and weigh between 190 and 260 kg (419-573 lb.).
5. Large bottlenose dolphins in the Pacific may be 3.7 m (12 ft.) and weigh 454 kg (1,000 lb.). In the Mediterranean, bottlenose dolphins can grow to 3.7 m (12 ft.) or more.

Body Shape

1. A bottlenose dolphin has a sleek, streamlined, fusiform body.
The bottlenose dolphin’s streamlined body, together with its flippers, flukes, and dorsal fin, adapt this mammal for life in an aquatic environment.

Skin

1. A dolphin’s skin is smooth and feels rubbery. The skin has no hair or sweat glands.
2. A dolphin’s outer skin layer, the epidermis, is about 10 to 20 times thicker than the epidermis of terrestrial mammals.
3. Just like human skin, dolphin skin constantly flakes and peels as new skin cells replace old cells. A bottlenose dolphin’s outermost skin layer may be replaced every two hours. This sloughing rate is nine times faster than in humans. This turnover rate ensures a smooth body surface and probably helps increase swimming efficiency by reducing drag (resistance to movement).
4. A bottlenose dolphin’s skin color is gray to dark gray on its back, fading to white on its lower jaw and belly.

   This coloration, a type of camouflage known as countershading, may help conceal a dolphin from predators and prey. When viewed from above, a dolphin’s dark back surface blends with the dark depths. When seen from below, a dolphin’s lighter belly blends with the bright sea surface.

   Some bottlenose dolphins show spots on their bellies or light streaks along their sides. Many populations of Indo-Pacific bottlenose dolphins are ventrally spotted.

5. The skin layer beneath the epidermis is the dermis. The dermis contains blood vessels, nerves, and connective tissue.
6. A dolphin’s blubber (hypodermis) lies beneath the dermis. Blubber is a layer of fat reinforced by fibrous connective tissue.

   Blubber contributes to a dolphin’s streamlined shape, which helps increase swimming efficiency.

   Blubber stores calories, which provide energy when food is in short supply.

   Blubber reduces heat loss, which is important for thermoregulation.

   Blubber thickness fluctuates by season as well as with body size and health status.

Pectoral Flippers

1. A dolphin’s forelimbs are pectoral flippers. Pectoral flippers have the major skeletal elements of land mammal forelimbs, but they are foreshortened and modified. The skeletal elements are rigidly supported by connective tissue.
2. Pectoral flippers are curved back slightly and pointed at the tips.
3. Pectoral flipper length averages 30 to 50 cm (11.7-19.5 in.).
4. Dolphins use their pectoral flippers mainly to steer and, with the help of the flukes, to stop.
5. Blood circulation in the flippers adjusts to help maintain body temperature.

Arteries in the flippers are surrounded by veins. Thus, some heat from the blood traveling through the arteries is transferred to the venous blood rather than the environment. This countercurrent heat exchange aids dolphins in conserving body heat.

To shed excess body heat, circulation increases in veins near the surface of the flippers and decreases in veins returning to the body core.

**Flukes**

1. Each lobe of a dolphin’s tail is called a fluke.
2. Flukes are flattened pads of tough, dense, fibrous connective tissue, completely without bone, cartilage, or muscle.
3. From tip to tip, an adult’s flukes measure about 60 cm (23.4 in.) across. Fluke spread is about 20% of the total body length.
4. Longitudinal muscles of the back and peduncle (tail stock) move the flukes up and down to propel a dolphin through water.
5. Like the arteries of the flippers, the arteries of the flukes are surrounded by veins to help conserve body heat in cold water.

**Dorsal Fin**

1. A bottlenose dolphin’s dorsal fin is often falcate (curved back), although the shape is quite variable. It is located at the center of the back.
2. Like the flukes, the dorsal fin is made of dense, fibrous connective tissue, with no bone, cartilage, or muscle.
3. As in the flukes and the flippers, arteries in the dorsal fin are surrounded by veins to help conserve or dissipate body heat.
4. The dorsal fin may also help maintain balance as a dolphin swims, but is not necessarily essential. In fact, some whales and porpoises don’t have dorsal fins at all.

**Head**

1. The rounded region of a dolphin’s forehead is called the melon. The melon contains fat and plays an important role in dolphin echolocation.
2. In front of the melon, a bottlenose dolphin has a well-defined rostrum (snoutlike projection). The rostrum is typically 7 to 8 cm (3 in.) long, marked by a lateral crease.
3. Teeth are conical and interlocking.

   Teeth are designed for grasping (not chewing) food.
Bottlenose dolphins have 18 to 26 teeth on each side of the upper and lower jaws, a total of 72 to 104 teeth.

A tooth’s diameter measures about 1 cm (0.4 in.).

Dolphin teeth are not replaced.

4. Eyes are on the sides of the head, near the corners of the mouth.

Glands at the inner corners of the eye sockets secrete an oily, jellylike mucus that lubricates the eyes, washes away debris, and probably helps streamline a dolphin’s eye as it swims. This tearlike film may also protect the eyes from infective organisms.

A dolphin’s eyes may move independently of each other.

5. Ears, located just behind the eyes, are small inconspicuous openings, with no external pinnae (flaps).

The dimple below this dolphin’s eye is the very small external opening to its inner ear.

6. A single blowhole, located on the dorsal surface of the head, is covered by a muscular flap. The flap provides a water-tight seal.

A bottlenose dolphin breathes through its blowhole.

The blowhole is relaxed in a closed position. To open the blowhole, the dolphin contracts the muscular flap.

At the surface, the dolphin quickly inhales and then will relax the muscular flap to close its blowhole.
Senses

## Bottlenose Dolphins

### Senses

#### Brain

1. Comparisons of mammal brains are described as the ratio of brain size relative to body size. Bottlenose dolphin brains are larger than many other mammals of the same body size. Scientists are still determining what aquatic adaptations require the large brain size. One likely theory is that a larger brain size in dolphins may be at least partially due to an increased size of the auditory region to facilitate sound processing.

2. Hypotheses that large brain size in dolphins indicates high intelligence are untested and disputed. The ability of an animal to process information is based upon its brain anatomy as well as the specific experiences the animal has. Rating the intelligence of different animals is misleading and extremely subjective. In fact, a reliable and consistent intelligence test for humans has yet to be developed. It would be improper to attempt to quantify or qualify the intelligence of animals using only human guidelines.

#### Hearing

1. Dolphins have a well-developed, acute sense of hearing.

   The auditory cortex of the brain is highly developed.

   The dolphin’s auditory nerve is about twice the diameter of the human eighth nerve (connecting the inner ear to the brainstem) leading to more rapid sound processing for dolphins. In addition, a dolphin’s auditory nerve supply is about three times that of humans—possibly providing more ultrasonic information to a dolphin’s central nervous system for echolocation.

2. Hearing range.

   Bottlenose dolphins hear tones with a frequency up to 160 kHz with the greatest sensitivity ranging from 40 to 100 kHz. The average hearing range for humans is about 0.02 to 20 kHz.

3. Sound reception.

   A dolphin’s small external ear openings don’t seem to be important in conducting sound. They lead to reduced ear canals that are not connected to the middle ears.

   Soft tissue and bone conduct sound to a dolphin’s middle and inner ears. In particular, fat lobes in a toothed whale’s lower jaw appear to be an adaptation for conveying sound to the ears.

   In dolphins, ears aren’t attached to the skull. Ligaments hold each ear in a foam-filled cavity outside the skull. This separation of the ears allows a dolphin to localize sound, which is important for echolocation. Humans and most land mammals cannot effectively localize sounds under water.

#### Eyesight

1. Dolphins have acute vision both in and out of the water. A dolphin’s eye is particularly adapted for seeing under water.
Dolphins have excellent eye sight both above and below the water's surface.

2. In air, certain features of the lens and cornea correct for the refraction of light caused by the transition from aquatic to aerial vision. Without this adaptation, a dolphin would be nearsighted in air.

3. A dolphin’s retinas contain both rod cells and cone cells, indicating that they may have the ability to see in both dim and bright light. (Rod cells respond to lower light levels than cone cells.) Researchers theorize that all modern cetaceans, including all toothed whales, lack S-cone cells and therefore aren’t able to discriminate color in the blue wavelengths.

4. Dolphins’ eyes have a well-developed tapetum lucidum, a light-reflecting layer that reflects light through the retina a second time, adapting their vision to low-light levels.

**Tactile**

1. Studies of bottlenose dolphins suggest that the most sensitive areas on the dolphin’s body are the blowhole region and areas around the eyes and mouth.

**Taste**

1. Little is known about a toothed whale’s sense of taste. They do have taste buds at the base of the tongue, although they haven’t been well studied.

2. Whales and dolphins have taste buds. One research study showed that bottlenose dolphins can distinguish chemicals such as citric acid. In zoological parks, whales and dolphins show strong preferences for specific food fishes.

**Smell**

1. Olfactory lobes of the brain and olfactory nerves are absent in all toothed whales, indicating that they may not have a sense of smell.
Because their brains don't have olfactory lobes, it is believed that dolphins have no sense of smell.
Adaptations

Bottlenose Dolphins
Adaptations For An Aquatic Environment

Swimming

1. Swimming speed and duration are closely tied: high-speed swimming probably lasts only seconds, while low-speed swimming may last for long periods of time.

2. Bottlenose dolphins routinely swim at speeds of about 5 to 11 kph (3-7 mph).

3. Exercise studies indicate that bottlenose dolphins can reach burst (maximum) speeds of 29 to 35 kph (18-22 mph).

4. A dolphin's characteristic fusiform shape is quite energy-efficient for swimming. Compared to other body shapes, this shape creates less drag (the opposing force an object generates as it travels through water). Blubber smooths the contour of a dolphin and contributes to its smooth shape.

5. Bottlenose dolphins sometimes "porpoise" at the surface: they swim fast enough to break free of the water, flying up and out and then back under in one continuous movement, which they generally repeat. Porpoising uses less energy than swimming fast at the surface.

6. Certain toothed whales, such as bottlenose dolphins, sometimes ride ocean swells or a boat's bow or stern wake. Riding a wave or a wake, a dolphin can go almost twice as fast using the same energy cost.

Respiration

1. A dolphin breathes through a single blowhole on the top surface of its head. The blowhole is covered by a muscular flap, which provides a watertight seal.

   A dolphin holds its breath while below water.

   It opens its blowhole and begins to exhale just before reaching the surface of the water. To open the blowhole, a dolphin contracts the muscular flap.

   At the surface, the dolphin quickly inhales and relaxes the muscular flap to close the blowhole.

2. The visible spout of water that often rises from a dolphin's blowhole is not coming from the lungs, which (like ours) do not tolerate water.

   Water that is on top of the blowhole when the powerful exhale begins is forced up with the exhaled
Especially in cool air, a mist may form; it is water vapor condensing as the respiratory gases expand in the open air.

The visible blow of a dolphin is formed by both the seawater that has collected around the blowhole and the water vapor condensing in the respiratory gases as they expand in the cooler air.

3. During each respiration a dolphin exchanges 80% or more of its lung air. This is much more efficient than humans, who exchange only about 17% of their lung air with each breath.

4. Exhaling and inhaling takes about 0.3 seconds.

5. A bottlenose dolphin’s respiratory rate is about 1.5 to 4 respirations per minute.

**Diving**

1. Bottlenose dolphins generally do not need to dive very deep to catch food.

   Depending on habitat, most bottlenose dolphins regularly dive to depths of 3 to 46 m (10-150 ft.).

   They are, however, capable of diving to greater depths. Under experimental conditions, one bottlenose dolphin dove to 535 m (1,755 ft.). In another study, a female, offshore bottlenose dolphin dove to depths of 600 to 700 m (1,968-2,297 ft.).

2. On average a dive may last up to ten minutes. A bottlenose dolphin’s maximum breath-holding capability is about 12 minutes.

3. All marine mammals have special physiological adaptations for diving. These adaptations enable a dolphin to conserve oxygen.

   Dolphins, like other marine mammals, have a slower heart rate while diving.

   During a dive, blood is shunted away from tissues tolerant of low oxygen levels toward the heart and brain, which require a constant supply of oxygen.

   Certain protein molecules - hemoglobin and myoglobin - store oxygen in body tissues.

   Hemoglobin occurs in red blood cells. Long-diving mammals have higher blood volumes (as a percent of body weight) than do shallower-diving mammals.

   Myoglobin occurs in muscle tissue. The muscle of whales has a higher myoglobin concentration than the muscle of land mammals.

4. Unlike humans, marine mammals don’t get “the bends” when they dive.

   As pressure increases with depth, the amount of gas that goes into solution in a diver’s blood and body tissues also increases. At about 2 atmospheres of pressure (about 60 feet), tissues are saturated. If a human diver returns to the surface too quickly, the gases, especially nitrogen, come out of solution and form bubbles in muscles and blood. This painful and sometimes fatal condition is called “the bends.”

   The bends is most common in scuba divers, but human breath-hold divers can also get the bends from deep diving. Under pressure, a human’s bronchioles collapse. Lung air is forced into the alveoli: the numerous tiny areas of the lungs where gas exchange takes place. Here gases are absorbed under pressure.

   Unlike human scuba divers, a dolphin doesn’t breathe air under pressure. It inhales only at the surface. Furthermore, in diving mammals, the alveoli collapse at about 3 atmospheres of pressure (about 90 feet), forcing air into the bronchioles (rigid air passages), a region where gases are not exchanged.
Thermoregulation

1. Like other mammals, dolphins maintain a constant body temperature. A dolphin’s core body temperature is about 36° to 37°C (96.8°-98.6°F) - about the same as that of a human.

2. Dolphins have several thermoregulatory strategies to retain or release heat.

   *Decreased surface-to-volume ratio.* The dolphin’s fusiform body shape and reduced limb size decrease the amount of surface area exposed to the external environment. This helps dolphins conserve body heat. Dolphins adapted to cooler, deeper water generally have larger bodies and smaller flippers than coastal dolphins, further reducing the ratio of surface area to overall body mass.

   *Increased insulation.* Dolphins deposit most of their body fat into a thick layer of blubber. This blubber layer insulates the dolphin, helping to conserve body heat. Blubber differs from fat in that it contains a fibrous network of connective tissue in addition to fat cells. A bottlenose dolphin’s body fat generally accounts for about 18% to 20% of its body weight.

   *Heat exchange system.* A bottlenose dolphin’s circulatory system adjusts to conserve or dissipate body heat and maintain body temperature.

   Arteries in the flippers, flukes, and dorsal fin are surrounded by veins. Thus, some heat from the blood traveling through the arteries is transferred to the venous blood rather than the environment. This countercurrent heat exchange aids dolphins in conserving body heat.

   In cold water, circulation may decrease to blood vessels near the surface of the flippers, flukes, and dorsal fin, and increase to blood vessels circulating blood to the body core, thus conserving body heat.

   During prolonged exercise or in warm water, a dolphin may need to shed excess heat. In this case, circulation increases to blood vessels near the surface of the flippers, flukes, and dorsal fin, and decreases to blood vessels circulating blood to the body core. Excess heat is shed to the external environment.

   A countercurrent heat exchange system exists in the flippers, flukes, and dorsal fin of a bottlenose dolphin.

3. In general, bottlenose dolphins have a higher metabolic rate than land mammals of similar size. This increased metabolism generates a great deal of body heat.

4. Mammals lose body heat when they exhale. But dolphins conserve a considerable amount of heat because they breathe less frequently than land mammals.

Sleep

1. When studying sleep in bottlenose dolphins, researchers found that dolphins spent about 33% of each day sleeping.

2. Researchers have shown, through both observations and electrophysiological studies that deep sleep in bottlenose dolphins and other whales may occur in only one brain hemisphere at a time.
Communication & Echolocation

**Bottlenose Dolphins**

**Communication & Echolocation**

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**Why Sound In The Sea Is Important**

1. Dolphins rely heavily on sound production and reception to navigate, communicate, hunt, and avoid predators in dark or limited vision waters.

**Sound Production**

1. A human vocalizes (makes sound) by exhaling—our lungs force air through our larynx. Vocal cords in the larynx vibrate as air flows across them, producing sounds. Our throat, tongue, mouth and lips shape these sounds into speech.

2. A dolphin does not have vocal cords in its larynx. Sounds are probably produced by air movements in the nasal passage.

   - Technological advances in bioacoustic research enable scientists to better explore the nasal region. Studies suggest that a tissue complex in the nasal region is probably the most likely site of all sound production. This complex, called the dorsal bursa, includes "phonic lips"—structures that project into the nasal passage. As air pushes through the nasal passage and past the phonic lips, the surrounding tissue vibrates, producing sound.

   - A dolphin has two dorsal bursa/phonic lip complexes, which can operate independently and simultaneously. Bottlenose dolphins can produce both clicks and whistles at the same time.

3. During some vocalizations, bottlenose dolphins actually release air from the blowhole, but scientists believe that these bubble trails and clouds are a visual display and not necessary for producing sound.

4. Bottlenose dolphins produce whistles and sounds that resemble moans, trills, grunts, squeaks, and creaking doors. They make these sounds at any time and at considerable depths. Sounds vary in volume, wavelength, frequency, and pattern.

   - Clicking
   - Squeaking
   - Creaking
   - Buzzing Clicks

5. The frequency of the sounds produced by a bottlenose dolphin ranges from 0.2 to 150 kHz. The lower frequency vocalizations (about 0.2 to 50 kHz) are likely used in social communication. Social signals have their most energy at frequencies less than 40 kHz. Higher frequency clicks (40 to 150 kHz) are primarily used for echolocation.

**Signature Whistles**

1. A bottlenose dolphin identifies itself with a signature whistle. The signature whistle is so distinct that scientists can identify individual dolphins by looking at their whistle shapes on a sonogram.

2. Signature whistle frequencies typically range from 7 to 15 kHz and last less than one second.

3. A mother dolphin may whistle to her calf almost continuously for several days after giving birth. This
4. A dolphin develops its signature whistle as young as one month old.
5. Dolphins may mimic each other’s signature whistles and scientists have hypothesized that dolphins use the whistles for social interaction.
6. Scientists have found no evidence of a dolphin language.

Echolocation

1. The term echolocation refers to an ability that odontocetes (and some other marine mammals and most bats) possess that enables them to locate and discriminate objects by projecting high-frequency sound waves and listening for echoes as the sound waves reflect off objects. Odontocetes echolocate by producing clicking sounds and then receiving and interpreting the resulting echo.

   Bottlenose dolphins produce directional, broadband clicks in sequence. Each click lasts about 50 to 128 microseconds. Peak frequencies of echolocation clicks are about 40 to 130 kHz.

   The click train sequences pass through the melon, which consists of special fats (sometimes called acoustic lipids). The melon acts as an acoustical lens to focus these outgoing sound waves into a beam, which is projected forward into water in front of the animal. These sound waves bounce off objects in the water and return to the dolphin in the form of an echo.

   Sound waves travel through water at a speed of about 1.5 km/sec (0.9 mi/sec), which is 4.5 times faster than sound traveling through air.

   High frequency sounds don’t travel far in water. Because of their longer wavelength and greater energy, low frequency sounds travel farther. Echolocation is most effective at close to intermediate range, about 5 to 200 m (16–656 ft.) for targets 5 to 15 cm (2–6 in.) in length.

   The major areas of sound reception are the fat-filled cavities of the lower jaw bones. Sounds are received and conducted through the lower jaw to the middle ear, inner ear, and then to hearing centers in the brain via the auditory nerve.

   The brain receives the sound waves in the form of nerve impulses, which relay the messages of sound and enable the dolphin to interpret the sound’s meaning.

2. By this complex system of echolocation, dolphins can determine size, shape, speed, distance, direction, and even some of the internal structure of objects in the water.
3. Bottlenose dolphins are able to learn and later recognize the echo signatures returned by preferred prey species.
4. Despite the effectiveness of echolocation, studies show that a visually-deprived dolphin takes more time to echolocate on an object than a dolphin using vision in tandem with echolocation.
5. Many of the details of echolocation are not completely understood. Research on echolocation continues.

   Dolphins echolocate by producing high frequency clicks that pass through the melon, then receiving and interpreting the resulting echo.

Loud Impulse Sounds

1. Loud impulse sounds recorded from bottlenose dolphins may serve to stun prey or confuse predators; however this suggestion has not yet been confirmed.

Other Sounds

1. Dolphins produce sounds above the water surface. Dolphins also make sounds when they jump, breach, or strike the water surface with flippers and flukes. These sounds may function in communication.
Behavior

Bottlenose Dolphins

Social Organization

1. Bottlenose dolphins live in fluid social groups.

   In the past, bottlenose dolphin groups have been referred to as pods—social groups of unchanging composition. More recently, long-term studies of bottlenose dolphins have now shown that their group composition changes.

   Bottlenose dolphins commonly swim in groups of 2 to 15 individuals. Several groups may temporarily join (for several minutes or hours) in open ocean waters to form larger groups during which the dolphins may change associates.

   In general, group size tends to increase with water depth and openness of habitat. This may correlate with foraging strategies and protection.

   Some group members establish strong social bonds.

2. In the wild, group composition and structure are based largely on age, sex, reproductive condition, family relationships, and association histories.

   For example, the Sarasota, Florida resident dolphin community shows patterns of association. Basic group types include nursery groups (mothers and their most recent offspring), juveniles (both males and females), and adult males (alone or in pairs).

   Mother-calf bonds are long-lasting; a calf typically stays with its mother three to six years.

   A female may return to its mother or female relatives to raise its own calves, comprising a multigenerational group.

   Adult male pair bonds are strong and long-lasting. Male pairs often engage in a number of cooperative behaviors. Researchers have documented 20-year pair bonds.

   Associations between males and females are short-lived.
3. Social hierarchies exist within bottlenose dolphin groups.

Bottlenose dolphins establish and maintain dominance by biting, chasing, jawclapping, and smacking their tails on the water.

Dolphins often show aggression by raking-scratching one another with their teeth, leaving superficial lacerations that soon heal. Traces of light parallel stripes remain on the dolphin's skin. These marks have been seen in virtually all dolphin species. Dolphins also show aggression by emitting bubble clouds from their blowholes.

Daily Activity Cycles

1. Bottlenose dolphins are active to some degree both day and night.
2. Observations indicate that dolphins undergo daily cycles of activity, which include feeding, socializing, traveling, and resting.
3. Social behavior comprises a major portion of bottlenose dolphins' daily activities.
4. Feeding usually peaks in the early morning and late afternoon.
5. Daily activity cycles are influenced by both environmental factors (habitat, time of year, time of day) and physiological factors.

Individual Behavior

1. Dolphins frequently ride on the bow waves or the stern wakes of boats. This activity is probably adapted from the natural behavior of riding ocean swells, the wakes of large whales, or a mother dolphin's slip stream (hydrodynamic wake).
2. Dolphins have been seen jumping as high as 4.9 m (16 ft.) from the surface of the water and landing on their backs, bellies, or sides in a behavior called a breach.
3. Both young and old dolphins chase one another, carry objects around, toss seaweed to each other, and use objects to solicit interaction. Such activity may be practice for catching food.

Protection & Care

1. Large adult males often roam the periphery of a group, and may afford some protection against predators.
2. Researchers have observed scouting behavior in bottlenose dolphins. An individual may investigate novel objects or unfamiliar territories and "report" back to the group.
3. Bottlenose dolphins may aid ill or injured dolphins. They may stand by and vocalize, or they may physically support the animal at the surface so it can breathe.

**Interaction With Other Species**

1. Bottlenose dolphins have been seen with groups of toothed whales such as pilot whales (*Globicephala macrorhynchus*), Risso's dolphins (*Grampus griseus*), spotted dolphins (*Stenella attenuate*), and rough-toothed dolphins (*Steno bredanensis*).

2. Bottlenose dolphins have been seen riding the pressure waves of gray whales (*Eschrichtius robustus*), humpback whales (*Megaptera novaeangliae*), and right whales (*Eubalaena spp.*).

3. Researchers have observed bottlenose dolphins chasing and displacing other species of dolphins from prime bow-riding spots in waves.

4. Dolphins respond to sharks with tolerance, avoidance, and aggression. Tiger sharks elicit the strongest responses from dolphins. Researchers have observed dolphins attacking, and sometimes killing, sharks in the wild.

5. Some dolphins may approach divers, swimmers, or boaters.
Diet & Eating Habits

Bottlenose Dolphins
Diet & Eating Habits

Food Preferences & Resources

1. Dolphins are active predators and eat a wide variety of fishes, squids, and crustaceans such as shrimps. The foods available to a dolphin vary with its geographic location.

   Coastal dolphins tend to eat fishes and bottom-dwelling invertebrates.

   Offshore dolphins tend to eat fishes and squid.

   Some offshore dolphins were found with deep-sea fishes in their stomachs. This evidence suggests that offshore dolphins may dive to more than 500 m (1,600 ft.).

Food Intake

1. Adult bottlenose dolphins eat approximately 4% to 6% of their body weight in food per day. A nursing mother's daily intake is considerably higher: about 8%.

2. A dolphin's stomach is compartmentalized for rapid digestion.

Methods Of Collecting Food

1. Feeding behavior is flexible and adapted to a dolphin's particular habitat and available food resources.
2. Hunting strategies are varied and diverse.

Bottlenose dolphins often cooperate when hunting and catching fish.

In open waters, a dolphin group sometimes encircles a large school of fish and herds the fish into a small, dense mass. The dolphins take turns charging through the school to feed.

Occasionally dolphins herd schools of fish against sand bars, shorelines, or mud banks to trap them in shallow water where the fish are easy prey.

Dolphins also feed on individual, nonschooling fishes.

A bottlenose dolphin may use its tail flukes to flip a fish out of the water, and then retrieve the stunned prey.

Some coastal bottlenose dolphins in Shark Bay, Western Australia seem to use a certain species of sponge (Echinodictyum mesenterium) as a shield when foraging in areas with rocky or sandy bottoms. Researchers have observed a small number of females carrying the sponges on their beaks, diving down, and then dropping the sponge just prior to surfacing and swallowing prey. Researchers theorize that the sponge acts as a shield to protect the dolphin’s beak (rostrum) from spines of certain fishes or stingrays, or from sharp shells or rocks when the dolphin digs into sandy-bottomed habitats in search of prey. This sponge-carrying tool-use behavior has only been seen in several female dolphins and some of their female offspring at Shark Bay.

Bottlenose dolphins often feed in association with fishing operations. Dolphins may accompany shrimp trawls or other fishing vessels and feed on discarded fishes caught incidentally in the nets.

3. Dolphins do not chew their food. Before eating large fishes, bottlenose dolphins shake them or rub them on the ocean floor until suitable-size pieces break off. They also strip meat from spiny fishes, reducing the chance of injury from sharp spines.
Bottlenose Dolphins

Reproduction

Sexual Maturity

1. A dolphin's age at sexual maturity varies by geographical location and whether the dolphin is a male or female.

   In Florida waters, the average female is sexually mature at about 5 to 12 years and 2.2 to 2.3 m (7.2-7.6 ft.). Males become sexually mature at about 10 to 13 years and 2.4 to 2.6 m (8-8.5 ft.).

   In waters along the central U.S. Atlantic coast, females become sexually mature at about 7 to 13 years.

   In South African waters, the average female is sexually mature at about 9 to 11 years. Males become sexually mature at about 14.5 years.

Mating Activity

1. Bottlenose dolphins may breed throughout the year. However, certain breeding seasons have been observed and vary with location. Breeding seasons generally coincide with calving seasons.

2. Male and female bottlenose dolphins have multiple mates in a given reproductive season.

3. During courtship, dolphins engage in head-butting and tooth-scratching.
Birth & Care of Young

Bottlenose Dolphins

Birth & Care of Young

Gestation

1. The gestation period is about 12 months.

Birth Seasons

1. Worldwide, calves are born throughout the year.
2. Seasonal calving peaks vary by area.

   Dolphin births off the coast of Sarasota, Florida occur in late spring to early summer. A secondary peak occurs in early autumn.

   In waters along the central U.S. Atlantic coast, the prolonged calving season shows a spring peak.

   In Patagonia and South Africa, births peak in summer.

   Most dolphin births along coastal Texas waters occur in March.

   Peak calving for dolphins in Florida's Indian River Lagoon occurs in April and August.

   Bottlenose dolphins in the Pacific Ocean along the coast of Southern California have shown a calving peak in the fall.

Frequency Of Birth

1. A female dolphin can potentially bear a calf every two years, but calving intervals generally average three years.

Calving

1. Calves are born in the water. Deliveries are usually tail-first, but head-first deliveries are also seen. The umbilical cord snaps during delivery.
Dolphin calves are born in the water usually tail first.

2. Sometimes an assisting dolphin may stay close to the new mother and calf. Although this assisting dolphin often is referred to as an "auntie" dolphin, it may be male or female. This auntie dolphin is often the only other dolphin a mother allows near her calf.

Calf At Birth

1. Calves are approximately 100 to 135 cm (39-53 in.) long and weigh about 10 to 20 kg (22-44 lb.).
2. In the first few days after birth, the calf's dorsal fin and tail flukes are pliable and lack firmness, but gradually stiffen.
3. Calves, darker than adults, show several vertical, light lines on their sides, a result of fetal folding. These lines disappear within six months.

Care Of The Young

1. Nursing.

   Calves nurse below water, close to the surface.

   The calf suckles from nipples concealed in abdominal mammary slits.

   Observations in zoological parks show that nursing usually begins within six hours of birth. A calf nurses as often as four times per hour for the first four to eight days.

   Each nursing instance usually lasts only about five to ten seconds. A calf nurses three to eight times per hour throughout the day and night.

   Milk is composed of 33% fat, 6.8% protein, and 58% water, with traces of lactose. The rich milk helps the baby rapidly develop a thick blubber layer.

   A calf may nurse for up to 18 months.

2. In caring for her calf, a mother dolphin stays close by and attentively directs the calf's movements. The calf is carried in the mother's "slip stream," the hydrodynamic wake that develops as the mother swims. This helps the baby swim and enables the mother and calf to stay up with the group.
This dolphin calf is being carried along in its mother's "slip stream".

3. There is probably a considerable amount of learning involved in mothering.

Calf Development

1. Bottlenose dolphin breeding colonies in marine zoological parks continue to provide a unique opportunity to observe and quantify dolphin reproductive biology.

Valuable information has been learned about dolphins by studying them in marine zoological parks like SeaWorld.

2. In zoological environments, calves begin to take a few fish at about three to four months, when their teeth begin to erupt. Calves begin to eat fish when they reach about 130 to 150 cm (51-59 in.).

3. Within a few days of birth a calf can vocalize, but signature characteristics develop with age.

4. Mother-calf bonds are long-lasting; a calf typically stays with its mother three to six years.
Longevity & Causes of Death

Bottlenose Dolphins

Longevity & Causes of Death

1. Most bottlenose dolphins probably live 20 years or less. This estimate is based on census data from the bottlenose dolphin population off the coast of Sarasota, Florida. The Sarasota Dolphin Research Project (SDRP) is the longest-running study of wild dolphins in the world.

2. SDRP studies have shown that some dolphins live into their 40s; a few females have even lived past 50. This appears to be a maximum age, comparable to a human living to be about 100. Only 1% to 2% of dolphins reach that age.

3. Current scientific data show that bottlenose dolphins in Alliance of Marine Mammal Parks and Aquariums (AMMPA) member facilities, such as SeaWorld, live longer than their counterparts in the wild.

4. In a facility that is a member of the AMMPA, a one-year old bottlenose dolphin is expected to live an average of more than 25 years.

Aging Studies

1. As a dolphin ages, it periodically produces growth layer groups (GLGs) of dental material. Age can be estimated by examining a sliced section of a tooth and counting these layers.

2. Researchers studying bottlenose dolphin survivorship in the Indian River Lagoon System on Florida's east shore used teeth from stranded animals for age estimation. The researchers decalcified and stained 2-mm (0.8 in.) tooth sections then examined GLGs, which represent annual layers. They placed dolphins into age classes by rounding to the last fully formed GLG.

   Age can be estimated by examining a sliced section of a tooth and counting the growth layer groups of dental material.

Disease & Parasitism

1. As in any animal population, a variety of diseases and parasites can be responsible for dolphin deaths. Dolphins may suffer from viral, bacterial, and fungal infections. In addition, they may develop...
stomach ulcers, skin diseases, tumors, heart disease, urogenital disorders, and respiratory disorders.

Parasites that typically affect dolphins include tapeworms, flukes, and roundworms.

2. In 1987 and 1988, more than 740 dead bottlenose dolphins washed ashore on the east coast of the United States. Scientists originally believed that the dolphin deaths were triggered by a naturally occurring “red tide” toxin (originating in small marine organisms called dinoflagellates) combined with bacterial and viral infections. Further analysis concluded that, while exposure to brevetoxin may have made the dolphins more vulnerable to infection, morbillivirus caused the deaths. Morbillivirus is a deadly disease that rapidly affects many animals in the same area at the same time.

Predators

1. Natural predators include certain large shark species such as tiger sharks (Galeocerdo cuvier), dusky sharks (Carcharhinus obscurus), bull sharks (Carcharhinus leucas), and great white sharks (Carcharhinus carcharias). It’s not uncommon to see dolphins with shark bite scars.

Dolphins sometimes fall prey to large species of sharks.

2. Killer whales (Orcinus orca) may occasionally prey on bottlenose dolphins, but documented cases are rare.

3. While stingrays are not dolphin predators, some dolphin deaths have been attributed to trauma, infection, and poisoning from stingray wounds.

Human Impact

1. Dolphins, particularly coastal animals, are affected by heavy boat traffic, habitat destruction, and pollution. Industrial and agricultural pollutants in coastal habitats have resulted in high levels of toxins in the water and high concentrations of toxins in dolphin tissues.

   In a study of South African dolphins, researchers found that first-born calves acquired 80% of their mother’s accumulated toxins.

   Accumulation of toxins in body tissues, even at low levels, may make dolphins more vulnerable to disease or even death.

2. In the past, bottlenose dolphins have been taken directly for meat, leather, oil, and meal (for fertilizer and animal feed). Hunting still occurs in various parts of the world including Peru, Sri Lanka, Taiwan, and Japan.

3. Fisheries interactions.

   In the course of fishing operations, gear and nets can accidentally entangle and injure or drown dolphins. Dolphins that are injured or killed and discarded in the course of fishing operations are called bycatch. Experts have concluded that it’s likely hundreds of thousands of marine mammals are killed as bycatch each year. The incidental capture of whales and dolphins in fishing gear is one of the most significant threats to some bottlenose dolphin populations. In the United States, when data indicate that the bycatch of a species exceeds its sustainable removal threshold, experts must develop and implement a plan for reducing bycatch. As a result, the bycatch of whales has declined since 1995.

   In some areas, prey populations become overfished, leading to depleted populations of dolphins. In the Mediterranean and Black Seas, for example, prey depletion by commercial fisheries caused significant drops in populations of bottlenose dolphins.

   When catches decline, fishermen sometimes believe that local populations of toothed whales are the cause. In some areas, fishermen organize dolphin kills in an effort to control their populations. In some places, they may offer bounties for dead animals. Probably the largest and best-known of
these kills was the drive-fishery on Iki Island, Japan. Over the course of ten years, thousands of

toothed whales, including bottlenose dolphins, were killed. The Iki Island kills ended in 1986.

4. United States federal laws do not permit people to feed and swim with dolphins or other marine

mammals in the wild. These actions are considered "harassment." When people try to get close to wild

marine mammals, they put the animals and themselves at risk. Feeding and swimming with marine

mammals in the wild is harmful to animals and sometimes dangerous to people.

When people feed marine mammals in the wild, the animals may become less able or willing to

search for food on their own.

The U.S. National Marine Fisheries Service (NMFS) has serious concerns about the quality of fish

being fed to wild marine mammals and has received complaints that animals are being fed harmful

items such as sandwiches, cookies, candy, and chips. Fish that has not been inspected for freshness

can cause illness in the animals fed. There also is strong evidence that feeding marine mammals in

the wild can lead to their learning to steal fish off fishing lines. Animals that have stranded on the

beach have been found with hooks and fishing lines in their stomachs.

Reports of injuries to people by marine mammals habituated to being fed in the wild are increasing.

Unsuspecting individuals have been bitten, and swimmers have been rammed and pulled under

water by wild dolphins that have been taught to expect food from humans.

Feeding, swimming with animals, or intruding on wild environments also can have a negative

influence on many other normal marine mammal behaviors. People are disturbing dolphin resting

areas. Scientists believe that the long-term effects of such activities may include the disruption of

normal resting patterns, mother-calf nursing and bonding behaviors, and social interactions

between animals.

5. Marinelife parks, aquariums, and zoos offer many animal interaction programs that are carefully

controlled, monitored by knowledgeable staff, and approved by the government, and are safe, positive

experiences for both human and animal participants.

According to the results of a 2005 public opinion poll conducted by Harris Interactive®, 91% of

respondents agree that interacting with dolphins offers people a deeper understanding and

appreciation of them.

Because most people will not engage in behavior that they know will hurt animals, NMFS, the

Alliance of Marine Mammal Parks and Aquariums, and SeaWorld are educating people of the harm

caused by disturbing marine mammals or their habitats in the wild. The Alliance of Marine

Mammal Parks and Aquariums is an international association of more than 36 marinelife parks,

aquariums, zoos, scientific research facilities, and professional organizations that are dedicated to

the conservation of marine mammals and their environments through public display, education,

and research.
The International Whaling Commission

1. The purpose of the IWC is to protect the future of whale stocks as a resource.
2. Members of the IWC are requested to report direct and indirect catches of small cetaceans, including bottlenose dolphins, as part of the National Progress Reports on Cetacean Research. For the most part, however, these catches go largely unreported.

IUCN/The World Conservation Union Species Survival Commission (SSC)

1. IUCN/ The World Conservation Union Species Survival Commission Cetacean Specialist Group Action Plan contains several projects related to bottlenose dolphin conservation, including studies of accidental entanglements.

The Convention On International Trade In Endangered Species Of Wild Fauna And Flora (CITES)

1. Bottlenose dolphins are listed on CITES Appendix II. Appendix II includes species identified as threatened, or likely to become endangered if trade isn’t regulated. All toothed whales are protected by CITES.
The Marine Mammal Protection Act (MMPA)

1. All marine mammals in and around U.S. waters are protected by the Marine Mammal Protection Act of 1972 (MMPA).

2. According to the MMPA, it is illegal to harm, harass, touch, feed, restrain, and even to approach marine mammals in the wild. This is for their protection, and for ours.

3. The MMPA is administered and enforced by the National Marine Fisheries Service (NMFS), which regulates all activities that affect dolphins in the United States. NMFS programs support the domestic and international conservation and management of living marine resources.

U.S. Dolphin Protection Consumer Information Act (DPCIA)

1. This Act, passed on 1990, legislated the "Dolphin Safe" designation for tuna not caught by setting fishing nets on dolphins.

2. As a result, incidental dolphin deaths declined dramatically in U.S. waters—from 5,083 in 1990 to 0 in 1996.

3. The United Nations adopted a similar resolution in 1991, which established a global moratorium and effectively reduced dolphin mortality in the Eastern Pacific Ocean.

Marinelife Parks

1. In the protected environment of marinelife parks, scientists can examine aspects of dolphin biology that are difficult or impossible to study in the wild.

2. SeaWorld parks rescue, rehabilitate, and release bottlenose dolphins that have stranded along U.S. coasts.

3. At marinelife parks, guests learn about dolphins and other marine animals, their ecosystems, and conservation measures. Guests leave with a heightened appreciation of the importance of conserving marine animals and preserving their habitats.

A 2005 public opinion poll conducted by Harris Interactive® found the following:

- 97% of respondents agree that marine life parks, aquariums, and zoos play an important role in educating the public about marine mammals they might not otherwise have the chance to see.

- 96% agree that marine life parks, aquariums and zoos provide people with valuable information about the importance of oceans, waters, and the animals that live there.

- 93% agree that visiting a marine life park, aquarium, or zoo can inspire conservation action that can help marine mammals and their natural environment.

- 93% agree that people are more likely to be concerned about animals if they learn about them at marine life parks, aquariums, and zoos.

The SeaWorld & Busch Gardens Conservation Fund

1. The non-profit SeaWorld & Busch Gardens Conservation Fund is committed to species research,
habitat protection, animal rescue, and conservation education. The Fund was created to strengthen and expand the parks' existing conservation efforts while also providing guests an easy, direct way to make a difference for wildlife. To learn more about the Fund visit SWBG-ConservationFund.org. The Fund has granted thousands of dollars to various dolphin conservation projects around the world, including:

**Species research and conservation**

Texas A&M University received a grant to partially fund the assessment study of coastal dolphins in Tanzania, East Africa, to provide knowledge of the ecology and population biology of the dolphin species in the reserve, assess potential environmental implications, delineate appropriate mitigation measures, and lay down scientific bases for a broader long-term management plan.

**Habitat protection**

The Fund supported the Hubbs-SeaWorld Research Institute's long-range citizen-based project aimed at monitoring ocean noise and describing the noise in Florida's Indian River Lagoon. Public and scientific concern over the impact of anthropogenic sound in the marine environment and on marine animals, particularly marine mammals, has grown exponentially in recent years. The National Research Council made several key recommendations aimed at elucidating the effects of ocean noise on marine mammals. The lagoon is an extremely important habitat for bottlenose dolphins, Florida manatees, loggerhead and green sea turtles, and a host of marine bird species.

**Rescue, rehabilitation, and release**

The Wildlife in Need Foundation of Lompoc, California received a grant from the Fund to support the rescue, rehabilitation, and release of stranded whales and dolphins in the Phillipines.
Books For Young Readers

Bottlenose Dolphins

Book List


References


