

# Sirenian Biology

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## Introduction to Sirenians

Manatees and dugongs are some of the most fascinating animals on the planet and have been around for the past 50 million years. The three extant species of manatees (Family: Trichechidae) and their close cousin, the dugong (*Dugong dugon*) have their own order: the Sirenia. The origin of the order's name is a fascinating case of mistaken identity. Apparently, Carl Illiger (1811) thought that manatees looked just like mermaids and decided to call them Sirenia (after the Sirens of Greek mythology). At the present time, there exist only four species of Sirenia; however, there were dozens earlier in their history. It is not completely understood why so many earlier species have disappeared, although it has been suggested that the changing quality or quantity of sea grass was a contributing factor (Vélez-Juarbe, 2014).

The ancestors of today's sirenians look nothing like their descendants; they had front and hind legs instead of flippers, and of course lived on land (Domning, 2001a). One interesting forebear was the pig-sized *Pezosiren portelli*, who had a hippo-type body morphology. The tail of the Pezosiren was otter-like in structure and movement, very unlike the paddle shaped and forked fluke of modern sirenians (Domning, 2001a). All sirenian species are listed as endangered, threatened or vulnerable by the IUCN – World Conservation Union.

## West Indian Manatee (*T. manatus manatus* and *T. manatus latirostris*)

### Introduction

West Indian manatees are currently divided into two subspecies, Antillean manatees (*T. manatus manatus*) and Florida manatees (*T. manatus latirostris*). It has been suggested that there is a third subspecies based on genetics, differences in skull and body size, and geographic distribution (Barros et al., 2017)

## Florida manatee (*Trichechus manatus latirostris*)

(subspecies of West Indian manatee)

## **Range**

Animals are divided into four regional subpopulations (Atlantic, Upper St. Johns, Northwest, and Southwest) based on their preference for warm water refuges. While its year-round range is confined to peninsular Florida, in warm weather manatees have been seen as far east and south as the Bahamas and Cuba and observed around the Texas and Louisiana coastlines. Manatees have been tracked as far north as Massachusetts and Rhode Island. Around November, manatees travel to their winter refuges due to lack of a long tolerance for temperatures less than 68°C. These refuges come in many flavors: warm water discharges from powerplants, natural springs, and passive thermal basins.

## **Habitat**

Manatees are classified as marine mammals, although they also enjoy fresh and brackish environments (i.e. euryhaline). They have specialized kidneys that help maintain an internal water and salt balance; however, it appears they still need fresh water to drink (Ortiz et al., 1998). Manatees tend to stay in depths less than 5 meters since their food source, seagrass, grows in shallow waters (Lefebvre et al., 2001).

## **Anatomy**

Florida manatees regularly exceed ten feet in length and more than a ton in weight, with the record being some 3600 pounds. They are noted for their extremely thick, tough skin, which can approach three inches in thickness. This thick hide serves as a wonderful shield against abrasions of all sorts and is able to heal quickly. Female manatees are often larger than their male counterparts. While manatees may appear to be chubby, the fact is that, like all extant Sirenians, they do not possess a layer of blubber like whales, seals, and walruses. Their rotund appearance is a combination of swollen ribs, thick sheets of axial musculature, and the large intestinal tract they need to process the vegetation they consume. Their lack of blubber also highlights their need to remain within tropical and subtropical regions.

Lungs of manatees stretch nearly two-thirds the length of their bodies and are oriented in the horizontal plane, enabling manatees to float easily. The snout deflection of West Indian manatees is intermediate between the sharply deflected snout of dugongs and the lesser deflection characteristic of the Amazonian and West African species. Manatees have each lung in a separate cavity within the chest, and two diaphragms called “hemi-diaphragms.” This anatomy allows the animal to inhale and exhale separately in the right and left lung. The lungs simultaneously aid in breathing and buoyancy control.

## **Diet**

Manatees and dugongs are unique among marine mammals; they are herbivores, feeding primarily on high fiber seagrasses but have observed opportunistically eating barnacles, tunicates, and fish (Best, 1981; Courbis & Worthy, 2003; Smith, 1993). They are known to

subsist on over 60 varieties of plant species including mangroves as well as invasive species like hydrilla and water hyacinth, and have even been recorded grazing placidly on lawn grass close to the water. When a manatee approaches food, muscles around the snout flatten and expand into what has been coined a “flare response” by biologist Dr. Christopher Marshall (1998, 2003). Manatees also have prehensile lips, which can take hold of food and deliver it directly into their mouths.

Like all sirenians, manatees have a horny “crushing plate” in front of the teeth that help crush the tough vegetation that makes up their diet (Gohar, 1957). Their chewing is aided by their famous “marching molars,” a feature they share with elephants and one species of kangaroo, but curiously not with dugongs (Domning & Hayek, 1986). The molars then grind the grass to ease swallowing and digestion. As teeth become worn out from abrasion, they are replaced by new ones (with brand new grinding edges) that “march” forward at the rate of about one millimeter a month. Manatees can eat 10-15% of their body weight each day, and it takes seven days to digest the food they eat.

### **Lifestyle and Behavior**

Manatees spend approximately 6-8 hours feeding (Reynolds & Odell, 1991) and two to twelve hours a day resting (Lefebvre & Frohlich, 1986). They are quite capable of resting on the surface or the bottom and come up for air an average of every three to five minutes. They are considered “semi-social,” and while they seem to get along well with each other, they do not form permanent social bonds like dolphins, and in general are considered to have a less complex social life. Manatees spend a portion of their time playing and socializing with other individuals. Manatees can be observed kissing (muzzle to muzzle) and mouthing one another. Play can also be more active and include tail thrashing, spyhopping (vertically pokes its head out of the water), and wrestling.

### **Sex and Reproduction**

In general, females are the larger sex. The only other way to distinguish males from females is by waiting to see if one rolls over in front of you. In males, the genital slit is close the navel; in females it is closer to the anus. Manatees reach sexual maturity between the ages of two (males) and five (females). Mating involves one focal female being courted by a group of males called an estrous or mating herd (this can go on for three weeks, and the female may mate with more than one male) The scientific name for this mating activity is “scramble polygyny” (Anderson, 2002). Manatees can mate at any time during the year, although a preponderance of calves are born in the spring and summer.

The manatee gestation period is about 13 months, with a single calf the usual outcome. Only about one in a hundred births are of twins. The newborn weighs about 60 pounds and is a little over a yard long. Manatee babies are often born dark and tend to lighten as they age. The dark

coloration may help the young absorb heat. Manatees can vocalize from the time they are born and are able to swim to the surface for air. Babies may stay with their mothers for more than two years. Nursing takes place from a teat located in the “armpit” (axilla) just behind the flipper. The mother will have a calf only every three to five years.

### **Senses**

**Vision:** Manatees are able to distinguish some colors (both rods and cones are present) but are thought to have poor visual acuity. In any case, one would not expect manatees, who often dwell in murky rivers to have the clear vision of an eagle soaring through empty space. All manatees and dugongs (like many mammals) have nictitating membranes that protect their eyes when they dive.

**Hearing:** Although manatees have barely visible external ear openings, they have excellent hearing and can hear frequencies from 400- 96000 Hz, although their ideal range is between 16-18 kHz (Gerstein et al., 1999; Gerstein, 2002). Their internal ear bones are quite large and well developed. Scientists believe that in manatees sound is transmitted through the fat-filled jaw and is carried to the earbones (Ames et al., 2002; Ketten et al., 1992).

**Olfactory:** It is possible that manatees recognize one another by smell and males probably recognize females in estrous, or heat, by smell.

**Tactile:** Manatees have hairs all over their bodies, although the face is 30 percent hairier than the rest of the body. Manatees have two kinds of tactile hairs, those around the mouth and another type on their bodies. The 3000 body whiskers, evenly spaced every two or three inches around the animal’s body, contain 20-50 nerve fibers each. The vibrissae on their backs, while sparse, are thought to be used to detect changes in current, temperature, and movement of other animals.

**Taste:** There is some limited evidence that manatees may use taste to determine hormones of receptive females in their environment. Their tastebuds are located posteriorly on the tongue.

### **Intelligence**

While the manatee’s smooth, small brain may not seem impressive, manatee behavior indicates a notable level of intelligence. They have superb memories, learn how to locate fresh drinking water, and can master complex migratory patterns, returning to their chosen warm water refuges year after year. They know when boat traffic is particularly heavy in certain areas; therefore, they will return to an area in off-hours.

### **Threats**

The giant size of manatees keeps them safe from all predators except human beings. Manatees face untold human-created challenges, with watercraft collisions topping the list. Manatees have

also been reported to drown or be crushed in flood gates or canal locks. Monofilament line and fishing nets create even more problems; they can easily wrap around an animal's flipper, head, or tail and restrict blood flow, eventually resulting in necrotic (i.e. dead) tissue. Manatees also suffer from red tide outbreaks. Red tides are caused by the tiny marine organism dinoflagellates that produce a brevetoxin, which can kill a manatee if swallowed or inhaled.

Manatees have low genetic diversity and a slow reproductive rate (the intrinsic rate of reproduction is estimated at about 8%). This, combined with their low numbers, makes their future a major concern. When large, slow reproducing animals like manatees suffer a decline in population, it takes a long time for them to recover. Manatees are protected by law in the US by two federal laws: the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. They are also protected by the Florida Manatee Sanctuary Act of 1978. It is illegal to harass, hunt, capture, or kill any marine mammal.

## **Antillean Manatee (*Trichechus manatus manatus*)**

(subspecies of West Indian Manatee)

### **Range**

Antillean manatees live in the coastal and inland waterways of eastern Mexico, Central America, the Greater Antilles, the Caribbean, and along the northern and eastern coasts of South America. There may be fewer than 3000 left. Belize has the greatest number of Antillean manatees; they are found both in coastal areas and around the Turneffe Atoll — the largest coral atoll in the western hemisphere — located 25 miles off the Belizean mainland.

### **Habitat**

Like their Florida manatee counterparts, Antillean manatees thrive in fresh, salt, and brackish water and feed on any available vegetation.

### **Anatomy**

Antillean manatees differs from their Florida cousins mainly through certain characteristics in the skull. It's almost impossible to tell them apart by just looking. They probably run a bit smaller on average and are lighter in weight, but that doesn't help any individual identification. The major factor separating the subspecies is the deep water and strong currents in the Straits of Florida. The mouth of Antillean manatees is divided and each side can move independently, while the snout deflection (like Florida manatees) is intermediate between the sharply deflected snout of dugongs and the lesser deflection characteristic of the Amazonian and West African species. This indicates that they feed mostly on "floating meadows" of grass rather than submerged vegetation.

**Diet**

Seagrass beds

**Threats**

While their range is large, it is also discontinuous, and the current population is unknown. This creates a problem for manatee conservation – while Florida manatees are largely confined to one state, the Antilleans ranges over 21 countries, each of which has its own ideas about how to protect manatees. Belize, Mexico, and Guatemala have sound protection programs and refuges in place, but enforcing the rules is another matter. However, Belize in particular is to be commended for its success in conserving manatees. Like all Sirenians, Antillean manatees face loss of habitat and pollution dangers.

## **Amazonian Manatee (*Trichechus inunguis*)**

**Range**

Primarily the Amazon Basin of South America

**Habitat**

Amazonian manatees live in a more specialized environment than other manatees, living solely in freshwater, and preferring blackwater lakes and oxbows. The species seems to have been separated from its manatee and dugong cousins by certain geological events which closed the Pacific entrance to the upper Amazon River.

**Anatomy**

The species name “*inunguis*” literally means “without nails,” and sure enough, Amazonian manatees lack the three or four nails present in the other varieties. It also has characteristic white markings on its belly that are not present in other manatees. Amazonian manatees also have smooth skin, which contrasts sharply with the wrinkled, pebbly skin of the other manatee species. Amazonian manatees have a less deflected snout compared to West Indian manatees. This is probably an adaptation for dining of emergent and natant seagrass. The same is true for West African manatees.

**Threats**

Like other manatee species, Amazonian sea cows have been victims of humans and human-related dangers. In the past, this species was seen in groups of hundreds, now they are more likely to be glimpsed in tiny groups.

# **West African Manatee (*Trichechus senegalensis*)**

West African manatees are considered to be least studied large animal in Africa and has been referred to as the “forgotten” sirenian. They are assumed to be similar to West Indian manatees (it is hypothesized that they arrived in African through transoceanic currents during the late Pliocene.)

## **Range**

West African manatees are currently found from Senegal to Angola

## **Habitat**

They inhabit estuarine lagoons, large rivers, and freshwater lakes, traveling freely between salt and freshwater and may venture about 20 miles a day. There appear to be two populations – one coastal and one inland, but there seems to be no significant differences between them.

## **Anatomy**

Like Amazonian manatees, African manatees tends to be a bit more slender than West Indian manatees, and according to some accounts, have more bulging eyes. West African manatees have a less deflected snout than West Indian manatees. This is probably an adaptation for dining of emergent and natant seagrass. The same is true for Amazonian manatees.

## **Diet**

Like other manatees, they are primarily herbivores, but have been observed eating clams and mollusks or even fish caught in nets. They will also graze off low-hanging mangroves.

## **Lifestyle and Behavior**

Unlike other manatees, West African manatees are largely nocturnal and may occur in small groups of up to six animals. Even larger groups can form, with females generally outnumbering the males.

## **Sex**

Females achieve sexual maturity at about three years of age; males between nine and ten. Like their cousins in the Americas, they can breed all year round. Their lifespan has been estimated to be thirty years; much shorter than that of West Indian manatees.

## **Threats**

Sharks and crocodiles have been known to predate on young manatees. Human poaching also occurs in parts of this animal’s home range.

# Dugongs

## Introduction

There is only one extant species of dugong (unlike manatees, which make up three living species). This is the *Dugong dugon*.

## Evolution

Despite their similarity in appearance, the ancestors of dugongs and manatees went their separate ways 25-40 million years ago. Dugong fossils of various species reveal that each species has a distinct arrangement of teeth and facial structure, so each was adapted to a slightly different kind of habitat.

## Range

Dugongs range from the western Pacific to the eastern coast of Africa; they are found in the coastal waters of 37 countries and territories. Their populations are extremely fragile in East Africa, and only one small isolated but protected population lives off of the coast of India. The largest population lives off the coast of Australia with over 25,000 living in the Torres Strait. Dugongs once occupied the Mediterranean and are even mentioned in the Bible, but that population is long extinct. However, at one time dugongs were everywhere, as demonstrated in their rich fossil record. In fact, ancient dugong bones have been found in the Mediterranean, Europe, the Caribbean, southeastern US, South America, Indian Ocean and even the North Pacific. One example of a now extinct member of the dugong family is the Steller's Sea Cow.

## Habitat

Unlike manatees, dugongs are primarily creatures of the sea, although they can occasionally travel in fresh or brackish waters. They reside in warm coastal waters. Dugongs select different areas of habitat according to their needs and availability of seagrass, their favorite food. Calving generally takes place in protected estuaries.

## Anatomy

Manatees and dugongs attain a similar size; as with manatees, female dugongs tend to be larger. The skull of dugongs is quite different from that of manatees, notably on account of its sharply down-turned premaxilla, which are stronger in males. The upper snout is divided as in manatees, with each side moving independently. However, the snout ends in a flattened "rostral disk." The sharply deflected snout indicates that they are exclusively benthic (bottom) feeders.

The oral disk is larger than that of manatees.

Dugongs also have smooth skin and a forked tail, unlike the paddle tail of the manatee.

Like manatees, dugongs are characterized by pachyostosis (thick, heavy bones) which are also solid (osteosclerotic) and can be used as a ballast as they float just beneath the surface.



## **Dentition**

One of the most important differences between dugongs and manatees is the teeth. Early dugongs developed tusks (incisors) rather than the marching molars characteristic of manatees (although dugong cheek teeth move forward with age, they are not replaced). While modern dugongs don't appear to use these tusks for anything other than intraspecific aggression, ancient dugongs apparently used them to uproot the rhizomes that provided nutrition (Domning 2001b; Domning & Beatty, 2007). The continually growing tusks generally erupt with sexual maturation only in male dugongs. While females have them, they generally remain unerupted until late in life. The dugong has two tusks which emerge in males during puberty. The age of a dugong can be calculated by checking the number of growth layers in a tusk.

## **Respiration**

Dugongs take a breath every five or six minutes and have been observed resting upright with their tails and their heads above water, taking the air for several minutes. They are better divers than manatees and have been known to dive to a depth of 128 feet and have been observed feeding at nearly that depth. However, they spend most of their time in water with a depth of less than ten meters.

## **Senses**

**Vision:** Probably poor

**Hearing:** Acute

**Olfactory:** Dugongs appear to be able to smell out desirable plants.

**Tactile:** Like manatees, dugongs have long sensitive vibrissae with which to experience their environment. Cows and calves also constantly touch each other.

**Vocalizations:** Like manatees, they are capable of producing a variety of different sounds including "chirp squeaks" (while foraging and when on patrol); trills (displays), whistles, and barks (when angry). Much of the communication occurs between mother and calf.

## **Diet**

Dugongs dine upon seagrass families and apparently prefer fast growing, low fiber, high nitrogen plants like *Halophilia* and *Haloldule*. They do not eat algae or seaweed except when better food is not available. Their downturned snout confines them to benthic feeding, unlike manatees who can eat anywhere throughout the water column. When moving along the sea bed, they sometimes walk on their flippers, as manatees do. They will often yank up the entire plant and vigorously shake the sand off it before ingesting it.

## Lifestyle

Unlike manatees, dugongs are true marine animals, and while one occasionally ventures for a time up a river, this is unusual. Dugongs are very long-lived animals; the oldest known dugong attained an age of 73 years.

## Sex

Dugongs are slow developers, reaching sexual maturity between the ages of six and eighteen. Mating occurs all year round; there is no “mating season.” In males, the genital slit is close to the navel; in females, it’s closer the anal opening. Dugongs swimming with a calf at their side are female. Males do not help parent their offspring.

Different populations of dugongs have adopted different mating practices. In some areas, a male will establish a court that is visited by females, a very different practice from that of manatees. These are known as lekking areas and are used only during mating and probably not by all males. More than one male may occupy a lekking area, and unlike manatees, dugongs are somewhat territorial and will defend their areas. As with manatees, females can mate with several males (polyandry), and pregnancy is almost assured. The gestation period is 13-15 months, with females giving birth to their first calf between the ages of six and 17. Births can be separated by two to seven years.

## Parenting

Babies are born in shallow water, with one calf being the norm. The calf weighs about 60 pounds (like manatees) and will nurse for up to a year and a half, although it will also begin eating sea grass soon after birth. Babies have been observed riding on their mother’s back.

## Threats

Other dangers posed by human beings (e.g. hunted and entangled in fishing nets). Juvenile dugongs can fall prey to killer whales, large sharks, or saltwater crocodiles. More serious seems to be disease, including various sorts of parasites. In fact, it’s been estimated that 30 percent of dugong deaths in Queensland since 1996 occurred because of various pathogens.

## Comparison Chart of Extant Sirenians

Feature	Florida	Antillean	Amazonian	African	Dugong
Fluke Type	Paddle	Paddle	Paddle	Paddle	Forked
Nails	Present 3-4	Present 3-4	Absent	Present 3-4	Absent

Teeth	Marching molars	Marching molars	Marching molars	Marching molars	Incisors (tusks) canines, premolars, molars
Skin Type	Pebbly	Pebbly	Smooth	Pebbly	Smooth
Color	Gray-brown, darker at birth	Gray-brown, darker at birth	Black or dark gray, often with white or pinkish belly	Gray-brown	Gray-brown on top, lighter below, lighter at birth
Size	Up to 3.5 m	Up to 3.5 m	2.8-3 m	Up to 3.5 m	Up to 3.5 m
Habitat	Salt, Brackish, Fresh	Salt, Brackish, Fresh	Fresh	Salt, Brackish, Fresh	Marine
Breeding Age	5-7 yrs (females); 8-9 (males)	5-7 yrs (females); 8-9 (males)	2-5 yrs	2-5 yrs	6 yrs (both sexes)
Body Type	Fusiform VERY Rotund	Fusiform Rotund	Fusiform Streamlined	Fusiform Rotund	Fusiform Streamlined
Flippers	Long, flexible	Long, flexible	Long, flexible	Long, flexible	Short
Snout Deflection	Intermediate	Intermediate	Least	Least	Most
Cervical Vertebrae	6	6	6	6	6 or 7
Conservation Status	IUCN: vulnerable	IUCN: vulnerable	IUCN: vulnerable	IUCN: vulnerable	IUCN: vulnerable

Manatee Ranges:

[http://de.academic.ru/pictures/dewiki/77/Mapa\\_distribuiacao\\_Trichechus.png](http://de.academic.ru/pictures/dewiki/77/Mapa_distribuiacao_Trichechus.png)Source:

## Steller's Sea Cow (Extinct)

The most recently extinct sirenian is the Steller's Sea Cow (*Hydrodamalis gigas*), a northern species that died out in the 1700s – probably hunted to death by shipwrecked Russian sailors. The species was about 28 feet long and weighed in at about seven tons. So far as we know, this is the only Sirenian that ever ventured from warm southern waters. They most likely lived on a diet of kelp.

Europeans discovered Steller Sea Cows in 1741, when a group of Russian sailors about the brig St. Peter were shipwrecked off the Commander Islands (the utmost western point of the Aleutian chain). The head of the expedition was a Dane named Vitus Jonassen Bering (to which the famous Straits owe their name). The goal of the expedition was to measure the distance between Siberia and Alaska. The star of the journey, however, at least for our purposes was Georg Wilhelm Steller, a German naturalist. His job was to record all the interesting flora and fauna they encountered. Unfortunately for everyone eventually concerned, Steller couldn't draw well and the ship didn't have room for a professional illustrator, so we are stuck with Steller's word-pictures of what he saw. During the expedition, the ship ran aground off of Bering Island. Of course, it was not Bering Island then (and was uninhabited by humans). All the men got sick from scurvy as the only food they could find were sea otters and another peculiar sea mammal no one had ever seen before. Steller was right on the money when he recognized the animal as a sirenian of some sort (not a whale or walrus) and he guessed it could weigh up to eight thousand pounds. He compared its skin texture to the bark of an oak, and said it was black, wrinkled, hairless, and tough as stone. He also mentioned that the lips were covered with bristles (like manatees) but that the animal had only horny plates, no teeth. The flippers bore no nails, and at least according to Steller, it didn't dive, living on kelp. When Steller was shipwrecked there were an estimated 2000 animals extant. Now there are none.

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