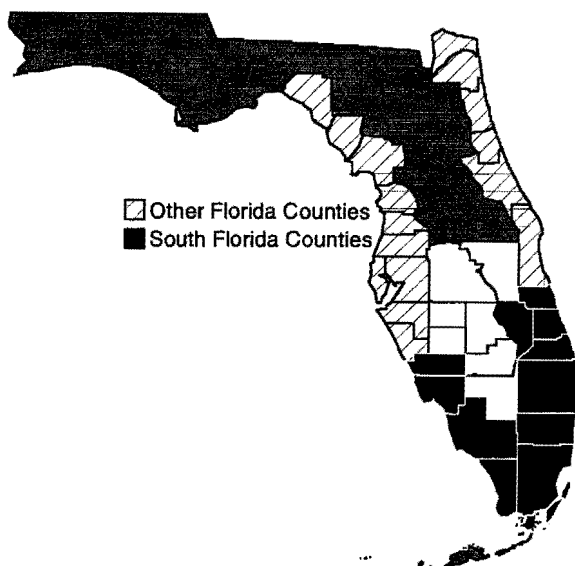


West Indian Manatee

Trichechus manatus

Federal Status:	Endangered (March 1967)
Critical Habitat:	Designated (1976)
Florida Status:	Endangered

Figure 1. Florida distribution of the West Indian manatee



Once mistaken as a mermaid by sailor's of the past, the West Indian manatee is one of the largest, coastal mammals in North America. This unusual marine mammal with its massive, seal-like body, has been able to adapt well to life in the sea. Manatees migrate seasonally to adapt to changing water temperatures. West Indian manatees roam in fresh, brackish, and marine waters throughout Florida, the Caribbean, and Central America. Intensive hunting pressures between the 1500-1800s reduced the number of manatees. Today, manatee populations throughout the world are endangered.

This recovery plan is an addition to the recently published 1996 West Indian manatee Recovery Plan.

Description

The West Indian manatee is an aquatic mammal with a robust, fusiform body that is compressed dorsoventrally. Its grey to grey brown, thick, tough skin is sparsely covered with small, thick hairs (30-45 mm) (Husar 1978) and is sometimes covered with barnacles and algae. Manatees do not have a distinct head but have a protruding, truncated, muzzle-like snout with whiskers. The rounded body of the manatee has no hind limbs, but it has paddle-like forelimbs or flippers with three to four nails present on the dorsal surface of each flipper. The body tapers to a spatulate, horizontally flattened tail. There is evidence of sexual dimorphism; females have a single prominent mamma or teat behind the axilla of each flipper and a short anal-genital distance (Rathbun 1984). The urinary and reproductive opening in males is located just behind the navel.

The average adult manatee is 3.5 m long and weighs 1,000 kg. Male and female manatees are similar in size and appearance (Rathbun 1984), although females appear bulkier. Newborn calves are, on average, 1.2 to 1.4 m long and weigh an average of 30 kg (Odell 1981).

Manatees have a dense skeleton. The massive skeletal bones lack marrow cavities in the ribs and forelimbs (Odell 1981). Similar to other marine mammals, manatees have large blubber stores.

The deeply-set, small eyes have no visible upper or lower lids, but instead have a nictating inner membrane capable of covering the eyeball for protection. Manatees can see for considerable distances, although their depth perception may be limited (Packard *et al.* 1984). Manatees can hear well even though their inconspicuous ears have no external pinnae or earlobe flaps (Robineau 1965). Most often, manatees communicate through different squeaks, chirps, grunts, and groans, that are within human audible range (Hartman 1979). Two nostrils are located on the long upper snout that are capable of opening and closing by muscular valves. Manatees have an enlarged, lobed upper lip with short, stiff bristles and two muscular projections or prehensile pads that aid them in bottom feeding (Odell 1982).

To compensate for the excessive tooth wear caused by the tough vegetative matter they feed upon, manatees replace old, worn-down teeth with new ones. In a manner that is similar to a conveyor belt, their teeth move forward horizontally through their jawbones until worn-down teeth fall out and are replaced by new teeth in the back of their mouths. This replacement process occurs at a rate of about one mm per month. Manatees may use 30 or more molars in a lifetime (Rathbun 1984).

Taxonomy

The mammalian Order Sirenia has four recognized families, three recent genera and five recent species (Rathbun 1984). The two recent families: Dugongidae and Trichechidae have two genera with four living species and one extinct species. The Family Dugongidae contains two genera *Dugong* and *Hydrodamalis* and two species; of which *Dugong dugong* is the only living species of this family. The second species, Steller's sea cow (*Hydrodamalis giga*), was hunted to extinction by 1768 (Reeves *et al.* 1992). The family Trichechidae was described by Gill in 1872 (Rathbun 1984). The second living genus, *Trichechus*, includes three allopatric species: the Amazonian manatee (*T. inunguis*), the West African manatee (*T. senegalensis*), and the West Indian manatee (*T. manatus*). The West Indian manatee is represented by two subspecies, the Florida manatee (*T. manatus latirostris*) and the Antillean manatee (*T. manatus manatus*) (Hatt 1934). *T. manatus* was described by Linnaeus in 1758, and further distinguished as *T. m. latirostris* in 1924 (Harlan 1924). The four living sirenian species are geographically isolated, and listed as threatened or endangered (32 FR 4001, 35 FR 8495, 44 FR 42911). The closest, living terrestrial mammalian relative to the manatee is the elephant.

Sea cows (*Protosiren*) first appeared during the Eocene period about 55 million years before the present when flowering plants first evolved. The family Trichechidae appeared in South America in the early Miocene (20 million years before present), about the same time as whales, apes and grazing animals

(Domning 1982, Domning *et al.* 1982). During the Pliocene (12 million years before present), the time period when large carnivores evolved, members of Trichechidae first appeared in Atlantic North America (Reinhart 1951, 1959). Pleistocene *Trichechus* fossils have been recovered from the United States' East Coast from Florida to Maryland (Simpson 1932).

Distribution

The global distribution of sirenians, including dugongs and manatees, includes coastal waters, estuaries, and fresh water rivers from eastern Africa to the Ryukyu Islands, Indo-Australian Archipelago, western Pacific and Indian Oceans; tropical western Africa, including Niger-Benue Basin; tropical western Atlantic Coast; Caribbean Sea; Amazon and Orinoco River basins (Rathbun 1984). The extinct Steller's sea cow range included the Bering Sea.

The present distribution of the West Indian manatee includes the coasts and rivers of Florida, the Greater Antilles, eastern Mexico and Central America and northern and eastern South America (Husar 1977, Lefebvre *et al.* 1989). *T. manatus latirostris* is found in and around Florida; with *T. manatus manatus* occurring in the remaining areas of its range. Generally, water temperatures greater than 20 degrees C (68 degrees F) determine distribution limits for the West Indian manatee. The cooler winters along the U.S. coast of Gulf of Mexico, in combination with the deep water and strong currents of the Straits of Florida, create a barrier between the Antillean and Florida manatee; the resulting isolation contributes to their status as subspecies.

The seasonal distribution of manatees is also affected by water temperatures. Manatees are cold sensitive and restricted to areas with water temperatures (Hartman 1979). Waters colder than 20 degrees C. increase the manatees' susceptibility to cold-stress and cold-induced mortality. Because of this temperature restriction, manatees seek out warm water refuges to help reduce energetic maintenance costs.

Antillean manatee

The present distribution of the Antillean manatee has fluctuated through time, being mainly affected by past and current hunting pressures. The distribution of the Antillean manatee includes Mexico, Central America, South America, and the Caribbean (Lefebvre *et al.* 1989, Marsh and Lefebvre 1994). Today, the three areas in Mexico that have the largest number of recorded Antillean manatee sightings are the wetland areas of Tabasco and Chiapas, northern and eastern coastal areas of Quintana Roo, and rivers near Alvarado in Veracruz (Husar 1977). In Central America, Antillean manatees are found in Belize, Guatemala, Honduras, Nicaragua, Costa Rica, and Panama (Husar 1977, Rathbun *et al.* 1983, Moe Shu *et al.* 1990, O'Shea and Salisbury 1991). In South America, Antillean manatees have been reported from Columbia, Venezuela, Trinidad, Guyana, Surinam, French Guyana, and Brazil. Antillean

manatees occur throughout the Caribbean, especially near Puerto Rico, Jamaica, Dominican Republic, Haiti, Cuba, and occasionally the Bahamas (Sirenia 1993).

Florida manatee

The Florida manatee occurs primarily in the southeastern United States. The only year-round populations of manatees occur throughout the coastal and inland waterways of peninsular Florida and Georgia (Hartman 1974). During the summer months, manatees may range as far north along the East Coast of the U.S. as Rhode Island, west to Texas, and, rarely, east to the Bahamas (Florida Manatee Recovery Team 1994, Lefebvre *et al.* 1989). The northernmost record occurred in 1995 from sighting and telemetry records of a lone male manatee that traveled up the Atlantic Coast to Rhode Island (FWS 1996). There are reports of occasional manatee sightings from Louisiana, southeastern Texas, and the Rio Grande River mouth (Gunter 1941, Lowery 1974).

In Florida, manatees are found from the Georgia/Florida border south to Biscayne Bay on the east coast and from Wakulla River south to Cape Sable on the west coast (Hartman 1974, Powell and Rathbun 1984) (Figure 1). Manatees are also found throughout the waterways in the Everglades and occasionally in the Florida Keys. Although temperatures are suitable for manatees in the Florida Keys, the low number of manatees has been attributed to the lack of fresh water (Hartman 1974). Manatees also occur in Lake Okeechobee.

In warmer months (April-November), manatees are found throughout Florida, especially in waters greater than 1-2 m in depth (Beeler and O'Shea 1988). In cooler months (December-March), manatees seek out warmer waters either at man-made or natural sources. Manatee abundance varies throughout Florida, with manatee distributions shifting to more southerly locations and warm water resources (Hartman 1974, Beeler and O'Shea 1988, Lefebvre *et al.* 1989).

The distribution of manatees along the east coast of Florida tend to be greater around the St Johns River, the Banana and Indian Rivers to Jupiter Inlet, and Biscayne Bay. On the west coast of Florida, larger numbers of manatees are found at the Suwannee, Crystal and Homosassa Rivers, Charlotte Harbor/Matlacha Pass/San Carlos Bay area, the Caloosahatchee River and Estero Bay area, the Ten Thousand Islands, and the inland waterways of the Everglades.

In the winter, higher numbers of manatees are seen on the east coast at the natural warm waters of Blue Spring and near man-made warm water sources near the Indian River Lagoon, Canaveral, Vero Beach, Ft. Pierce, Riviera Beach, Port Everglades, and Ft. Lauderdale power plants, and throughout Biscayne Bay and nearby rivers and canals (FWS 1996). On the west coast, manatees move in the winter to Crystal River and Homosassa Springs (Powell and Rathbun 1984, Rathbun *et al.* 1990). They also aggregate near industrial

warm water outflows in Tampa Bay, the warmer waters of the Caloosahatchee and Orange River (from the Ft. Myers power plant), and in inland waters of the Everglades and Ten Thousand Islands.

Thirteen counties in Florida were designated in 1989 as "key" counties by the Governor of the State of Florida. This designation recognized the necessity of implementing protection measures in order to protect manatees in these counties (see Management section for more). Considering over 80 percent of manatee mortalities have occurred within these counties, this protection was necessary to reduce the amount of manatee deaths and injuries.

Manatees frequently migrate throughout the waterways in South Florida. The South Florida Ecosystem region is home to the most resident manatee populations and transient migrants in Florida. In South Florida, manatees are most prominent year round in the Indian River, Biscayne Bay, Everglades and Ten Thousand Island area, Estero Bay and Caloosahatchee River area, Charlotte Harbor area. Some of the largest winter aggregations (50 or more manatees) occur in south and central Florida (FWS 1996).

Habitat

Manatees occur in both fresh and salt water habitats within tropical and subtropical regions. Once believed to be restricted to mainly fresh water environments, it is now commonly known that manatees spend as much time in saline environments, although it is believed manatees show preferences to waters with salinity levels of < 25 ppt (Hartman 1979). Manatees depend on areas with access to natural springs or man-made warm water refugia and access to areas with vascular plants and freshwater sources (Humphrey 1992). Several factors contribute to the distribution of manatees in Florida. These factors are habitat-related and include proximity to warm water during cold weather, aquatic vegetation availability, proximity to channels of at least 2 m in depth, and location of fresh water sources (Hartman 1979).

Manatees frequent coastal, estuarine, and riverine habitats and are capable of extensive north-south migrations throughout the year (Reeves *et al.* 1992). Manatees have been observed migrating great distances northward in the springtime and southward in the fall and winter (Longielliere 1994); as a result, abundances in regional populations change seasonally (Hartman 1974). There are seventeen major aggregation sites in Florida (Garrott *et al.* 1994). These aggregation sites occur at or near man-made or natural warm water refugia. Manatees will migrate to these warmer areas when water temperatures drop below 20 degrees C. Large aggregations of manatees occur at these warm water areas. With the rise in water temperatures in the spring, some manatees may begin to migrate away from their winter refugia, while others remain relatively close. Manatees often return to the same winter refugia each year (Powell and Rathbun 1984, Reid *et al.* 1991). In the winter, manatees stay closer to warm water during the day, then move to vegetated areas in the late afternoon or at dusk to feed.

Foraging Habitat

The distribution of manatees is also dependent upon location of foraging sites. Normally, manatees feed on a variety of submergent, emergent, and natant (floating) vegetation. In northeast Florida, where submerged vegetation is scarce, especially in the St. Johns River, manatees feed on floating vegetation. In South Florida, submerged vegetation is more plentiful. Manatees usually forage in shallow grass beds that are adjacent to deeper channels (Hartman 1979, Powell and Rathbun 1984). The proximity of these deeper channels may allow easy access to and from feeding areas while providing escape routes.

Manatees often seek out quiet areas in canals, creeks, lagoons or rivers. These areas provide habitat not only for feeding, but also for resting, cavorting, mating, and calving. Deeper channels are often used as migratory routes.

Fresh Water Sources

It is not known whether manatees are dependent upon fresh water, but they appear to prefer areas with access to fresh water (O'Shea and Kochman 1990). Natural or artificial fresh water sources are sought by manatees, especially manatees that spend time in estuarine and brackish waters (FWS 1996).

Critical Habitat

Critical habitat was designated for the manatee in the early 1970s, although no specific primary or secondary constituent elements were included in the designation. Critical habitat for the manatee identifies specific areas occupied by the manatee, which have those physical or biological features essential to the conservation of the manatee and/or may require special management considerations.

Behavior

Because their brains are well-developed, manatees can process large amounts of complex information (O'Shea and Reep 1990, Reep and O'Shea 1990). Manatees emit sounds, including short, low squeaks and squeals that are within human auditory range (Hartman 1979). These vocalizations are probably not used in navigation, but more likely used for communication. Manatees hear fairly well, especially low frequency sound (Husar 1977, Gerstein 1994).

Manatees have low metabolic rates indicating a possible adaptation to their large size and poor quality food sources, or to permit long dives since manatees have less advanced diving abilities than other marine mammals. Manatees can remain submerged for several minutes, with the longest submergence record lasting 24 minutes (Reynolds 1981). Manatees increase submergence times while cruising, feeding and resting. Female manatees coordinate their breathing and submergence times with their calves. Manatees do not appear to be fast swimmers, but they usually swim 4 to 10 km an hour and may attain faster speeds in short bursts (Husar 1977).

Manatees are not overly gregarious, but they aggregate at warm-water refugia and during mating. Manatees have been observed displaying playful and behaviors such as chasing, tumbling, nuzzling, and kissing (Hartman 1979, Bernier 1985).

Fresh water has been suggested as an important need for manatee osmoregulation or metabolic control (Hartman 1979, O'Shea and Kochman 1990). Fresh water may also provide manatees with relief from ecto- or endoparasites that are less tolerant of low salinities than manatees (Smith 1993).

Reproduction

The manatee population sex ratio is considered to be 1:1 for both adults and calves (Rathbun *et al.* 1992). Females reach sexual maturity at 3-5 years of age (Marmontel 1993) and males may reach sexual maturity at 3-4 years of age. Individuals at least 275 cm in total length are considered to be in their reproductive prime, although the modal female may not successfully rear young until 6 years or older. Fecundity is relatively constant throughout a manatee's life, but increased fecundity may occur in age classes 4-12 (Marmontel 1993). Manatee longevity has been estimated at 50 years or more and they appear to be able to reproduce their entire adult life (Marmontel *et al.* 1992). Odell *et al.* (1992) reported a captive female manatee reproduced throughout its 34 years at the Miami Seaquarium.

The combination of suitable seagrass beds, nearby deeper water access, and minimal boat traffic may be indicative of important mating, calving, and nursery grounds for manatees (MMC 1988, Smith 1993). Female manatees typically return to their places of birth to give birth. Reproduction can occur throughout the year, although sperm production in male manatees virtually ceases during the winter (Hernandez *et al.* 1995). Most manatee calves are born in the spring or early summer (Irving and Campbell 1978). Breeding usually commences when one or more males are attracted to an estrous female but permanent pair bonds are not formed (Marmontel *et al.* 1992). Instead, manatees may form large breeding herds, although researchers suspect that larger, presumably older males, dominate mating herds and may be responsible for most pregnancies (Rathbun *et al.* 1992).

The minimum interval between manatee birth is 2 years, but not all female manatees are this fecund. At any one time, 33 percent of mature, female manatees may be pregnant, which suggests a 3-year interval between calving (Marmontel 1993). If the interval between calving is 3 years and continues over a 36 year period, a female manatee could produce approximately 12 calves during her lifespan (Marmontel 1993). Calving intervals may be affected by the age and health of the female manatee. Although sexual activity may occur, female manatees experience infertile estrous periods (Hartman 1979). Many manatees in younger age classes are not able to carry pregnancies to term due to anatomical or physiological constraints. Injuries caused by watercraft may also disrupt the manatee's estrous cycle (Marmontel 1993).

Gestation of the single calf takes 12 to 14 months (Reid *et al.* 1992). Age to weaning varies from 1-2 years. Calves usually stay close to their mothers during their first several years.

Per capita reproductive rates in Florida manatees have been estimated from a low of 0.15 (± 0.060) in the Blue Spring population to a high of 0.19 (± 0.009) in the Atlantic coast population (Eberhardt and O'Shea 1995). The maximum potential rate of population increase has been estimated at 2.0-7.0 percent, this

rate is most sensitive to changes in adult survival and, secondarily, subadult survival (Packard 1985, Marmontel 1993). For many years, the FWS (among others) has expressed concern about how the mortality rate will affect the survival and recovery of the manatee. These concerns were confirmed by the population viability analysis conducted by Marmontel (1993), which evaluated the probability of the manatee's persistence and the mean time to its extinction. The simulations conducted by Marmontel (1993) suggest that a 10 percent mortality rate is probably a critical threshold for the survival and recovery of manatees. Although the minimum population estimate reached a record high in 1996 with approximately 2,639 manatees, the number of manatees killed in the first quarter of 1996 almost equal ten percent of that minimum population estimate. According to DEP, 261 manatees died in 1996.

Although Marmontel's (1993) PVA had limitations resulting from the lack of specific life history information on the manatee, her simulations represent the best information available regarding the consequences of human activities on the manatee. First, she noted that the small population size of the manatee lessens their probability of persistence and increases the chances that the populations will be adversely affected by environmental variation or additional mortalities. Second, her simulations projected that a 10 percent increase in overall manatee mortality would reduce the manatee below the critical threshold of 500 animals in about 100 years. Finally, her simulations projected that reducing the mortality of adult manatees by watercraft would be the most productive mechanism to increase the probability of manatee survival and recovery.

Foraging

Manatees feed with the help of their two muscular lips which are flexible and move independently, in a fashion similar to an elephant's trunk or human fingers. The lips are capable of manipulating food: grasping and moving food into the mouth. Manatees also use their forelimbs to dig into the sediment to remove seagrass rhizomes or roots (Hartman 1979, Provancha and Hall 1991, Lefebvre and Powell 1990). Manatees usually spend more time foraging in the late autumn (6.9 hours/day) than in early spring (3.2 hours/day) (Bengston 1983). Manatees must eat large amounts of aquatic vegetation to meet their metabolic requirements and may consume up to 20 percent of their body weight per day in aquatic plants (Zieman 1982).

These animals frequently forage at depths of one to three meters where aquatic vegetation is abundant. Manatees are opportunistic herbivores and feed on a variety of submerged, emergent, or floating aquatic plant species, including seagrasses, bank grasses, and overhanging mangroves (see Hurst and Beck 1988, and Smith 1993 for complete review). They may also feed on algal complexes attached to rocks, pilings, and dams (Reynolds 1981), and may occasionally eat fish or invertebrates while feeding on floating or submerged vegetation (Powell 1978, Smith 1993). On the northeast coast of Florida, where submerged vegetation is scarce, manatees feed more on floating vegetation such as water hyacinth (*Eichornia crassipes*), alligator weed (*Alternanthera philoxeroides*), and water fern (*Salvinia rotundifolia*). In South Florida, manatees feed primarily on submerged vegetation such as turtle grass (*Thalassia*

testudinum), manatee grass (*Syringodium filiforme*), cuban shoal grass (*Halodule wrightii*), and *Halophila* spp., although a variety of other emergent and floating vegetation is also eaten. Manatees may also forage on a variety of shoreline vegetation including red mangrove (*Rhizophora mangle*) leaves and cordgrass (*Spartina alterniflora*) (Longieliere 1994). In fresh water, manatees feed primarily on submerged aquatic macrophytes such as *Myriophyllum* spp. and hydrilla (*Hydrilla verticillata*).

Preferred manatee habitat in South Florida is characterized by the availability of submerged aquatic vegetation (SAV) (Smith 1993). Due to light limitations, most SAV, such as seagrass beds, are limited to shallow, nearshore waters. Seagrasses comprise the largest component of the manatee's diet, especially in South Florida (Hartman 1979, Zieman 1982, Smith 1993). Some manatees have been observed to return to the same seagrass beds to feed year after year and may show preferences for certain areas (Sirenia 1993, Smith 1993). Preference may also shown for areas with healthy seagrass beds adjacent to relatively deeper waters with little boat traffic (Kadal and Patton 1991, Sirenia 1993). Manatees exhibit diel feeding patterns during the winter; they rest in warm waters during the day and head out in the late afternoon to feed in surrounding, sometimes, cooler areas (Bengston 1981).

Migration

Manatees normally migrate along shorelines and use deeper corridors to access shallow-water feeding and resting areas. Calves probably learn migratory patterns from their mothers (Sirenia 1993). Migration patterns often vary between individuals, but individuals tend to utilize the same migratory paths year after year. Some manatees may undertake extensive migrations along the coast and up rivers and canals (Reeves *et al.* 1992). Manatees may travel 40 km/day for several consecutive days, usually traveling directly and rapidly to a particular destination site with males ranging longer distances than females (Bengston 1981, Sirenia 1993). Typically manatees migrate northward in the springtime and southward in the fall and winter (Longieliere 1994). Manatees do not range far offshore, but may travel along the coast (Beeler and O'Shea 1988).

The increase in the number of man-made warm water sources over the years has influenced manatee behavior, specifically migratory patterns and social behavior. Warm water sources offer manatees refugia to escape the stresses of cold water temperatures. Manatees will aggregate at warm water sites when temperatures begin to drop below 20 degrees C (Garrott *et al.* 1994). Most research has concentrated on developing methods to determine population trends at these sites, but little work has investigated manatee behavior in relation to these man-made water sources. Although man-made, warm-water sites provide a type of refugia for manatees in winter, the effects of the associated behavioral changes (e.g., mating, convorting, calving) as a result of the availability of artificial refugia has not been closely examined to determine if there are any negative effects to the manatee. During the 1996 die-off, a large number of manatees aggregating in warm waters near the Ft. Myers powerplant died from exposure to a red tide brevetoxin outbreak. Their vulnerability was

increased because they were congregated near this artificial refuge when the red tide occurred. When large aggregations of manatees occur, their susceptibility to such natural phenomena is even greater (Lefebvre *et al.* 1989).

Boat channels are often used by manatees to travel from one region to another (Curran 1989, Sirenia 1993). During low tide, manatees also use these deeper channels to rest or cavort (Zoodsma 1991). Although these channels may provide deeper waters for manatees to avoid or escape oncoming boats, for reasons not yet understood, they do not always move out of the way of approaching boats. Manatees are also vulnerable to collisions with boats in narrow waterways and shallow water areas. During high tide, manatees are able to access foraging habitat that is normally inaccessible during low tide (Smith 1993). Although watercraft may utilize deeper navigation channels, coastal shallow areas are used intensively for fishing and general sightseeing. The shallow depths of these areas increase the likelihood of manatee injury or death if a powerboat passes over them.

Relationship to Other Species

The manatee is an indicator species for aquatic habitats, including seagrasses and mangroves, in the South Florida ecosystem. Because this species is dependent upon the health of its entire habitat, the status of the manatee acts as a signal for the condition of many of the other flora and fauna that rely upon aquatic systems. For example, seagrass beds and mangroves provide important areas for manatee foraging, calving, resting, and mating. They also provide important habitat resources for other aquatic species such as wading birds, crocodiles (*Crocodylus acutus*), turtles, fish and invertebrates. The stability of these aquatic communities is essential for manatees and many other species.

Manatees have no known predators, except for humans. Manatees and their habitats are continually threatened by human activities such as, habitat loss for residential and commercial purposes, increased turbidity levels from upland urbanization activities, pollution from sewage discharge and stormwater runoff, aquatic recreational and commercial activities, and alterations of natural hydrology. Several threatened and endangered sea turtles use the same seagrass beds as manatees for juvenile refugia and feeding. In addition, many migratory birds, and fish, both trust resources, rely on the aquatic habitats manatees use. Habitat requirements of all of these species need to be considered and balanced in order to conserve and protect these resources.

Human interferences with natural water flows have affected the dynamics of vegetative communities in the South Florida ecosystem. Changes in these flow regimes may affect not only manatees but other species as well, including the endangered American crocodile and pink shrimp (*Penaeus duorarum*), an important fishery species. Returning hydrologic flows to mimic more natural conditions will allow more fresh water into northeastern Florida Bay and may increase the amount of suitable crocodile nesting habitat. A decline in the pink

shrimp fishery has been attributed to a lack of fresh water inflow into Florida Bay and a loss of seagrass habitat. The effects of hydrologic conditions on manatees is not well known; but effects on habitat have been observed.

Although reactions may be different, manatees are susceptible to the same natural and human disturbances other aquatic organisms experience, such as changes in water quality, loss of habitat, and susceptibility to diseases and natural catastrophes. Considering man is the only known predator of manatees, it is our responsibility to ensure our actions do not jeopardize the continued existence of this species nor those other species that share its home.

Status and Trends

The Federal government has recognized the threats to the continued existence of the Florida manatee for thirty years. The West Indian manatee was first listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (16 U.S.C. 668aa(c)) (32 FR 48:4001), the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa(c)) continued to recognize the West Indian manatee as an endangered species (35 FR 16047), and the West Indian manatee was also among the original species listed as an endangered pursuant to the Endangered Species Act in 1973. Critical habitat was designated for the manatee in 1976. The justification for listing as endangered included impacts to the population from harvesting for flesh, oil, and skins as well as for "sport"; coastal feeding grounds modification by siltation; and the volume of injuries and deaths resulting from collisions with the keels and propellers of powerboats. Manatees are also protected under the provisions of the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 et seq.) and have been protected by Florida law since 1893.

Historic information on *T. manatus* distribution indicates manatees were once more common before pre-Colombian times. Manatees were highly utilized for their meat, oil, bones, and hide; hence, their early decline has been attributed to overhunting (Lefebvre *et al.* 1989). Extirpation and range contraction is evident throughout the manatee's range; areas previously with abundant populations now contain few or none. For example, manatees have been extirpated from some coastal areas in Mexico, Virgin Islands, and Honduras.

Florida is at the northern limit of *T. manatus*' year round range. Exact estimates of the historic manatee population is uncertain, but overhunting between the 1700s and 1900s is believed to be responsible for reducing manatee population to only a few relict groups (Hartman 1979). A slow increase in manatee numbers in the late 1800s is attributed to their protection by the 1893 State law prohibiting their killing.

The geographic distribution of manatees within Florida has changed since the 1950 and 60s (Lefebvre *et al.* 1989) and prominent shifts in seasonal distribution are also evident. Before man introduced warm effluents from power plants to the natural environment in the early 1950s, the winter range of the manatee in Florida was most likely the Sebastian River on the east coast and

Charlotte Harbor on the west coast (Moore 1951). Since that time, manatees altered their normal migration patterns and appreciable numbers of manatees began aggregating at these sites. As new powerplants became operational, more and more manatees began taking advantage of the sites by traveling great distances just to bask in the warm waters. The introduction of power plants in northern Florida, southern Georgia, Louisiana, and Texas has given manatees the opportunity to expand their winter range to areas not usually frequented (Hartman 1979).

As discussed earlier, determining exact population estimates or trends is difficult for this species. The best indicator of population trends is derived from mortality data and aerial surveys (Ackerman *et al.* 1992, Ackerman *et al.* 1995, Lefebvre *et al.* 1995). Aerial surveys conducted over the past 19 years have shown an increase in numbers, but this information is not an accurate account of trends since data has been obtained using different survey methods. O'Shea (1988) found no firm evidence of a decrease or increase between the 1970s and 1980s, even though aerial survey counts have increased. Increases in the number of recovered dead manatees have been interpreted as evidence of increasing mortality rates (Ackerman *et al.* 1992, Ackerman *et al.* 1995). Because manatees have low reproductive rates, these increases in mortality may lead to a decline in the population (O'Shea *et al.* 1988, 1992). Until better survey techniques are developed, efforts to reduce human-caused manatee deaths, like boat strikes, need to continue.

Although there are no accurate estimates of manatee population size, the 1996 synoptic aerial surveys conducted between February 18-19, estimated there were at least 2,639 manatees in Florida's waters. The numbers of manatees on the east coast and west coasts of Florida are almost equal (Rathbun *et al.* 1992). Approximately 1,457 manatees were found on the east coast of Florida—including Florida Keys and Florida Bay—and 1,182 manatees were found on the west coast, including the west coast of Everglades NP. These estimates represent the minimum number of manatees in Florida waters and may not represent the total population size (for discussions on bias in aerial surveys, see Garrott *et al.* 1995 and Lefebvre *et al.* 1994). Although this has been the highest estimate of manatees since the synoptic surveys were started, the results of these surveys may vary because of such factors as sampling methodology, manatee behavior, and weather conditions. Because of this variation and the high degree of uncertainty in surveying, it is difficult to correlate these manatee population estimates with overall manatee population trends (Ackerman *et al.* 1995). Although the synoptic surveys cannot be used to determine if the manatee population is increasing or decreasing, the surveys can identify trends such as increased mortality; they can also provide a general index of the manatee's population status.

Despite the lack of accurate estimates of the manatee population size, human activities have significantly affected manatees by eliminating or modifying suitable habitat, altering migratory access routes, increasing mortality,