Florida Manatee
Trichechus manatus latirostris

BEFORE THE
THE UNITED STATES
DEPARTMENT OF THE INTERIOR
and
THE UNITED STATES
FISH AND WILDLIFE SERVICE

Petition for a Rule to revise Critical Habitat for the Florida manatee, *Trichechus manatus latirostris*, pursuant to the Endangered Species Act, 16 U.S.C. §§ 1531-1544 and the Administrative Procedure Act 5 U.S.C. § 553(e)

Submitted By:

Wildlife Advocacy Project
Save the Manatee Club
Center for Biological Diversity
Defenders of Wildlife

I. INTRODUCTION

The Wildlife Advocacy Project, Save the Manatee Club, the Center for Biological Diversity and Defenders of Wildlife ("Petitioners"), pursuant to the Endangered Species Act, 16 U.S.C. §§ 1531-1544, and the Administrative Procedure Act, 5 U.S.C. §553(e), petition the Secretary, United States Department of the Interior ("Secretary") and the Director, the United States Fish and Wildlife Service ("Service" or "FWS") to revise the Critical Habitat designation for the Florida subspecies (*Trichechus manatus latirostris*) of the endangered West Indian manatee (*Trichechus manatus*).[1]

The Florida manatee was among the first species to be listed as endangered and also among the first for which Critical Habitat was designated. Since that time, the meaning of Critical Habitat has changed. Critical Habitat revision is now in order for a number of reasons: the lack of constituent elements in the designation, changes in use patterns by manatees since the designation, and new information from scientific studies carried out since the designation.

More than thirty years have passed since the Critical Habitat for this species was designated in 1976. Patterns of use by the species have changed, largely in response to coastal development, industrial growth, and increased recreational use of the manatee's nearshore habitats. Critical Habitat should be revised to add new Critical Habitat that has become essential to the manatee.

Finally, advances in the large cumulative body of scientific research on manatees in the past few decades provides us with greater knowledge of the biology, ecology, distribution, and behavior of manatees. Thanks to aerial surveys, a photo identification database, a carcass recovery database, and radio and satellite tracking of wild and rehabilitated manatees, it is possible to better identify which habitats are essential at specific times of year for specific biological functions.[2] Critical Habitat can now be defined with far greater precision.

This revision would be particularly timely as the Service recently completed the five-year review on the listing status of the Florida manatee. The public comment solicited through this process has provided even more current information on manatee use of habitat.

---

[1] The principal author of this petition is manatee biologist Patti Thompson. Co-authors are Eric Glitzenstein, Laura Combs, and Judith Wallace. Work on the petition was supported by a generous grant to the Wildlife Advocacy Project from the Harder Foundation.

[2] A thorough explanation of how aerial survey data are interpreted, how tagging is done, and how the photo ID database was established (and the incredible amount of continuous updating required to maintain accurate information as manatees acquire new scars) can be found in James A. Powell and Galen B. Rathbun, Distribution and Abundance of Manatees Along the Northern Coast of the Gulf of Mexico, 7 Northeast Gulf Science, July 1984, at 2-5.

Moreover, both by protecting a species that is a major focus of ecotourism and by affording certainty as to which habitat areas warrant protection, the economic impact of the requested revision is likely to be a net benefit for the citizens of Florida, as well as federal decisionmakers. When the Critical Habitat and its components are identified with precision and based on the best available scientific data, it will be far simpler to assess which federal agency actions will alter Critical Habitat to the detriment of the species and which will not. Accurate Critical Habitat designation will also help state, regional, and local governments that incorporate the federal designation into their own comprehensive land use planning to target their land acquisitions and regulations wisely.

The Service, the federal agency with primary responsibility for endangered species management, has long acknowledged the need to revise the Critical Habitat of the manatee. Indeed, the Florida Manatee Recovery Plan expressly recognizes the need for such a revision, as do many Biological Opinions and other consultation documents issued by the Service. This petition is designed to ensure that this concededly necessary and long overdue revision is finally carried out.

II. PETITIONERS

The Wildlife Advocacy Project ("WAP") is a non-profit organization based in Washington, D.C., whose purpose is to advocate for the conservation of the nation's biodiversity resources, protection of wildlife, and curtailment of animal abuse. WAP has previously pursued a number of projects on behalf of the Florida manatee.

Save the Manatee Club ("SMC") was established in 1981 by former Florida Governor Bob Graham and singer/songwriter Jimmy Buffett. SMC was founded so that the public could participate in conservation efforts to save endangered manatees from extinction. SMC is a membership-based, national nonprofit organization. Funds from the Adopt-A-Manatee program go toward public awareness and education projects, manatee research, rescue and rehabilitation efforts, advocacy and legal action in order to ensure better protection for manatees and their habitat. Currently, there are about 40,000 SMC members.

The Center for Biological Diversity ("CBD") is a non-profit organization with its headquarters in Tucson, Arizona. Striving to secure a future for animals and plants hovering on the brink of extinction and for the wilderness they need to survive, on behalf of its more than 180,000 members and supporters, CBD is actively involved in specis and habitat protection advocacy throughout the United States.

Defenders of Wildlife ("Defenders") is a non-profit organization with over one million members and supporters across the country. Defenders is dedicated to the protection and restoration of all native wild animals and plants in their natural communities. Defenders has devoted substantial organizational resources to efforts to conserve the manatee, reduce human-caused manatee mortality and injury, and prevent the loss and degradation of manatee habitat.

III. STATUTORY FRAMEWORK FOR CRITICAL HABITAT

A. Goals of the Endangered Species Act

In 1973, Congress acknowledged the unprecedented loss of biodiversity taking place worldwide, and expressed its concern that "various species ... have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation." Endangered Species Act, 16 U.S.C. § 1531(a)(1). In recognition of the "aesthetic, ecological, educational, historical, recreational and scientific value to the Nation and its people" of these rapidly disappearing species, and the inadequacy of existing laws to protect them, the Endangered Species Act ("ESA") was enacted "to provide a means whereby *the ecosystems upon which endangered species and threatened species depend* may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions" mentioned in the ESA. 16 U.S.C. § 1531(a)(3), 16 U.S.C. § 1531(b) [emphasis added]. In its statement of purpose the ESA explicitly recognizes that conservation of the habitats of listed species is a central goal.

The goal articulated by the ESA is not the maintenance of the status quo through the prevention of further decline, but rather the *recovery* of threatened and endangered species. Toward this end, the ESA authorizes a broad range of programs, including "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are no longer necessary. Such measures ... include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance..." 16 U.S.C. § 1532(3).

The most significant provisions are the requirements that the Department of the Interior develop and implement plans for the conservation and survival of the species (referred to as a "recovery plan"), designate Critical Habitat for the species, and review federal actions to ensure they do not jeopardize recovery efforts or destroy or adversely modify Critical Habitat, and the prohibition against taking or trading in endangered species. 16 U.S.C. §§ 1533(f)(1), 1533(b)(1)(B)(2), 1536(a), 1538(a). This petition relates to the government's legal obligation to designate and appropriately revise Critical Habitat for all endangered species.

B. Status of the Florida Manatee

Both species of the West Indian Manatee, the Florida manatee *(Trichechus manatus latirostris)* and the Antillean manatee *(Trichechus manatus manatus)*, are listed as endangered species. 50 C.F.R. §17.11; 35 Fed. Reg. 8491, 8498 (June 2, 1970). This listing recognizes that the species is "in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. §1532 (c)(6).

The West Indian manatee has long been recognized as one of the most appropriate and important subjects of conservation law. It was among the first animals to be protected under the precursor to the ESA, the Endangered Species Protection Act of 1966. 32 Fed. Reg. 4001 (1967).[3] The Service completed its five-year review of the manatee's listing status and released its results in April 2007. The review recommends reclassifying the manatee from endangered to threatened even though the Southwest sub-population (which accounts for approximately 41 percent of the Florida manatee population) is currently declining. Further, the Service's population model shows that the Atlantic sub-population (which accounts for approximately 44 percent of the population) will begin to decline in approximately 10 to 12 years, the manatee's warm water habitat is far from secure (contributing to the decline of the Atlantic sub-population), and the human population and related threats from boating and habitat loss continue to grow, further contributing to the entire population's expected decline.

C. Basic Legal Requirements for Critical Habitat

The ESA and implementing regulations both require Critical Habitat to be defined to the maximum extent prudent and determinable. 16 U.S.C. § 1533(a)(3); 50 C.F.R. § 424.12(a). Critical Habitat consists of both a geographic area and elements such as plants or natural features within that area. The ESA defines it as "(i) the specific areas within the geographic area occupied by the species, at the time it is listed ... on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed ... upon a determination by the Secretary that such areas are essential for the conservation of the species." 16 U.S.C. §1532 (5)(A); 50 CFR § 424.12(b).

The "constituent elements" of critical habitat – which "*shall* be listed with the Critical Habitat description," id. [emphasis added] – may include (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. Department of Interior regulations also specify that these elements "may include, but are not limited to, the following: roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dry land, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types." Id.

There are no such elements listed in the West Indian manatee Critical Habitat designation. Because management of Critical Habitat is based on the management of constituent elements, this omission seriously compromises the utility of the designation.

---

[3] For a description of the earliest efforts to protect marine mammals, see MICHAEL J. BEAN & MELANIE J. ROWLAND, THE EVOLUTION OF NATIONAL WILDLIFE LAW 109-11 (1997).

D. Benefits of Critical Habitat

Critical Habitat designation provides many significant protections to a listed species. The most important is the consultation requirement. The ESA requires federal agencies contemplating action to consult with the FWS to ensure that the action is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated Critical Habitat. 16 U.S.C. § 1536(a)(2). As several courts of appeals have now ruled, in analyzing whether an action will destroy or adversely modify critical habitat, Congress did not intend that the analysis should simply mirror the Service's jeopardy assessment. Rather, because critical habitat is that which is necessary to "conserve" -- i.e., recover -- listed species, the Service must use the consultation process to ensure that federal agencies are not permitted to destroy or degrade habitat necessary to bring about the recovery, and not merely forestall the extinction, of listed species. See Giffortd Pinchot Task Force v. U.S. Fish & Wildlife Service, 378 F.3d 1059, 1070 (9th Cir. 2004) ("Congress, by its own language, viewed conservation and survival as distinct, though complementary, goals, and the requirement to preserve critical habitat is designed to promote both conservation and survival."). "Clearly, then, the purpose of establishing 'critical habitat' is for the government to carve out territory that is not only necessary for the species' survival but also essential for the species' recovery." Id.; see also Sierra Club v. U.S. Fish and Wildlife Serv., 245 F.3d 434, 441-42 (5th Cir. 2001) ("'Conservation' is a much broader concept than mere survival. The ESA's definition of 'conservation' speaks to the recovery of a threatened or endangered species.").

Critical habitat designation offers several additional benefits. It provides guidance for private landowners; it also facilitates judicial review of agency action that impacts habitat rather than (or in addition to) individual members of a species. Because the Critical Habitat designation outlines the habitat needs of the species, the designation also affects related activities governed by the ESA such as incidental take permits, habitat conservation plans, land acquisition by the federal government and conservation groups, and the development of recovery plans. See Pamela Baldwin, The Role of the Designation of Critical Habitat under the Endangered Species Act, in Paul Foreman, Endangered Species: Issues and Analysis 165 (2002).

E. Revision of Critical Habitat

The ESA provides for revision of Critical Habitat designation as appropriate. 16 U.S.C. § 1533(a)(3)(b). Any determination about a revision is to be made according to the same criteria as the original designation: on the basis of the best scientific evidence, after taking into account economic and other impacts. Id. at § 1533(b)(2).

F. Process for Submission and Review of Citizen Petitions

The ESA allows individuals to petition for revision of Critical Habitat, in accordance with the Administrative Procedure Act, which provides that "each agency shall give an interested person the right to petition for the issuance, amendment, or repeal of a rule." 16 USC § 1533(b)(3); 5 USC § 553(e).

The evaluation of petitions to revise Critical Habitat is detailed in the ESA and in 50 CFR § 424.14(c). Within 90 days, the Secretary "shall make a finding as to whether the petition presents substantial scientific information indicating that the revision may be warranted" and "shall promptly publish such finding in the Federal Register." 16 USC § 1533(b)(3)(D)(I). The rule also provides that the petitioner shall be notified. 50 CFR § 424.14(c)(1). If the evidence is "not sufficiently definitive," the Secretary may solicit comments and additional information. 50 CFR § 424.15(a). Within 12 months, "the Secretary shall determine how he intends to proceed with the requested revision, and shall promptly publish notice of such intention in the Federal Register." 16 USC § 1533(b)(3)(D)(ii); 50 CFR § 424.14(c)(3).

IV. BACKGROUND ON THE FLORIDA MANATEE & ITS HABITAT NEEDS

A. Taxonomy

Manatees are marine mammals of the order Sirenia and the family Trichechidae. The West Indian manatee (*Trichechus manatus*) includes two subspecies, the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). The West Indian manatee's closest relatives are the other two species of manatee, the West African manatee and the Amazonian manatee, as well as the dugong and the extinct Stellar's sea cow. Sirenians evolved from land mammals more than 50 million years ago. Their closest living relatives are elephants. Fossils of ancient Sirenians dating back 45 million years have been found in Florida, indicating that the manatee is a native species.

B. Basic Physiology

The average adult manatee is about 10-12 feet long and weighs about 1,500-1,800 pounds, but manatees can grow to more than 13 feet and weigh over 3,500 pounds. In spite of their size, they have little body fat, which, along with their extremely low metabolic rate, may account for their extraordinary vulnerability to cold. Their large, gray-brown bodies taper to a flat, paddle-shaped tail. Manatees are evolved from an earlier land mammal that returned secondarily to the sea. The nails on their two flippers and their vestigial pelvic bones embedded in muscle are a testament to the species' terrestrial origins. Manatees surface to breathe through two valved nostrils located at the tip of the head . It is widely thought that they can live to about 60 years of age, although they rarely approach that age in the wild.

C. Habitat

Because manatees, like all Sirenians, are herbivores, they are found in relatively shallow waters where sunlight can penetrate and stimulate plant growth. They live in salt, fresh, and brackish waters in slow-moving rivers, estuaries, saltwater bays, canals and coastal areas. Manatees prefer waters that are three to seven feet deep. Along the coast, manatees tend to travel in water that is 10-16 feet deep and are rarely seen in waters more than 20 feet deep. Manatees are very susceptible to cold-induced stress, and generally cannot survive long in water colder than 20° Celsius (68° F). While deeper water basins and canals provide hundreds of manatees with warmer water, these sources may not provide adequate warm water in colder months. Therefore, the majority of Florida manatees tend to depend upon areas near natural warm springs and the warm-water effluents of power plants where available.

D. Diet

Manatees feed on a wide variety of submerged, emergent, and floating plants. Seagrass beds are important feeding sites for manatees. In marine habitats, their diet includes manatee grass (*Syringodium filiforme*), turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), widgeon grass (*Ruppia maritima*), and smooth cordgrass (*Spartina alterniflora*). In fresh water, they are known to eat hydrilla (*Hydrilla verticillata*), eelgrass (*Vallisneria americana)*, water hyacinth (*Eichornia crassipies*), and water lettuce (*Pistia stratiotes*), among other species. They sometimes ingest small tunicates, mollusks, or any of several species of zooplankton while feeding on submerged aquatic vegetation (SAV). It is estimated that a manatee can eat up to 10-15% of its body weight in vegetation daily.

E. Breeding and Reproduction

A major obstacle to the recovery of manatees is their slow reproductive rate. Typically, females do not begin to bear young until they are about five years old, and they usually bear one calf every two to five years. Males are not sexually mature until approximately age five. The gestation period is long (13 months) and a calf is dependent on its mother for up to two years. Manatees are relatively solitary creatures and the only known social bond is the one between mother and calf; however, they are often seen in aggregations in the vicinity of needed resources such as warm water and fresh water sources and seagrass beds.

Manatees do not form permanent pair bonds. During her approximately three-week long estrous period, a single female is usually followed by a group of males, forming a mating herd. They appear to breed at random during this time. Although breeding and birth can occur at any time during the year, there appears to be a slight spring calving peak. After calving, a female and her calf will remain in a sheltered area for several weeks, until the calf is able to travel.

F. Sensory Perception and Communication

On the whole, the sensory systems of the manatee are not fully understood, but recent research is revealing new information, particularly about manatee hearing. Anatomically, manatees have extremely large ear bones, which indicates they may have a good sense of hearing. Current research is determining how well manatees hear sound in the aquatic environment and how well they localize sound. Studies so far show that manatees responded to changing frequencies at a rate ten times faster than humans (Mann, *et al* 2005). Manatees have fairly good visual acuity and can distinguish between different-sized objects, different colors, and patterns. It is thought the vibrissae (whiskers) on a manatee's snout have a sensory function. Recent studies by researchers at the University of Florida suggest the sparse hairs located along their bodies may also have a sensory function. Further research to determine this is ongoing.

Manatees emit sounds underwater that are used in communicating with one another. It is not believed they are used for navigation. Vocalizations may express fear, anger, or sexual arousal, and are used to maintain contact, for example when a female and calf are feeding or traveling in turbid water.

G. Range

Manatees are a migratory species. Many individuals exhibit strong site fidelity, returning to the same warm-water wintering areas every year, including warm natural springs and the warm-water effluents of power plants (Deutsch, *et al.*, 2000), and protected deep water basins and canals. Florida manatees are concentrated in Florida from November through March but have been found in summer months as far west as Texas and as far north as Rhode Island, although sightings at the western and northern extremes of their range are rare.

H. Population and Distribution

1. Limitations of Current Population Survey Methods

Because manatees generally travel singly rather than in herds, and because viewing conditions are widely variable among their various habitats and between survey dates, which often makes them unavailable for observation, it is difficult to monitor the total size of the population. Most of what we know about manatee population and distribution has been learned after Critical Habitat was designated.

In fact, a population model developed by the FWS and U.S. Geological Survey in 2003 warns that two of the four manatee populations in Florida stand no chance of recovery within the next 100 years without additional management action, and that the other two populations face serious challenges to their recovery (Runge 2003).

In 1991, Florida began to carry out large-scale, state-wide, aerial surveys and ground counts that attempt to count every manatee visible in the state over the course of two days. These studies have been undertaken on average once a year for the past 15 years, but variations in weather and other conditions make the results quite variable and therefore cannot be used for comparison between surveys. For example, two synoptic surveys one month apart in early 1997 showed a 25% disparity. Thus, the surveys provide insight into the minimum population on a given day but are not particularly helpful in tracking population trends or health over time. The highest-ever synoptic survey result was 3,300 in 2001. State and federal manatee scientists stress that this count does not indicate that the population is increasing. The January 30 – February 1, 2007 statewide synoptic surveys conducted by the state's Fish and Wildlife Research Institute counted approximately 2,817 manatees. These surveys, together with the long-term databases tracking mortality, photo ID of individual animals, and the movements of tagged individuals, are being used to develop modeling techniques which it is hoped will eventually allow effective tracking and prediction of population trends. It is sometimes asserted that increased mortality rates are evidence of an increase in the manatee population. (Langtimm *et al.*, 2004). However, there is no evidence to support this leap in logic; increased mortality is only evidence of increased threats to manatees. In fact, despite significant advances, there is still no completely reliable census method for manatees, as the FWS acknowledges. Proposed Rule, Incidental Take During Specified Activities, 17 Fed. Reg. 69078, 69082 (Nov. 14, 2002).

2. Distribution in Four Sub-Populations: Northwest, Upper St. Johns River, Atlantic, and Southwest

The Florida manatee population is generally studied as four regional management groups: Northwest, Upper St. Johns River, Atlantic, and Southwest. The Upper St. Johns River and Northwest "subpopulations" are growing at rates of 6.2% and 3.7%, respectively. However these two subpopulations combined make up only 14.8% of the statewide manatee population. The Atlantic subpopulation is stable or increasing slightly (Runge *et al.* 2007). The Southwest subpopulation is the most vulnerable in the state and is likely declining.

§ The Northwest subpopulation comprises 11.4% of all Florida manatees, which inhabit the counties along the Gulf of Mexico from Escambia County east and south to Hernando County, Lafayette and Gilchrist Counties, and Marion County adjacent to the Withlacoochee River;

§ The Upper St. Johns River subpopulation comprises 3.4% of all Florida manatees, which inhabit Putnam County from Palatka south; Volusia, Flagler, and Marion Counties adjacent to the St. Johns River or its tributaries; and Lake and Seminole Counties;

§ The Atlantic subpopulation comprises 43.9% of all Florida manatees, which inhabit the counties along the Atlantic coast from Nassau County south to Miami-

Dade County; the portion of Monroe County adjacent to the Florida Bay and the Florida Keys; Okeechobee County; and counties along the lower portion of the St. Johns River north of Palatka, which includes Putnam, St. Johns, Clay and Duval Counties; and

§ The Southwest subpopulation comprises 41.3% of all Florida manatees, which inhabit the counties along the Gulf of Mexico from Pasco County south to Whitewater Bay in Monroe County and DeSoto, Glades, and Hendry Counties.

I. Leading Causes of Mortality

Manatees face both natural and man-made threats. It is not known what the minimum viable population number is - that is, how many manatees are sufficient to maintain a healthy, genetically diverse population. Large mammals that have a long potential life span and slow reproductive rate normally have a low adult mortality rate. A major concern is that the analysis of recovered manatee carcasses shows a high mortality rate among adults from human-related causes, which may have grave implications for the recovery of the species (Marmontel *et al.* 1997).

1. Human-Related Threats to Manatees

The most common human-induced causes of death are collisions with watercraft and deaths in canal locks and flood control structures. Loss of habitat is also a major threat.

- Watercraft Collisions: This is the leading identified cause of manatee deaths in Florida. The number of manatees killed by watercraft in both 2001 and 2002 established new record highs, and 2006 was the second deadliest year on record, surpassing 2001. Because manatees generally move at about three to five miles per hour, and can "sprint" short distances at 15-20 mph, they are vulnerable to boats moving faster than 20 mph. Most manatee deaths caused by watercraft collisions are from the actual impact of the boat's hull or the lower unit of an outboard motor striking the manatee rather than from propeller injuries. Therefore, although prop guards may be helpful, they cannot completely eliminate the threat from collisions. In fact, at high speeds, a prop guard can be source of blunt trauma to a manatee. The FWS Recovery Plan for the manatee notes that, based on carcass recovery, watercraft-related deaths rose during 1980-1999 and continue to rise in all regions studied, in some areas over 10% per year, and that nearly half of all manatees live in areas in which the watercraft-related deaths are "increasing rapidly" (U. S. Fish & Wildlife Serv. 2001). A recent analysis of threats to manatees concludes that watercraft-related mortality is having the greatest impact on manatee population growth and resilience (Runge et al. 2007a). A secondary but important outcome of some watercraft-related manatee deaths is that calves may be orphaned when the mother is killed. If an orphaned calf is not old enough to survive independently, does not find a surrogate mother, or is not rescued, it will die. If rescued, it will either

remain in captivity or be released when it is older. Reintroduction methodology is improving; however, the process is not always successful. Rehabilitation of orphans and post-release monitoring both require substantial resources.

Flood Gates/Canal Locks: Manatees can be crushed and/or drowned when caught in the rush of water caused by the operation of floodgates or canal locks. The FWS confirms that water control structure deaths are a concern in the Southwest, and are particularly high in the Atlantic region. (U. S. Fish & Wildlife Serv. 2001, Lefebvre *et al.* 2001). Flood control structures are prevalent in coastal areas of Florida where homes have been built in low-lying areas. Vertical gate opening and closing operations create a rush of water that may pin down manatees and prevent them from surfacing to breathe; they may drown first and then are crushed. Canal locks are used primarily for navigation purposes. In Florida, they also control flooding, salt water intrusion, and tidal currents. Many of the flood-gates and canal locks that were most deadly to manatees have now been retrofitted with devices that cause the gates to reverse action when a manatee is detected. There are still gates and locks in need of retrofitting, particularly in the Lake Okeechobee area. For example, 35 lock mortalities have occurred in Glades County; the most recent two deaths occurred in May 2007. The Ortona Lock gates on the Okeechobee Waterway in Glades County were recently retrofitted with an acoustic array like those installed on the Canaveral Lock and the St. Lucie Lock, which should prevent future lock-related deaths there.

Habitat Loss: Manatees rely primarily on three types of warm water refuges: power plant discharges, natural springs, and sheltered, quiet deep-water basins. The loss of warm water refuges or the decrease in their output is one of the greatest threats facing manatees. Potential power industry deregulation, aging power plants that will ultimately be decommissioned, and power plant outages are all threats to the manatees that rely on their discharges as warm water refuges in the winter. Natural springs are another significant source of warm water for manatees. Unfortunately, a booming human population and its associated use of ground water has reduced flow of known springs and likely eliminated other springs. Florida has not yet set meaningful minimum flows to protect these critical manatee resources. Sheltered deep warm water areas (thermal basins) are also threatened by new development. Manatees who utilize these areas are often disturbed by boating traffic and may be forced into colder waters, putting them at risk. Some of these areas are either undeveloped or minimally developed and experience very minimal boat traffic, but plans for development of boating facilities in some of these manatee warm water refuges are pending.

Coastal development for housing, boating facilities, agricultural, and commercial purposes can disturb vegetation, thus causing shoreline to be eroded and the sediments transported into nearshore seagrass beds, blocking sunlight and smothering the plants. Once seagrasses are destroyed, sediments are easily dispersed, turbidity increases, sunlight penetration is reduced, and reestablishment may not be possible. Phosphate-rich runoff from agricultural land, domestic sewage discharges, and runoff

from developed areas increases nutrient loading in nearshore areas. This promotes growth of micro-, epiphytic, and macro-algae, which further block the sunlight needed by seagrass. Denser development can have secondary impacts, by leading to increased boating and fishing and the associated propeller scarring, pollutants and litter related to these activities. Boat propellers employed in shallow water can tear up large swaths in seagrass beds, leaving damage that can persist for up to five years. Where boat traffic is heavy, constant damage may mean that seagrass beds never recover. A 1995 report conservatively claims that more than 173,000 acres of seagrass in coastal Florida counties have been scarred by boat propellers (Sargent *et al* 1995). With approximately 300,000 additional boats registered in Florida since 1995, propeller scarring and the threats to manatees have certainly increased.

Climate Change

Florida is already showing the early effects of climate change: eroding shorelines, dying coral reefs, and saltwater intrusion (NRDC 2001). Low-lying coastal areas are especially vulnerable to sea level rise. The most significant impacts of sea level rise to coastal areas are inundation and displacement of wetlands, coastal erosion, increased vulnerability to storm damage and flooding, and salt water intrusion into surface and ground water (Neumann *et al.* 2000). As sea levels rise, the freshwater streams and springs that manatees depend on could be threatened. Other specific threats to manatees from climate change include increased hurricane intensity, impacts to aquatic vegetation (Learmonth *et al.* 2006), and events such as toxic algal blooms (Twilley *et al.* 2001).

- Hunting and Fishing: It is illegal to hunt manatees in the U.S., but they are still hunted in all other parts of their range. Poaching of manatees is the U.S. is extremely rare, but it still occurs. Manatees can drown in fishing nets, such as those used on shrimp trawls. In Florida, manatees caught by fishing nets are accidental bycatch, not the target species. Manatees are often entangled accidentally in fishing lines or crab trap lines. Such entanglements can lead to death by wrapping the animal to the extent that it cannot feed or the entanglement may substantially hinder movement. Entanglement can also cause the loss of a flipper when the line tightens around the limb and stops blood flow or cuts through the bone.

- Other Human-Induced Mortality: Manatees can die from ingesting plastic bags, fishing lines and hooks, and other debris related to human use of Florida's waterways. Human interactions can disturb manatees, causing them to flee to less suitable habitat, such as high-speed boat corridors or colder waters during times when they depend on warm water refuges for survival. Boating, fishing, tourism (swimming, snorkeling, diving, feeding) and other activities cause disturbances, which may ultimately result in injury and death of manatees (Wooding 1997).

2. Natural Threats to Manatees

There are significant natural threats that can prevent manatees from living out their natural life span, which may typically be up to 60 years.

- Red Tides: A single catastrophic red tide event in 1982 contributed to the death of 37 manatees, another in 1996 was responsible for 151 manatee deaths. In 2003 and 2005, red tide was responsible for the deaths of 96 and 92 manatees, respectively. These toxic algal blooms give off a byproduct that affects the central nervous system of creatures in the area (U. S. Fish & Wildlife Serv. 2001). Although these natural events may not be preventable, methods to predict the events and reduce risks to manatees are being investigated.

- Perinatal Mortality: In recent years, approximately 60 manatees per year die soon after birth, mostly of undetermined causes (U. S. Fish & Wildlife Serv. 2001).

- Other Natural Threats: Manatees can die from natural causes such as gastroenteritis, an inflammation of the stomach and intestinal lining. The FWS has noted the emergence of papillomavirus (U.S. Fish & Wildlife Serv. 2001). Papillomavirus causes growths that can ultimately become so large that they may make movement and feeding very difficult.

V. CURRENTLY DESIGNATED CRITICAL HABITAT

Critical Habitat has been designated for the Florida manatee; however, as noted above, the designation lists only geographic areas. The area listed is "Florida. Crystal River and its headwaters known as King's Bay, Citrus County; the Little Manatee River downstream from the U.S. Highway 301 bridge, Hillsborough County; the Manatee River downstream from the Lake Manatee Dam, Manatee County; the Myakka River downstream from Myakka River State Park, Sarasota and Charlotte Counties; the Peace River downstream from the Florida State Highway 760 bridge, De Soto and Charlotte Counties; Charlotte Harbor north of the Charlotte-Lee County line, Charlotte County; Caloosahatchee River downstream from the Florida State Highway 31 bridge, Lee County; all U.S. territorial waters adjoining the coast and islands of Lee County; all U.S. territorial waters adjoining the coast and islands and all connected bays, estuaries, and rivers from Gordon's Pass, near Naples, Collier County, southward to and including Whitewater Bay, Monroe County; all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood Sounds between Key Largo, Monroe County, and the mainland of Dade County; Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County; all of Lake Worth, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County; the Loxahatchee River and its headwaters, Martin and West Palm Beach Counties; that section of the intracoastal waterway from the town of Seawalls

Point, Martin County to Jupiter Inlet, Palm Beach County; the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Seawalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between Indian and Banana Rivers, Brevard County; the St. Johns River including Lake George, and including Blue Springs and Silver Glen Springs from their points of origin to their confluences with the St. Johns River; that section of the Intracoastal Waterway from its confluences with the St. Marys River on the Georgia-Florida border to the Florida State Highway A1A bridge south of Coastal City, Nassau and Duval Counties." 50 C.F.R. 17.95.

However, as the section below demonstrates, although the geographical area listed is large, because of flaws in the listing, it provides inadequate protection of manatees.

VI. DEFICIENCIES IN CRITICAL HABITAT

A. Constituent Elements Required by Law are Absent

The lack of constituent elements may partly be a historical accident. Manatee Critical Habitat was designated in 1976, two years before the current requirement for constituent elements was included in the 1978 rule on Critical Habitat. This Critical Habitat designation was also the first for a marine mammal. It is long past time for the deficiency in this Critical Habitat designation--ironically, probably the result of the sense of urgency regarding this species--to be remedied.[4]

B. Changes in Use by the Species Necessitate Revisions

Since the manatee was listed and Critical Habitat was designated, the human population of Florida has increased 171%, from 6.8 million to an estimated 17.9 million in 2005; it is projected to reach approximately 23.5 million by 2020. Florida Office of Economic and Demographic Research, 2006; U.S. Census Bureau. See also Florida Department of Community Affairs, Division of Community Planning, Program Summary 2003 at 7 (Oct. 3, 2003). This dramatic rise in population, and the corresponding coastal development and increased recreational use of coastal area diminishes water quality, diminishes the availability of warm water, spreads marine debris, and causes general disturbances that have caused manatees to alter their use of these same areas. Emergency Rule to Establish Seven Additional Manatee Protection Areas in Florida, 67 Fed Reg 59,409 (Sept. 20, 2002). Decades of intensive water management throughout the state of

[4]Because extensive information is now available to the Service concerning the manatee's current and projected habitats needs and utilization, it is possible to describe the constituent elements in considerable detail. In doing so, petitioners are in no way are suggesting that this level of detail is legally required for any other critical habitat designation or revision.

Florida, in response to this development, have also significantly changed the habitats available to manatees.

Due to the phenomenal growth in Florida's residents and tourists, many of the previously quiet backwater areas used by manatees are now regularly and sometimes heavily used by boaters, increasing the threats to manatees. Further, in spite of public education efforts by government and private organizations, human-related harassment of manatees has not abated, but instead remains constant or has increased in some areas, causing manatees to sometimes flee warm water sanctuary areas for areas that are more dangerous to them. Some of the dangers include entering colder waters, entering areas of higher boating traffic, and separating mothers and calves.

C. Advancements in Science Provide New Information About the Needs of the Species

The FWS acknowledges that new information about manatees learned since 1976 warrants a reassessment of Critical Habitat (U. S. Fish & Wildlife Serv. 2001). This is quite an understatement—little was known about manatee distribution in 1976. For example, in the 1950s, the migration of manatees was considered a "legend" of fishermen; the use of springs by manatees in cold weather was but a hypothesis (Moore 1959).

Aerial surveys, radio and satellite telemetry studies, a carcass retrieval database, and the USGS-Sirenia Project photo identification database of at least 2,000 individuals (made effective, ironically, by the fact that most adult manatees bear distinctive scars from their encounters with propellers and fishing gear) have together revolutionized our knowledge of manatee distribution and use of habitat. The establishment of state and federal sanctuaries, such as the Crystal River National Wildlife Refuge established in 1982, provided scientists with the opportunity to conduct long-term studies of manatees that were relatively tolerant of humans in a sanctuary with excellent visibility (Rathbun, *et al.* 1990). Blue Spring State Park, established for the protection of manatees using the spring run as a warm water refuge, has the most comprehensive long-term database of manatee use of a warm water refuge of any area in Florida.

Nevertheless, much research about habitat use remains to be done--one recovery goal identified by the Service was to convene a Habitat Working Group (HWG) by October 2001. U. S. Fish & Wildlife Serv., Florida Manatee Recovery Plan, Third Revision (2001) at 84 (with additional habitat research goals noted at 94-95). The HWG has convened, meets regularly, and is in the process of compiling information and sponsoring promising research. One immediate goal of the HWG is to identify feeding areas associated with warm water aggregation sites and, ultimately, secure protection for these areas. A longer-term goal is to identify a network of migratory corridors, feeding, calving, and nursing areas and, ultimately, secure protection for these areas. U. S. Fish & Wildlife Serv., Florida Manatee Recovery Plan, Third Revision (2001).

D. The U.S. Fish & Wildlife Service Recognizes the Need for Revision

On numerous occasions, the FWS's own consultation documents have recognized the need to reassess manatee Critical Habitat in the face of new scientific information and deficiencies in the existing designation. See, e.g., FWS, Biological Opinion regarding Corps App. No. 4-1-97-F-602, at 7 (Jan. 28, 1998) ("The action area is within designated critical habitat for the manatee; however, no specific primary or secondary constituent elements were included in the critical habitat designation, ***making it difficult to determine when an action adversely modifies critical habitat***") (emphasis added).

Even more important, the Service's recovery plan for the species acknowledges the need to revise the critical habitat designation, explaining that "[m]uch has been learned about manatee distribution and habitat use in the decades since the designation of manatee Critical Habitat, and the Service's current Recovery Plan identifies the need to assess and revise Critical Habitat for this population. ***This task will be addressed in the future in a separate ESA action.***" U. S. Fish & Wildlife Serv., Florida Manatee Recovery Plan, Third Revision, at 98 (2001) (emphasis added).

VII. PROPOSED REVISIONS TO CRITICAL HABITAT

A. Proposed Constituent Elements Requiring Protection in All Critical Habitat

1. Warm Water

Manatees are extremely cold-sensitive due to their low percentage of body fat and remarkably low metabolic rates. They aggregate at confined warm-water refuges when coastal water temperatures begin to fall below 20° C (Irvine 1983). Access to warm water refuges during the winter is essential to their survival. Generally speaking, manatees require water temperatures of at least 19-20° C in order to avoid cold-related diseases (Bossart *et al.* 2002). Water temperatures in Florida routinely drop below that threshold, prompting manatees to migrate to warm water sources (Laist and Reynolds 2005). They also return year after year to the same warm-water areas. (Deutsch *et al.* 2003). Because use is predictable, these areas are ideal for Critical Habitat designation. Warm water sources should be protected constituent elements within Critical Habitat. Any warm water attractant, such as a power plant effluent, a natural spring, or a deep-water basin or canal that is used as a shelter from cold should be listed as a constituent element. Evidence suggests that metabolic changes occur when the water temperature drops below approximately 17° C that may affect normal feeding activity (Worthy *et al.*1999). Warm springs that attract manatees maintain temperatures of at least 22° C, significantly higher than surrounding water temperatures during cold winters.

Deep-water basins and canals provide adequate warm water for at least part of the winter season. Some of these, which were excavated for development or to provide navigation access, may have breached the ground water aquifers, thus supplying a

somewhat reliable source of warm water throughout the winter season. Others are simply deep enough that circulation patterns or thermoclines delay cooling and provide temporary thermal refuge (Smith 2000). Suitable water temperature should be listed as a constituent element.

Types of warm water sources: The two most important sources of warm water are effluents of power plants and natural springs. Other sources of warm water include dredged deep-water basins and canals, which are commonly used by manatees as secondary warm water refuges.

Warm water discharges: Power plant effluents are vital to manatees, but temporary shutdowns for repairs, especially of older plants, make them unreliable sources. It is inevitable that some older power plants will cease operations in the foreseeable future and these important warm water sources will be lost. Nonetheless, warm water outfalls at power plants currently used by manatees as warm water refuges should be protected constituent elements of Critical Habitat.

Natural springs: At the same time, tremendous increases in human demands on natural springs for municipal, residential, and agricultural use have reduced flows in the warm springs relied upon by manatees. Florida's water management districts are engaged in a long-term project to set, by regulation, minimum flows for all Florida springs. While the main purpose of this is to provide water for human consumptive uses, they are required to also determine spring flows necessary for the preservation of natural resources, including endangered species such as manatees. Blue Spring, in the upper St. Johns River, has been identified as an immediate priority; however, the St. Johns River Water Management District has adopted a water withdrawal scheme that will significantly reduce the spring flow, with a promise to return it to current levels by 2024. The Southwest Florida Water Management District has not prioritized the springs in Crystal River or Homosassa Spring in northwest Florida so the minimum flows for those springs will not be addressed until *at least* 2009-2010. Protection of these and other springs in northwest Florida and along the St. Johns River will increase in importance as industrial warm water sources cease to exist. Maintaining spring flows at current levels is essential for manatees and should be a protected constituent element. Unless this trend in diminished flows and the likelihood of loss of power plant effluents are mitigated by management action, they pose a serious threat to the recovery of the species (Runge 2003).

Passive thermal basins: These include dredged basins or naturally deep holes where solar radiation, circulation patterns, or thermoclines delay cooling of the water, thus creating warmer pockets of water (Smith 2000). It is also speculated that some of the deeper dredged basins may have breached the aquifer, providing seepage of relatively warmer water into the basin. Some of these basins are targeted for development and the associated threats caused by the introduction or increase of boating, tourism and other recreational activities will have an impact on manatees.

2. Food Sources

As large mammals eating a low-energy diet, manatees spend five to eight hours each day foraging and consume an average of 7% of their body weight each day (Deutsch et al. 2003). Seagrasses and freshwater SAV are the most important food sources and should be listed as a constituent element. Movements of manatees have been found to be strongly associated with the distribution of submerged aquatic vegetation, indicating that the availability of food may in fact drive the spring migration of manatees (Deutch *et al* 2003). Recognizing the importance of seagrass to the manatee, the FWS has advocated seagrass monitoring. U. S. Fish & Wildlife Serv., Florida Manatee Recovery Plan, Third Revision (2001) at 109 (section 3.3.8.2).

Seagrasses: The most important saltwater species are manatee grass, shoal grass, turtle grass, widgeon grass and smooth cordgrass. These plants can be harmed by urban and agricultural runoff, physical damage to the beds from dredging, propellers, and wakes, and high nutrient levels (Deutsch *et al.* 2003). Some of these seagrass species can be found only at depths of less than one meter; others can be found at depths of up to 15 meters if the water is sufficiently clear to allow light penetration.

Freshwater species: The most important freshwater food sources for the manatee include native SAV such as eelgrass and the exotic species hydrilla and water hyacinth. In fresh water areas where invasive exotics are the primary food source for manatees, a balance must be struck between management of these harmful SAV species and provision of forage for large numbers of over-wintering manatees. This is the case with hydrilla, particularly in Crystal River. In fact, the Recovery Plan notes that in both the Northwest and Upper St. Johns regions, potential conflict between weed control and manatee food supply is a habitat concern. U. S. Fish & Wildlife Serv., Florida Manatee Recovery Plan, Third Revision (2001) at 14.

Other food sources: Manatees will also graze on algae, even off sea walls, boat hulls and buoy lines. They opportunistically consume other grasses and have been documented pulling themselves partially out of the water with their pectoral limbs to feed on lawns where the grass meets the shore or grazing on submerged lawns during flooding. Manatees have even been documented feeding on acorns from overhanging oak trees during the winter in Blue Spring run when other food sources are not available (O'Shea 1986) and on mangrove leaves that may be within reach on the shoreline of estuarine habitat.

3. Travel Corridors

All of the other proposed constituent elements listed in this section are found in various, smaller geographic locations within larger geographic areas. Obviously, no single location contains adequate warm water, fresh water, food sources, and other constituent elements necessary for an individual manatee's survival. Therefore, manatees must travel between locations to meet their biological requirements. Their movement

patterns exhibit a strong tendency to return to the same locations year after year. Individual manatees typically occupy a few, relatively small core areas that are connected by lengthy travel corridors (Deutsch *et al.* 2003). The importance of these travel corridors cannot be overstated. Travel corridors should be a constituent element of Critical Habitat.

4. Shelter

Shelter sites within Critical Habitat should be listed as a constituent element. Shelter sites include residential canals, marina basins, backwaters, the upper reaches of rivers, and other areas that are protected from wind, lack strong water currents, and are relatively quiet, in terms of human activity.

Shelter from currents, rough water, and weather: Manatees tend to stay in shallow, intracoastal areas and largely avoid deep, open water where currents are strong and wave energy may be high. Manatees have been observed moving into sheltered areas when storms approach (Sharon Tyson, *pers. comm.*).

Shelter from disturbances: Manatees will react adversely to human-related disturbances, such as those from some waterborne activities, and will remove themselves from areas where they are feeding, resting, or seeking warm water to perhaps less suitable habitats, which may result in adverse effects on their health and fertility. It has even been hypothesized that the increase in boat traffic in winter may be a cause of winter migrations in locations where temperature is not a factor (Deutsch *et al.*, 2003). Disproportionate numbers of cow-calf pairs are found in quiet areas adjacent to healthy seagrass beds. Quiet areas free of disturbances also should be listed as a constituent element.

Calving areas: Manatees will seek a quiet, sheltered area, such as a residential canal or the upper reaches of a river to give birth and nurse. They usually will stay there with their calves for several weeks to allow them to strengthen and gain weight. The mother will often leave the calf temporarily in a quiet area and go off to feed on available SAV. A very large number of residential canal systems connected to larger water bodies are used in this way and warrant designation as constituent elements of Critical Habitat.

5. Fresh Water

Manatees also prefer areas with access to fresh drinking water. Current science suggests that although they can tolerate a wide range of salinities, they may be susceptible to dehydration after an extended period if fresh water is not periodically available (Ortiz *et al.* 1998). Recent research also suggests that fresh water availability, as much as any other factor, influences manatee movements within their range (Stith *et al.* 2006, Monica Ross, *pers. comm.*). Sources of fresh water in estuarine habitat include rivers and creeks that feed the estuaries, storm-water and sewage treatment outfalls, floodgates, weirs, drainage pipes, and private hoses. Fresh water sources should be a constituent element of manatee Critical Habitat.

6. Other Habitat Features

There is much known about manatee use of accessible habitat areas, however, there are several questions associated with manatee use of some habitat that have not been answered. Some areas that would seem to be highly suitable are not used, while some areas that might be considered marginal have regular use. This section lists some habitat features that may have a subtle influence on manatee distribution that may not be readily apparent or well documented. These habitat features should be considered when listing constituent elements of Critical Habitat.

Water Depth: Manatees feed, shelter, calve, rest, and travel in shallow water, but prefer feeding in the portions of seagrass beds that are adjacent to deeper water so they can easily dive to the deep areas to avoid power boats or other disturbances (Nowacek *et al.* 2004). Manatees also seem to prefer to travel in deeper water channels, perhaps because the depth affords them a degree of safety from vessel traffic.

Water Quality: Pesticides, herbicides, and other toxins contained in municipal wastewater and storm water runoff can diminish water quality, affecting the health of seagrass beds in near-shore waters. Freshwater releases into estuaries from canals designed for flood control of uplands and from sources such as Lake Okeechobee not only contain contaminants that degrade water quality but also have a detrimental effect on salinity levels required for healthy seagrass beds.

Salinity: Salinity in estuarine water bodies is affected by rainfall, fresh water runoff, and seawater influx into estuaries during storms. It is also affected by fresh water releases from flood control structures. Where there is variation in a water body's salinity, manatees have been known to shift their use to stay within waters with a preferred salinity (Deutsch *et al.*, 2003). Although manatees can be found in marine waters, they prefer habitat with a salinity of less than 25 ppt (parts per thousand). (Hartman 1979). Ocean water, in contrast, has a salinity of approximately 35 ppt. Appropriate salinity levels should be listed as a Critical Habitat constituent element.

B. Geographic Boundaries to be Altered and Constituent Elements Requiring Special Attention

The currently designated Critical Habitat, along with proposed revisions to the geographic area, and proposed constituent elements for each area, are detailed in this section. Some wholly new geographic areas that warrant Critical Habitat designation are also noted, and are detailed immediately following the closest currently designated Critical Habitat. Because the Service has determined that four, somewhat discrete regional subpopulations (or management units) of manatees exist, it is appropriate to address the revision of Critical Habitat based on the geographic areas generally inhabited by these regional groups.

Northwest Region:

Wakulla, Jefferson, Taylor, Dixie, Levy, Citrus, and Hernando Counties

This region represents the northwestern limit of the Florida manatees' typical, year-round range (Lefebvre *et al.* 2001). Manatees have been well documented west of Wakulla County and sightings along the northern Gulf coast have increased over the past decade; however these sightings are sporadic and relatively limited (Fertl *et al.* 2005). This subpopulation is experiencing healthy growth and the increased number of sightings in the Wakulla River and other areas in this most northwest limit of the range likely reflect that growth. Although little is known about actual routes of migration, individual manatees spotted in the Wakulla and St. Marks rivers have been identified by researchers as known animals from Crystal River, implying they move up the coast during spring migration, probably using other river systems as stopovers along the way ((Rathbun, *et al.* 1990, Terri Calleson, *personal communication*). These include: The Withlacoochee River, the Suwannee River, and the Steinhatchee River. Little is known about manatee migration routes along the coast of Taylor and Jefferson counties, but the area is described as shallow, low-energy coastline, characterized by intertidal marsh, salt flats, and submerged seagrasses, all of which define typical manatee habitat (Terri Calleson, *pers. comm.*).

New information: This expanded area is a striking example of how scientific knowledge has increased since Critical Habitat designation. The landmark study of the winter aggregation of manatees in this area was not published by Hartman until 1979, three years after the Critical Habitat designation. Powell and Rathbun's 1984 study suggests that this area may be "the best hope for the long-term existence of this endangered species in Florida." Aerial surveys in Wakulla County, which is located in northwest Florida along the Florida Panhandle, an area termed the "Big Bend," were flown from 1994-1996, adding to the limited amount of information on manatee use of the area. Prior to these surveys, the Suwannee River was considered the northernmost limit of manatees' year-round range on the Gulf coast (Powell and Rathbun 1984).

- ***Increased use:*** The number of manatees using this area has increased dramatically since the species was listed. Although these were not heavily used areas in the late 1960's, use of the Crystal River and Homosassa River thermal refuges increased by over 200% in just a 15-year period (Powell & Rathbun 1984). The Homosassa and Crystal rivers are now among the most heavily used winter sites on Florida's west coast. Powell and Rathbun offer several possible explanations for this population growth, each of which probably contributed in some way: their vegetation surveys indicate that before the release of invasive plant species in the late 1960's, there may not have been enough food in the area to support a population like the current one; relatively low mortality from boat strikes; and, finally, some manatees have also migrated from other areas. At the same time, spring flows have dramatically decreased at Homosassa Springs and other springs in the area over the past twenty

years (Runge 2003). Since double or triple the number of manatees now use Homosassa Spring, preservation of spring flows is more critical than ever.

Manatee use of the more northerly areas of this region has also increased. A high count of 24 manatees was made in the Wakulla River/Springs and St. Marks River area in 1996. An anecdotal sighting of 22 manatees was reported in the Wakulla River in 1999. Current information includes reports that more manatees are being sighted further upriver, closer to the springhead than previously observed (Terri Calleson, *pers. comm.*). Use of the St. Marks River has undoubtedly changed as well, since the Sam O. Purdom power plant on the St. Marks River, near the town of St. Marks has apparently changed its operations such that the warm water discharge has been modified so that it is no longer an attractant to manatees (Terri Calleson, *pers. comm.*). This may help explain the increased use of Wakulla Springs. Additional research is probably warranted in the Big Bend area.

- ***New Data:*** Aerial surveys of the Crystal River and Homosassa River areas have been flown since1991. A long-term photo-identification study has been ongoing in this important area since 1986 and has contributed greatly to better understanding of survival rates of manatees in this subpopulation. Several manatees have been tracked via radio and satellite telemetry providing insights into movements and usage patterns of individuals. These areas are important winter habitat, although they are used year-round in increasing numbers. They are particularly important because (1) they have some federal protection and (2) habitat is rapidly being lost elsewhere. There are many small creeks in this area that are used by manatees. It should be noted when interpreting the aerial survey numbers that poor visibility in some areas (particularly the Withlacoochee River, the Cross Florida Barge Canal, and the Suwannee River) may produce artificially low survey results. Also, some waterways (particularly the Weeki Wachee River) are so shallow that manatee use varies with the tides. The long-term mortality database maintained by the state's FWRI also provides information on manatee distribution and usage patterns as well as causes of death. Aerial surveys of the Wakulla and St. Marks River area were flown from 1994-1996. The highest single count of manatees during those surveys was 24 individuals in June of 1996.

Currently designated Critical Habitat: Crystal River and its headwaters known as King's Bay, Citrus County.

Proposed revision of geographic area: Expand north and westward to include the Wakulla River and the St. Marks River in Wakulla County. Include the Steinhatchee River on the border of Taylor and Dixie counties. Include the Suwannee River (up to and including Manatee Springs and Fanning Springs) on the border of Dixie and Levy counties. Include the Withlacoochee River on the border of Levy and Citrus, the Cross Florida Barge Canal, and coastal Citrus County. Continue the designation southward from Crystal River to include the Homosassa River (up to and including Homosassa

Springs), and including the Chassahowitzka River and Bay and tributaries; and south to the Weeki Wachee River. Perhaps also include coastal Taylor and Jefferson counties.

Notable constituent elements requiring listing:

- ***Warm water:*** The springs of the Crystal River complex and Homosassa Springs are two of the most important, large natural warm-water sources manatees rely upon in winter. The Crystal River complex of springs had a high count of 301 in 2000. Homosassa Springs had a high count of 123 in 1999. In recognition of the substantial manatee population and need to protect them from conflict with human uses, there are several manatee sanctuaries established in this area, in which federal law bans waterborne activities from November 15 to March 15. They are: the Banana Island Sanctuary, in Kings Bay; the Sunset Shores Sanctuary, also in Kings Bay; all of the submerged land lying within the mean high water line of a canal bordering the western, northern, and eastern sides of Paradise Isle Subdivision; a tract of submerged land in Sections 28 and 29 Township 18 South Range 17 East in Citrus County; two tracts of submerged land in Section 28 Township 18 South Range 17 East; the Three Sisters Spring Sanctuary and the Magnolia Springs Sanctuary, located in a canal system off Kings Bay; and the Blue Waters Sanctuary in the Homosassa River. The precise coordinates for boundaries of the sanctuary can be found at 50 C.F.R. 17.108. The sanctuary designation requires a substantial showing by the Service that protection is required to prevent the taking of manatees.

  The volume of flow of the springs at Crystal River is currently sufficient, making this a critical warm water area for the Northwest subpopulation. The Homosassa Springs flow is at risk. It has been estimated that the best possible scenario for Homosassa Springs, if water management efforts are successful, is a 10% flow reduction, but that a more than 50% reduction in this vitally important warm-water source is possible (Runge 2003). Minimum flows for Homosassa Springs and the springs complex at Crystal River will not be addressed until at least 2009, meaning reductions in spring flows will likely continue to occur without regulatory limitations due to demands for water by the increasing human population.

  Manatees also aggregate in the warm-water effluent of the FPC Crystal River power plant, located about 5 kilometers north of the mouth of the Crystal River, for short periods of time (Powell & Rathbun 1984). Warm water is available at Wakulla Springs where small numbers of manatees have been counted. Manatee Springs on the Suwannee River is used by small numbers of manatees and may be more heavily used as the Northwest subpopulation grows and industrial sources further south go offline. The same increased use may also occur at Fanning Springs. Weeki Wachee Spring supports small numbers of manatees in the winter months but, as mentioned above, the water level in the

spring run is tidally influenced such that it can be very shallow at times making access difficult.

- ***Food sources:*** Manatees in the Crystal River/Homosassa Springs area tend to feed on beds of widgeon grass and shoal grass found on sandbars next to channels, and on hydrilla, water hyacinth, and eelgrass in the fresh water portions of the area (Lefebvre *et al.* 2001). The Withlacoochee River provides feeding near the river mouth and in the area where the dredged residential canals at Yankeetown meet the river. The Chassahowitzka River and associated system of waterways provide widgeon grass along the channels and islands near the river mouth. Plentiful food also attracts manatees to Manatee Springs on the Suwannee River (Powell & Rathbun 1984). Manatees in the Wakulla River and St. Marks system feed on eelgrass and pondweed, among other species of SAV. The marine coastal areas of the Big Bend region have abundant seagrass beds, predominantly turtle grass, but also including manatee grass and shoal grass (Terri Calleson, *pers. comm.*).

- ***Travel corridors:*** During warm weather manatees can be found in significant numbers in the Suwannee River, the Withlacoochee River, the Crystal River, the Homosassa River, and the Chassahowitzka River (Powell and Rathbun 1984). Data showing a gradual decrease in use from an abundant population in the spring to lower numbers in the summer in the Chassahowitzka River, FPC Crystal River power plant effluent canal, Cross Florida Barge Canal, Withlacoochee River, and Waccasassa River have been interpreted to indicate that these rivers are used as stopover sites during the spring dispersal from the winter refuges (Rathbun, *et al.* 1990). Migrating manatees use the coastal area of the Big Bend region between Wakulla County and Citrus County as a travel corridor in warmer months. All of these areas are important travel corridors during spring and fall migration.

- ***Shelter:*** There are seven seasonal sanctuaries within the Crystal River National Wildlife Refuge. Six of these provide warm water as they are located in close proximity to natural springs. The seventh, Buzzard Island sanctuary, is a protected feeding area. All seven of these sanctuaries also provide manatees with areas where they can rest and avoid human contact. The Blue Waters sanctuary on the Homosassa River provides shelter from human contact for manatees using the river near Homosassa Spring for warm water. A recent dredging project has provided additional access to waters closer to the spring (which is currently fenced off and holds captive manatees) so that wild manatees in the river can also use this area, which is off limits to human activity. It is likely, from anecdotal reports, that residential canals in Citrus County are used as calving areas. Similarly, many reports of observed calving have come from residents living on the Withlacoochee River. The Cross Florida Barge Canal, particularly the portion of the Withlacoochee River that feeds into the canal, has disproportionately high perinatal mortality, indicating that this may be a preferred calving area. There are several features that make the canal a plausible favored birth site, including

shallow, calm areas at the Inglis Locks and along the Withlacoochee River below Lake Rousseau, light boat traffic in the canal, and its proximity to the Homosassa and Crystal Rivers (Rathbun, *et al.* 1990). The FPC Crystal River power plant effluent is used as a temporary safe haven in the spring and fall (Powell and Rathbun 1984).

- ***Fresh water:*** There is ample fresh water in this region. Wakulla Springs, the Wakulla River, the St. Marks River, and the Steinhatchee River are all freshwater systems. The Suwannee River is also fresh water. During the warm season, manatees use the estuarine areas created by oyster beds that trap fresh water at the mouth. The Withlacoochee River is a fresh water system, including the upper portion that is bisected by the Cross Florida Barge Canal and thus isolated from the lower river. The riverine habitats of the Crystal and Homosassa Rivers are used more heavily than their estuarine habitats, but the opposite is true in the Suwannee River and Chassahowitzka Rivers (Powell & Rathbun 1984). The Weeki Wachee system is also fresh water.

Southwest Region

This region is large and encompasses the west coast of Florida from Pasco County south to the Everglades portion of Monroe County. It is unusual in that it includes one of the best-studied areas of the state (Tampa Bay) and yet further south, Lee, Collier, and Monroe counties lag behind the rest of the state in the long-term Photo Identification database, making the status of this subpopulation less certain than in the other three regions. According to the most recent population information available, however, the southwest regional subpopulation is likely declining (Runge, *et al* 2007). Recent research in Ten Thousand Islands and Everglades National Park will be helpful in filling in the data gaps in the more remote areas of this region. Although there is some discussion that manatees using the Tampa Bay area, the Lee and Charlotte Counties area, and the Collier and Monroe Counties area are somewhat discrete groups, it was decided, given the available data, that they would be managed as one subpopulation (U.S. Fish & Wildlife Service, Florida Manatee Recovery Plan, Third Revision, 2001). Discussion of revision of Critical Habitat and the constituent elements in these areas will reflect acknowledgment of the relative separateness of their manatee groups.

New information: This region is another illustration of how scientific knowledge of manatees and habitat has improved since Critical Habitat designation. For example, Tampa Bay is now one of the best-studied areas in Florida, with nearly two decades of information on manatees and habitat in the bay. The Tampa Bay Estuary Program has overseen significant recovery of seagrasses in many areas of the bay due to water quality improvements over the past two decades. Winter aerial manatee counts at the Tampa Electric Company Big Bend Power Plant (TECO) and the Florida Power Corporation (Bartow) power plants in Tampa Bay have documented a significant increase in the numbers of manatees using the power plants over the years. Lee, Charlotte and Collier counties have experienced

seagrass loss due to development and propeller scarring. Freshwater grasses in the Caloosahatchee River, which were relied upon by manatees utilizing the Florida Power and Light warm water discharge have been decimated by huge fresh water releases from Lake Okeechobee, which literally rip them up from the substrate. Conversely, in years when rainfall is low and no water is released from Lake Okeechobee, freshwater grasses are inhibited by higher salinity in the Caloosahatchee River. Seagrass beds in San Carlos Bay have also been adversely affected by these releases. It is also now known that this subpopulation of manatees is declining due to human-related mortalities and red tide events, both of which appear to be occurring with increased frequency over the past two decades. New information on manatee use of the Everglades in southwest Florida is now available. For example, recent tracking studies show that manatees typically respond to drops in Gulf water temperature by seeking warmer inland sites, many of which have now been identified (Stith *et al.* 2006). Protecting this region by revising its Critical Habitat is of utmost importance to manatee recovery.

- ***Increased use:*** The documented number of manatees using this area has increased dramatically since the species was listed. Although relatively little was known about manatee use of southwest Florida when Critical Habitat was designated, it is now clear that this area supports approximately 41% of the manatee population in Florida. The use of Tampa Bay warm water refuges and of Lee and Collier County warm water refuges (both primary and secondary) has grown over the last several decades.

- ***New Data:*** Tampa Bay is one of the best-studied waterbodies in Florida. Bay-wide aerial manatee distribution surveys, which included waters of Pinellas, Hillsborough, and Manatee counties, were conducted from 1987-1997. Winter aerial manatee counts at the TECO and Bartow power plants have documented a significant increase in the numbers of manatees using the power plants over the years. Hillsborough, Pinellas, Manatee, Sarasota, Charlotte, Lee, and Collier counties have all been studied through multiple aerial survey, satellite telemetry, and photo identification efforts in the past two decades. In addition, the mortality database has improved through better carcass collection efforts and necropsy procedures, allowing researchers to better identify causes and distribution of manatee deaths. Recent information gathered about manatee use of south Collier County and Monroe County allows better analysis for the purpose of revising Critical Habitat in these less well studied habitats.

Pasco, Pinellas, Hillsborough, and Manatee Counties

Currently designated Critical Habitat: the Little Manatee River downstream from the U.S. Highway 301 bridge, Hillsborough County.

Proposed revision of geographic area: Expand northward to include the Pithlachascotee River and the Anclote River in Pasco County, including the waters around the power plant. In coastal Pinellas County, include the Anclote River, St. Joseph Sound, and Spring Bayou. Also include the Intracoastal Waterway/Clearwater Harbor in Pinellas County through Boca Ciega Bay to the confluence with Tampa Bay. In Pinellas and Hillsborough counties, include Old Tampa, Tampa, and Hillsborough Bays and all associated bays, harbors, rivers, and creeks. Specifically include Safety Harbor, Bishop Harbor, Mobbly Bay, the Hillsborough River south of the dam, the Alafia River south of U.S. Highway 301, the Palm River, Cockroach and Little Cockroach Bays and Miguel Bay. Most of these waterways have some degree of protection in the form of state boat speed zones in recognition of their use by manatees.

Notable constituent elements:

- ***Warm water:*** Tampa Bay has three power plant effluents used by manatees, of which the TECO plant, on the eastern shore of Tampa Bay is the most heavily used with 330 manatees counted in a single survey in 2003. The Bartow power plant across Old Tampa Bay from the Port of Tampa had a high count of 102 manatees during winter in 1999. The Port Sutton power plant is used by up to 25 manatees at a time. In recognition of the need to protect wintering manatees, waterborne activities are banned from November 15 to March 31 at the Bartow Manatee Sanctuary, the TECO Manatee Sanctuary, and the Port Sutton Manatee Sanctuary. (Precise coordinates are at 50 C.F.R. 17.108). In the TECO Manatee Refuge, south of the TECO Manatee Sanctuary, and in the Port Sutton Manatee Refuge, located in the area surrounding the Port Sutton Manatee Sanctuary, watercraft must operate at idle speed from November 15 to March 31. (Precise coordinates are at 50 C.F.R. 17.108). Sulphur Springs at the headwaters of the Hillsborough River provides warm water to a smaller numbers of manatees, although it is not heavily used, partly because it is behind a water control structure. Culbreath Bayou in Old Tampa Bay is also used as a secondary warm water site. The Progress Energy Anclote power plant in Pasco County is used as a secondary warm water site. Designating these areas as Critical Habitat for the purposes of warm water would provide protection to a vulnerable population in areas the state has already recognized as significant.

- ***Food sources:*** There are important seagrass beds up to the six-foot bathometric contour line throughout Tampa Bay, which have been somewhat recovered in the past 20 years due to improvements in water quality and are now an important food source. From 1950 to 1984, more than 40 percent of Tampa Bay's seagrasses disappeared; however the Tampa Bay Estuary Program has implemented a seagrass restoration program and improvements in water quality since then have allowed significant seagrass meadows to return to the bay in the past two decades. This coincides with the increased number of manatees using the bay throughout the year. In recognition of the importance of these seagrass beds, the State of Florida has made efforts to map the most important ones. The state has

recognized the importance of the seagrass beds in Old Tampa Bay north of Courtney Campbell Causeway and east to Safety Harbor. A particularly important area is the part of Old Tampa Bay from Courtney Campbell Causeway to Gandy Bridge, especially the area north of the Howard Frankland Bridge; the state has noted that manatee use of the dense seagrass beds in this area is particularly heavy and that the area has been inadequately protected. All of Bishop Harbor contains thick seagrass beds. The seagrass beds on the eastern shoreline of Tampa Bay south of TECO power plant are heavily used during winter season between cold spells. There are seagrasses around the mouth of the Little Manatee River. Now that seagrass has returned to southern Hillsborough Bay due to improved water quality, manatees have begun to feed there, too. Although not much is known about manatee use of this area, coastal Pasco County has lush seagrass beds along the coastline and extending into the Pithlachascotee River. Anecdotal sightings in the river along with 6 mortalities, three of which were watercraft-related, indicate that manatees use the river.

- ***Travel corridors:*** Migrating manatees use St. Joseph Sound and the ICW/Clearwater Harbor area down to Boca Ciega Bay. Hillsborough Bay is heavily used as a travel corridor to the Hillsborough River year-round. Manatees also travel up to feeding and resting areas in Old Tampa Bay and move across Tampa Bay, including in shipping lanes, year round. In winter months, manatees travel between cold spells to and from the TECO and Bartow power plants to feeding areas throughout Tampa Bay (Weigle *et al.* 2001).

- ***Shelter:*** The Hillsborough River, the Palm River, and the Alafia River are recognized as quiet areas that manatees use for resting and shelter. The Hillsborough River is a calving area. The Little Manatee River is known as a quiet area for resting and shelter from weather and heavy boat traffic. Residential canal systems including Culbreath Bayou, mostly along the eastern shorelines of Old Tampa and Tampa Bays, provide protected areas for calving and resting and protection from rough waters of the bay. Coffee Pot Bayou and associated bayous and canals south of Gandy Bridge in St. Petersburg are also shelter areas. Spring Bayou is a shelter area.

- ***Fresh water:*** The Hillsborough River is a freshwater site as well as a warm water site. The Alafia River and the Palm River are particularly useful as shelter and freshwater sites. Culbreath Bayou has natural freshwater springs and seeps (Weigle *et al.* 2001). The Little Manatee River is valuable as a freshwater site. Several other smaller creeks feed into Tampa Bay and provide fresh water, such as Frenchman's Creek. Coffee Pot Bayou and Boca Ciega Bay also provide freshwater sources. (Suzanne Tarr, *personal communication*). The Anclote River and the Pithlachascotee River provide fresh water. Spring Bayou provides fresh water.

Currently designated Critical Habitat: the Manatee River downstream from the Lake Manatee Dam, Manatee County.

Proposed revision of geographic area: Expand to be contiguous with proposed Tampa Bay designation, including Miguel and Terra Ceia Bays. Also extend to include by name: the Braden River (a tributary to the Manatee River), Anna Maria Sound, Palma Sola Bay, and the northern portion of Sarasota Bay in Manatee County. Most of these waterways have some degree of protection in the form of state boat speed zones in recognition of their use by manatees. (68C-22.014 F.A.C.)

Notable constituent elements to be protected:

- ***Warm water:*** No significant warm water aggregation sites are within this geographic area. However residential canals and the upper reaches of the rivers provide some warm water in the early winter season.

- ***Food sources:*** The seagrass beds in Miguel and Terra Ceia Bays are high manatee-use areas valuable for feeding. Feeding occurs in the plentiful seagrass beds in Anna Maria Sound, Palma Sola Bay, and northern Sarasota Bay. There is also feeding habitat at the mouth of the Braden River. The SAV in the freshwater portion of the Manatee River is not mapped but it is likely there is some fresh water vegetation available.

- ***Travel corridors:*** There are several important travel paths, including a deeper-water corridor into and through Miguel Bay, a travel corridor to the south of Joe Island, running east and west, a corridor to the west of Joe Island, running north and south, and the entrance channel into Bishop Harbor (Suzanne Tarr, *pers. comm.*). Anna Maria Sound is the northern portion of the important north-south intracoastal migratory corridor to southwest Florida.

- ***Shelter:*** The Braden River is utilized for shelter. This is among the highest-use waterways in the Tampa Bay area. Most of the manatee sightings have been near the southern boundary of the Braden Lakes subdivision, where the river is straighter and wider. This is probably an artifact of availability to observers because the upper portions of the river are tannin-stained, narrow, and winding, creating difficult sighting conditions (Suzanne Tarr, *pers. comm.*). Many relatively quiet, small rivers are used for calving and nursing, including, but not limited to, the Manatee and Braden Rivers and the residential canals associated with them. Bowlees Creek, off Sarasota Bay in Manatee County is a resting and calving area.

- ***Fresh water:*** The Manatee and Braden Rivers provide fresh water. Terra Ceia Bay has a fresh water seep on the east side. Palma Sola Yacht Club area in Palma Sola Bay is a source of fresh water (Suzanne Tarr, *pers. comm.*).

Sarasota County

New area to add: Sarasota Bay, Roberts Bay (north Sarasota County), Little Sarasota Bay, Blackburn Bay, Lemon Bay (the Sarasota County portion is included in this section but is contiguous with the Charlotte County portion in the next section), and all associated bays, creeks and rivers, including, but not limited to Pansy Bayou, Buttonwood Sound, Whitaker Bayou, Hudson Bayou, Coconut Bayou, Roberts Bay (south Sarasota County), Curry Creek, Dona Bay, Venice Canal, Philippi Creek, Forked Creek, Alligator Creek and the Sarasota County portion of Gottfried Creek.

Notable constituent elements:

- ***Warm water*:** Forked Creek has been identified as a secondary warm water aggregation site in this area (Weigle, *et al* 2001).

- ***Food sources:*** Sarasota, Little Sarasota, and Lemon Bays and the smaller, associated bays listed above are year-round feeding areas. All of these bays have extensive seagrass beds (Monica Ross, *personal communication*). Pansy Bayou provides feeding areas as well as shelter from disturbance.

- ***Travel corridors:*** All of Sarasota Bay, Roberts Bay, Little Sarasota Bay, Venice Canal, Lemon Bay, and connected bays in the Intracoastal Waterway are used as travel corridors throughout the year. Manatees regularly travel up Philippi Creek and Forked Creek for shelter and fresh water.

- ***Shelter:*** Relative quiet and protection from boats is provided in Pansy Bayou, a very important shelter area. In recognition of the importance of this small bay to manatees, motorized vessels are prohibited from entering. Buttonwood Sound is used for resting and shelter. Sarasota, Little Sarasota, and Lemon Bays provide breeding and resting sites along their shores, such as Philippi Creek and Forked Creek (Monica Ross, *pers. comm.*). Whitaker Bayou, Hudson Bayou, and Coconut Bayou are shelter areas. Upper Dona Bay is a resting and calving area.

- ***Fresh water:*** Philippi Creek and Forked Creek in Sarasota County are heavily used for freshwater and shelter year-round except during very cold weather (Monica Ross, *pers. comm.*). Curry Creek, Blackburn Canal, Alligator Creek, and Gottfried Creek provide fresh water.

Charlotte County (and portions of southern Sarasota and DeSoto counties)

Currently designated Critical Habitat: The Myakka River downstream from Myakka River State Park, Sarasota and Charlotte Counties.

Proposed revision of geographic area: Expand to include tributaries to the Myakka River, including Warm Mineral Springs and it's spring run, Salt Creek; Deep Prairie

Creek; Curry Creek, and the Myakkahatchee River (Big Slough). Clarify the description to specify designation of the entire Myakka River downstream from Myakka River State Park to the confluence with Charlotte Harbor.

Notable constituent elements:

- ***Warm water:*** Warm Mineral Springs and its spring run, Salt Creek, are a warm water aggregation site that has been experiencing increased use by manatees in recent decades. A high count of 74 manatees occurred in 2003.

- ***Food Sources:*** Manatees have been observed feeding along the river on shoreline vegetation. The SAV in the Myakka River has not been mapped but it is expected to have ample vegetation since some manatees have been known to spend much of the year in the river (Monica Ross, *pers. comm.*).

- ***Travel corridors:*** The Myakka River is a travel corridor for manatees that move from its upper reaches down to Charlotte Harbor and beyond.

- ***Shelter:*** The Myakka River and its tributaries are important resting, nursing, and calving areas. Calving peaks in the spring, but the area is used year-round for shelter.

- ***Fresh water***: The Myakka River is a freshwater system.

Currently designated Critical Habitat: the Peace River downstream from the Florida State Highway 760 bridge, De Soto and Charlotte Counties;

Suggested revision of geographic area: The Peace River and associated waters downstream from the Florida State Highway 760 Bridge, De Soto and Charlotte Counties to the confluence with Charlotte Harbor, including Shell Creek and all other associated waterways and canals, and the residential canals of Punta Gorda.

Notable constituent elements:

- ***Food sources***: Seagrass is present at the mouth of the Peace River (Judy Ott, *pers. comm.*) and water hyacinth flows over the dam in Shell Creek.

- ***Travel corridors:*** Manatees travel from the upper reaches of the Peace River out to Charlotte Harbor and beyond on a regular basis in the warmer months.

- ***Shelter:*** Manatees utilize the canals and braided backwater areas for resting. The federal manatee refuge that has been established provides some quiet areas in the upper braided portions of the Peace River when boaters comply with the protection zones. Manatees also rest in Shell Creek and in the canals associated with the Peace River. The Peace River, including the residential canals of Punta

Gorda, is also an important nursing and calving area, as illustrated by the number of perinatal manatee deaths. Manatee use peaks in the spring in these areas, but they are used year-round.

- ***Fresh water:*** Shell Creek provides freshwater at the dam, which is a well-known manatee attractant. Residential canals on the north side of the Peace River also provide fresh water.

Currently designated Critical Habitat: **Charlotte Harbor** north of the Charlotte-Lee County line, Charlotte County;

Proposed revision of geographic area: All of Charlotte Harbor, and all associated bays and waterways, including Turtle Bay and Bull Bay. Expand northward and include by name: Gasparilla Sound in Charlotte County (and northern Lee County), Placida Harbor, Lemon Bay, and all associated bays and waterways.

Notable constituent elements:

- **Warm water:** There are no known warm water sites in this area. However, manatees have been counted during cold weather synoptic surveys in the Cape Haze area between Lemon Bay and Placida Harbor and will use residential canals for warmer water in early winter.

- ***Food sources:*** Continuous seagrass beds are generally found in waters less than six feet deep in Lemon Bay, Placida Harbor, Gasparilla Sound, Charlotte Harbor, Turtle Bay, Bull Bay, and other associated waters and are important feeding habitat for manatees in this area. Seagrass beds in Turtle Bay, for example, are among the most lush feeding sites in the state.

- ***Travel corridors:*** Lemon Bay, Placida Harbor, Gasparilla Sound, and Charlotte Harbor are all contiguous waterways that constitute an important migratory corridor for manatees.

- ***Shelter:*** Relative quiet and protection from boats is provided within manatee protection areas in Turtle Bay when boaters comply with manatee protection regulations. Alligator Creek, Pirate Harbor, a nd other backwaters are used by manatees for shelter. Gottfried Creek is a shelter area.

- ***Fresh water:*** Gottfried Creek, Ainger Creek, Oyster Creek, and Buck Creek, which all feed into Lemon Bay, provide fresh water. Alligator Creek in Punta Gorda provides fresh water.

Lee County

Currently designated Critical Habitat: Caloosahatchee River downstream from the Florida State Highway 31 Bridge, Lee County;

Suggested revision of geographic area: Name all other associated waterways, including the Orange River, Eight Lakes in Cape Coral, Deep Lagoon, Hancock Creek and Billys Creek. The Caloosahatchee River/Orange River system is the deadliest waterway on Florida's west coast, with unacceptably high watercraft-related manatee deaths documented year-round.

Notable constituent elements:

- ***Warm water:*** The Fort Myers power plant in the Caloosahatchee River is a major attractant during winter. A high count of 434 manatees was recorded in 1996. The Orange River is important warm-water habitat. Use is heavier in winter but it is used year-round. The Franklin Locks, the Eight Lakes area in Cape Coral, and Deep Lagoon are secondary warm water sites used by manatees.

- ***Food sources:*** In warmer weather, manatees use the Caloosahatchee River to travel between upstream freshwater, foraging and resting sites and downstream food sources. The seagrass beds in San Carlos Bay and nearby waterways are used for foraging. Manatees wintering at the Ft. Myers Power Plant outfall on the Orange River rely on the seagrass in Pine Island Sound, San Carlos Bay, and Matlacha Pass during warmer periods in the winter. Freshwater submerged aquatic vegetation is sporadically available in the Caloosahatchee River near the Franklin Locks and the Orange River. The availability of this forage has become unreliable due to physical damage from the large fresh water releases from Lake Okeechobee and the drought periods when the releases from the lake are halted and saline water encroaches up to the locks.

- ***Travel corridors:*** Manatees travel up and down the Caloosahatchee River, through Franklin Locks to Lake Okeechobee to the east and out to San Carlos Bay to the west, on a year-round basis, with longer range travel heaviest in the warmer months. The travel corridors between the feeding areas for wintering manatees and the power plant outfall are critical to the survival of the regional population.

- ***Shelter:*** The canal systems in Fort Myers, including Deep Lagoon and Cape Coral are used for resting. The Orange River has a year round idle speed zone designation, which provides protection for manatees that use it for shelter. Manatees also use the large number of residential canals along the Caloosahatchee River as quiet areas. Unfortunately, speeding through these waterways remains a problem.

- ***Fresh water:*** The upper Caloosahatchee River, the Orange River, Billy's Creek, and Hancock Creek are important natural freshwater sources. Manatees also utilize manmade fresh water sources in the Cape Coral Canals and other residential canal systems.

- ***Other habitat features:*** In drought years, water is not released from Lake Okeechobee, resulting in hypersaline conditions in the Caloosahatchee River that can kill freshwater vegetation in the upper river, particularly eelgrass, a preferred freshwater food source for manatees. (Conversely, as mentioned previously, in periods of heavy rainfall when Lake Okeechobee is nearly overflowing, the South Florida Water Management District will release staggering quantities of water from the lake, which tear the SAV from the substrate.)

Currently designated Critical Habitat: all U.S. territorial waters adjoining the coast and islands of Lee County;

Proposed revision of geographic area: Specifically include by name: Pine Island Sound, Jug Creek, Matlacha Pass, San Carlos Bay, Matanzas Pass, Hurricane Bay, Hell Peckney Bay, Estero Bay up to and including the Imperial River to the southern border of Lee County, and include Mullock Creek and the Ten-Mile Canal System, Hendry Creek, and the Estero River and all other associated waterways in Lee County. The Charlotte Harbor/Matlacha Pass/San Carlos Bay area is a highly preferred site on the west coast of Florida (Lefebvre *et al.* 2001).

Notable constituent elements:

- ***Warm water:*** Matlacha Isles, a dredged deep-water basin, which is connected to Matlacha Pass, is a significant secondary warm water site. Dredging to approximately 15 feet breached the aquifer. Matlacha Isles is the only warm water source in the immediate area. The borrow pit at the end of Mullock Creek/Ten Mile Canal is also an important secondary warm water site, which has been utilized by more than 100 manatees on one day. Currently undeveloped, the borrow pit is threatened by development, having received permit approval by the U.S. Army Corps of Engineers.

- ***Food sources:*** Matlacha Pass is a critical feeding area for manatees utilizing both the Matlacha Isles warm water refuge and the Fort Myers FPL warm water refuge during the winter. Matlacha Pass has become even more critical in the last two years because of the loss of some seagrass in San Carlos Bay due to the large fresh water releases from Lake Okeechobee. Pine Island Sound is an important year-round feeding area. Estero Bay, Hurricane Bay, and Hell Peckney Bay are important year-round feeding habitat.

- ***Travel corridors:*** Pine Island Sound, Matlacha Pass, San Carlos Bay, Matanzas Pass, and Estero Bay are important travel corridors year round. Watercraft-related

manatee deaths have been increasing in Pine Island Sound in the last ten years, with noticeable peaks in 2004 and 2006, and they remain high in San Carlos Bay and Matlacha Pass.

- ***Shelter:*** Relative quiet and protection from high speed boating is found at Burnt Store Marina, Matlacha Isles, Pelican Bay at Cayo Costa, and the Bokeelia/Jug Creek area. River systems and canals in this large geographic area are important for breeding, calving, and nursing.

- ***Fresh water:*** Matlacha Isles, Tenmile Canal/Mullock Creek, Hendry Creek, the Estero River, the Imperial River, and Spring Creek are all freshwater sources.

- ***Other habitat features:*** The fresh water releases from Lake Okeechobee have seriously altered harmless, natural fluctuations in salinity in San Carlos Bay. At times of high rainfall, when immense quantities of water are released in relatively short periods of time, the bay becomes hyposaline. Seagrasses in the bay can tolerate some fluctuation in salinity but these huge releases of fresh water can kill seagrass, which can take considerable time to recover.

Collier County and Monroe County (west coast)

Currently designated Critical Habitat: all U.S. territorial waters adjoining the coast and islands and all connected bays, estuaries, and rivers from Gordon Pass, near Naples, Collier County, southward to and including Whitewater Bay, Monroe County.

Suggested revision of geographic area: Expand to include the intracoastal shorelines of Collier County from the Lee County line southward, including Little Hickory Bay, Wiggins Bay, Water Turkey Bay, and Vanderbilt Shores south to Wiggins Pass. Resume at Gordon Pass southward to previously designated southern boundary. Specifically mention by name: Naples Bay, Rookery Bay, Henderson Creek, Addison Bay, Goodland Bay, Barfield Bay, Caxambas Bay and Pass, the waters surrounding Cape Romano, and all other associated waterways. In the Ten Thousand Islands area, include by name: Chokoloskee Bay, the Faka-Union Canal (a 10 mile long canal leading to Port of the Islands), Faka-Union Bay, the Barron River, Wootens and Big Cypress basins, Fakahatchee Bay and River, Gate Bay, the waters surrounding White Horse Key and Round Key. In the Everglades area include by name: Whitewater Bay (including Mud Bay), Joe River, Rogers River, North River, Upper Broad River, Broad River Bay, Wood River Bay, Rogers River Bay, and Lostmans Creek.

Notable constituent elements:

- **Warm water:** There are no industrial or natural spring warm water sites in Collier and Monroe counties. However there are several passive warm water sites in this area. The most heavily used is the Faka-Union Canal/Port of the Islands system, which had a maximum single day count of 268 manatees in 2001.

Henderson Creek, which feeds into Rookery Bay, is a minor warm water refuge. The Tamiami Canal at Wootens basin and the canal at Big Cypress National Preserve Headquarters have been identified as secondary warm water sites. Recent research has identified many other smaller aggregation sites in the inland waters of the Everglades, including Whitewater Bay (in particular, adjacent areas such as Mud Bay), Joe River, Rogers River, North River, Upper Broad River, Broad River Bay, Wood River Bay, Rogers River Bay, and Lostmans Creek. These numerous sites lack the high counts associated with better known aggregation sites, however, that belies the fact that large numbers of manatees overwinter in Everglades National Park (ENP), scattered in smaller aggregations (Stith *et al.* 2006).

- ***Food sources:*** Dollar Bay and some patchy areas around Gordon Pass provide some seagrasses for feeding. Rookery Bay is a known feeding area. The Marco Island area is notable for feeding in the very shallow surrounding bays, such as Johnson Bay, Tarpon Bay, Barfield Bay, Addison Bay, Goodland Bay, and Caxambas Bay and Pass. Feeding also occurs around Cape Romano. Although documentation of SAV in the Everglades is limited, the Ten Thousand Islands/Everglades National Park area includes both marine seagrasses and macroalgae beds along the gulf coast, and freshwater tolerant species such as widgeon grass and algae periodically occur among the inner bays and rivers. Although there appears to be preferential use among areas, all of these SAV species are used by manatees as forage in the greater Everglades. Manatees are known to occasionally feed on mangrove leaves, and also have opportunities to access floating plants and bank grasses as forage. During the winter and dry seasons, relative densities of manatees in offshore areas of ENP were concentrated in the seagrass beds near the seasonal high-use areas of Lostmans and Broad River. During the summer and fall, offshore use was more widely distributed and extensive, shifting into the more northerly portions of ENP (Stith *et al.* 2006). The entire Ten Thousand Island/Everglades National Park provides many different kinds of forage depending on the location but feeding occurs throughout the area.

- ***Travel corridors:*** Little Hickory Bay, Wiggins Bay, Naples Bay, Dollar Bay, Water Turkey Bay, Gordon Pass, the Narrows, Johnson Bay, and Rookery Bay are all travel corridors. Several bays and passes around Marco Island are used for travel corridors. Manatees use several major travel corridors throughout the Ten Thousand Islands/Everglades National Park region from the offshore grass beds, through the inshore bays and passes, and up into river systems. These include Chokoloskee Pass, Rabbit Key Pass, Chokoloskee Bay, the Barron River, Turner River, Cross Bays, and the Lopez River through Ten Thousand Islands and Chokoloskee Bay and south to Whitewater Bay and other areas within Everglades National Park, including the Huston and Chatham Rivers and, to a lesser degree, Lostmans River into Lostmans Creek, and into the upper Wood River. Corridors

were also evident in Snook Channel, Dismal Key Pass, Little Wood River, Faka Union Pass, West Pass, and the Fakahatchee River (Stith *et al.* 2006).

- ***Shelter:*** Vanderbilt Shores includes a canal subdivision that is heavily used for shelter. All accessible canal systems in this area are important shelter. The canals in Naples Bay, Marco Island, and Port of the Islands/Faka Union Canal all provide important resting areas, and the numerous quiet canals of Marco Island are heavily used as shelter sites. The Naples Bay system, Marco Island canals and the Faka Union Canal system are all important calving areas. The backwaters of Ten Thousand Islands are resting and calving areas. The Barron River is also a shelter area. Many small bays and rivers provide shelter in Everglades National Park (Stith *et al.* 2006).

- ***Fresh water:*** The Faka-Union Canal, the Naples River, Henderson Creek, the Marco Island canals, and the many small creeks/waterways associated with Ten Thousand Islands provide fresh water. In the Everglades, manatees seeking fresh water may travel far upstream into narrow, shallow areas. Aerial survey data show that manatees were present in inland rivers and basins year-round, but especially during the dry season (winter and spring) when off shore salinities are highest and manatees seeking fresh water must move further inland (Stith *et al.* 2006).

Atlantic Region

This is the largest geographic region, stretching from the Florida Keys to southern Georgia. However, currently designated Critical Habitat is patchy and should be modified to reflect what is now known about manatee use of the entire Intracoastal Waterway (ICW) and adjacent waterways on the Atlantic coast. Recommendations start from the south and move northward for the purpose of geographical continuity with the Gulf (west) coast. For those counties that also have shoreline along the St. Johns River from Palatka, Florida, southward, the St. Johns River frontage will be considered in the section on the Upper St. Johns River subpopulation.

New information: Although manatee use of the Atlantic coast of Florida was somewhat well known in some areas of this region when Critical Habitat was designated, there is now a clearer understanding of use in these areas, as well as other areas that are not currently designated. For example, manatee use of the Florida Keys is now better understood and seasonal use of other areas along the eastern coast of Florida has shifted in response to habitat changes, notably the increased use of power plants in Broward County where there is no designation. Several studies confirm that northern Biscayne Bay is among the most heavily used manatee habitat (Lefebvre *et al* 2001; Deutsch *et al* 2003). It is now known that the Atlantic subpopulation of manatees is currently stable or slightly increasing but that threats to them from habitat loss, combined with watercraft-related mortalities, will result in a potentially precipitous decline within the next 10-12 years (Runge *et al.* 2007). None of the supporting data were available when Critical

Habitat was designated. Protecting this entire region by designating it as Critical Habitat is of utmost importance to manatee recovery.

- ***Radio and Satellite Telemetry Data:*** The USGS Sirenia Project conducted a long-term radio tagging program on the Atlantic coast from 1986 through 1998, in order to document seasonal movements, migratory behavior, and site fidelity of individual manatees along the Atlantic coast of Florida and southern Georgia. Those data were summarized and published in 2003, providing very useful information for this document.

- ***Aerial Survey Data:*** In addition to the USGS tagging program, aerial surveys have been flown in discrete geographical areas to determine the distribution of animals over time. The aerial surveys for each geographical region were somewhat standardized (more so in later years). The surveys were flown at two-week intervals (in some earlier cases once a month) over a period of two years (in some earlier cases only one year) in order to capture seasonal use of the area. The survey routes were fixed and generally followed the shoreline of the waterways manatees were known to use. In some waterways manatee use may be under-represented as a result of survey conditions, i.e., dark, tannin-stained rivers or turbid water make it very difficult to see manatees if they are not at the surface. In any case, the number of manatees counted is a minimum count of manatees in the area at the moment the plane flew over the area and is not used as a census. These surveys were flown to determine how and where the animals were distributed and what behavior was exhibited by each individual seen during the survey. Distribution surveys have been flown for all or part of Monroe, Miami-Dade, Broward, Palm Beach, Martin, St. Lucie, Indian River, Brevard, Volusia, Flagler, St Johns, and Duval counties.

- ***Photo-identification studies:*** The long-term photo-ID effort has contributed greatly to the understanding of survival rates of manatees. Photo-ID studies also give insight into usage patterns of identified individuals, particularly at warm water sites.

- ***Mortality data:*** In addition to causes of death, the long-term mortality database maintained by the state's FWRI also provides information on manatee distribution and usage patterns.

Monroe County (east coast)

Currently designated Critical Habitat: all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood Sounds between Key Largo, Monroe County, and the mainland of Dade County.

Proposed revision of geographic area: Include waters contiguous with Buttonwood Sound (including eastern portions of Florida Bay) south to Lower Matecumbe Key. Also include canals and waters associated with Vaca Key (including Boot Key Harbor) and

Key West. Mention by name the waters and canals of Barnes Sound around Ocean Reef Club, Tarpon Basin, Grouper Creek, Jewfish Creek, Little Blackwater Sound, and Manatee Bay.

Notable constituent elements:

- ***Warm water:*** The Keys area waters are generally warm enough in winter months that all specific warm water sites may not be identifiable by name. However, when cold weather fronts reach this far south, manatees use the bottoms of residential canals where the water may be a few degrees warmer than ambient waters or may also contain groundwater seeps. A few specific areas are: Boot Key Harbor; canals in upper Lower Matecumbe Key; Indian Waterways; the marina basin south of Tavernier Creek; Pirates Cove, the unnamed cove at the end of Sunset Blvd., and Hurricane Harbor in Buttonwood Sound; Bermuda Shores in southern Blackwater Sound; and Sexton Cove and Lake Surprise in northern Blackwater Sound; the waters in the vicinity of Key Largo Village in southern Tarpon Basin; and Treasure Harbor in Islamorada (Kathryn Curtin, *personal communication*). It should be noted that if power plants go offline, these areas will be absolutely essential to support a probable increase in the number of manatees over-wintering here.

- ***Food sources.*** All of the waters associated with the geographic areas listed here are shallow and clear and have extensive, healthy seagrass beds that are used by manatees, including but not limited to, seagrasses found around the entrances to residential canals.

- ***Travel corridors:*** Buttonwood Sound, Grouper Creek, Tarpon Basin, Duzenbury Creek, Blackwater Sound, Jewfish Creek, Barnes Sound, Steamboat Creek (and associated creeks), and Card Sound are waterways along the route taken by migrating manatees. Blackwater Sound, Little Blackwater Sound, and Manatee Bay are used as a travel corridor to access C-111 Canal for fresh water.

- ***Shelter:*** All areas above, including mangrove fringe areas and all residential canals, also provide shelter from wind and rough seas. All residential canals in the areas mentioned above are known as calving areas (Kathryn Curtin, *pers. comm.*).

- ***Fresh water:*** Availability of fresh water is suspected to be a limiting factor for manatees in the Keys; however, artesian springs and/or seeps are thought to be located in the bay side of the Upper Keys. Fresh water is also available across Florida Bay from Everglades run-off and the C-111 canal.

Miami-Dade County

Currently designated Critical Habitat: **Biscayne Bay**, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County;

Suggested revision of geographic area: This area should be expanded southward to be contiguous with currently designated (and suggested revisions of) Critical Habitat in Monroe County and northward to include the entire length of the ICW up to the Broward County line. Contiguous tidal canals and basins should also be included. Also, many important sites should be mentioned by name, including C-111 Canal, Card Sound Canal, Turkey Point canals, Homestead Bayfront Park/Biscayne National Park, Mowry Canal, Military Canal, North Canal, Princeton Canal, Barnes Sound and Manatee Bay, Card Sound, Black Point/Goulds Canal, Kings Bay, Cutler Channel and waters surrounding Chicken Key, Snapper Creek, Coral Gables Waterway, the Miami River, Tamiami Canal, Blue Lagoon, Palmer Lake, Little River, Biscayne Canal, Government Cut, Oleta River north to Dumfoundling Bay, Dumfoundling Bay and the ICW leading out of Dumfoundling Bay north to Port Everglades Inlet. The waters surrounding Key Biscayne, Virginia Key, and Fisher Island should be named. Snake Creek Canal and the Sky Lakes west of coastal flood structures should be added.

Notable constituent elements:

- ***Warm water***: The entire Biscayne Bay estuary and other southern basins serve broadly as warm water habitat, supporting overwintering in typical climate patterns. In particular, the upper Miami River and Palmer Lake, Little River, a few artificial canals near Turkey Point power plant, Black Creek Canal and basin, Coral Gables Waterway, and Biscayne Canal also support small to moderate-sized aggregations of up to 45 animals during extreme cold events, since they may be slightly warmer due to groundwater seepage than the shallow open waters of the Bay (Mayo and Markley 1995).

- ***Food sources:*** Biscayne Bay is a highly utilized feeding area year-round. Manatees wintering at the power plants to the north will travel south to feed in Dumfoundling Bay and north Biscayne Bay between cold spells. There are extensive seagrass meadows in throughout Biscayne Bay, Card Sound, and Barnes Sound that support manatees year around. Sightings of feeding manatees are particularly consistent in nearshore seagrass beds near Little River, east of the Miami River and west of Virginia Key, and off of Black Creek Canal. Manatees also feed on exotics such as hydrilla in the inland lakes and canal systems including Blue Lagoon and Sky Lake (Mayo and Markley 1995).

- ***Travel corridors:*** Manatees travel north and south throughout the ICW in north Biscayne Bay, and across Government Cut in the Port of Miami area. They also move from feeding locations in Biscayne Bay into the Miami River, Coral Gables

Waterway, and the Little River. The ICW leading out of Dumfoundling Bay north to Broward County waters is used extensively as a travel corridor, particularly in the colder winters when manatees use the power plants in Broward County then move south again to feeding areas in Biscayne Bay.

- ***Shelter:*** Manatees use most tidal canals and many artificial basins for resting or shelter. Calves, nursing, or mating behavior have been documented in many tributaries and relatively undisturbed areas including Oleta River, Biscayne Canal, Little River, Palmer Lake, Coral Gables Waterway, Virginia Key Critical Wildlife Area, Black Creek marina basin, and C-111 canal. Blue Lagoon is a resting and shelter area. Palmer Lake is a shelter area off the Miami River. (Mayo and Markley 1995) Snake Creek is used for calving and resting (Kathryn Curtin, *pers. comm.*).

- ***Fresh water:*** Although manatees can be observed throughout the Biscayne Bay system, their distribution and carcass recovery locations are most closely associated with sources of freshwater. The natural hydrology of the Biscayne Bay area was altered during the 20th century to provide drainage and flood control for urban and agricultural development. Sloughs and natural tributaries were channelized, and water control structures were built to prevent salt water intrusion. However, freshwater is still released from these areas year around, and manatees are routinely seen in these areas. As noted above, natural historic tributaries, such as Oleta River, Little River (C-7), Miami River (C-6), and Black Creek (C-1) provide many habitat functions, including providing fresh water. Freshwater is also regularly discharged year around through all other canals that are part of the Central and Southern Florida Flood Control Project, including Snake Creek (C-9), Biscayne Canal (C-8), Tamiami Canal (C-4), Snapper Creek (C-2), Princeton, Mowry, and C-111. Manatees are known to pass through water control structures and may utilize freshwater basins on the upstream side of some structures.

Broward County

***Geographical area to be added*:** Coastal and connected waterways of Broward County, including but not limited to: the ICW from the Miami-Dade County line northward to the Palm Beach County line, including Whiskey Creek, the New River system (including the south and north forks and canals and the Tarpon River), Dania Cut-off Canal (and associated residential canals between SW 30th Avenue and SW 42 Terrace), C-10 Canal, Port Everglades Inlet, the Stranahan River, the Middle River system, the Cypress Creek/Pompano Canal system, and the Hillsboro Canal on the Palm Beach County line. All of these waterways have some level of boat speed restrictions for manatee protection per Florida state rule (Broward County Manatee Protection Rule 68C-22.010 F.A.C.).
Notable Constituent Elements:

- ***Warm Water:*** Port Everglades Florida Power and Light Power Plant, and the FPL Lauderdale Power Plant are two major important warm water sites highly utilized by manatees in the winter months. A high count of 290 manatees was recorded at Port Everglades in 2001. The Ft. Lauderdale plant had a high count of 221 in 2003. The warm water provided by these plants should be a constituent element.

- ***Food sources:*** Broward waters are mostly linear, man-made, dredged waterways so there is not a lot of vegetation in the system. There is some seagrass at the mouths of Port Everglades and Hillsboro Inlets, however. Manatees have also been observed feeding on algae on the residential canal seawalls.

- ***Travel corridors:*** All of the ICW in Broward County is used as a travel corridor, both for seasonal migrations to areas to the north and for migrations between cold spells to and from the power plants and feeding areas to the north and south. There is relatively little vegetation in Broward County waters, making these foraging trips necessary. The New River system and Dania Cutoff Canal are travel corridors to and from the Lauderdale Power Plant and between the Lauderdale and Port Everglades plants.

- ***Shelter:*** Use of the "nursery" at Port Everglades Power Plant is well documented. C-10 Canal is used for shelter and resting. The residential canals associated with Dania Cutoff Canal are used for resting and calving. Ft. Lauderdale is known as "the Venice of America" due to its extensive residential canal systems. Manatees frequently use the Ft. Lauderdale residential canals for calving and nursing areas. The Hillsboro Canal, Cypress Creek/Pompano Canal system, Middle River are also used for resting and calving.

- ***Fresh water:*** Manatees drink water that seeps through the flood-gates from the upland side of the flood control structures on the New River canals, Dania Cutoff Canal, Midriver Canal, and Hillsboro Canal.

Palm Beach and Martin Counties

Currently designated Critical Habitat: that section of the Intracoastal Waterway from the town of Seawalls Point, Martin County to Jupiter Inlet, Palm Beach County; AND: all of Lake Worth, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway A1A southward to its southernmost point immediately north of the town of Boynton Beach, Palm Beach County.

Proposed revision of geographic area: Extend southward from Lake Worth to Palm Beach-Broward County line to include the entire ICW and all connected waterways. Particularly, include by name: C-15 Canal, Lake Boca Raton, Lake Wyman, Boynton Canal (C-16) and the Hillsboro Canal (on the Broward County line). Extend northward from Lake Worth to include Lake Worth Creek and the entire length of the ICW from

Lake Worth Creek northward to the current Jupiter Inlet designation. From Sewalls Point in Martin County, extend northward to the St. Lucie County line including all connected waterways and including Boca Raton, Jupiter, Palm Beach, and St. Lucie Inlets. In Palm Beach County, specifically include by name: the Riviera Beach power plant effluent canal in Lake Worth lagoon, the Earman Canal (C-17), including the interconnected North Lake and South Lake. Add reference to Jupiter Sound (on the border of Palm Beach and Martin counties). In Martin County, specifically add Hobe Sound, Peck Lake, Great Pocket, and the Crossroads area, including Willoughby Creek, Crooked Creek, Manatee Pocket and Manatee Creek. Also, in Martin County, add the St. Lucie River, Krueger Creek, the Martin County portion of the North Fork of the St. Lucie River, including all creeks and residential canals, and the South Fork, including the St. Lucie Canal (C-44) up to the St. Lucie locks, and including South Fork Creek and all other creeks and canal systems. Add Bessey Creek and the C-23 canal up to the floodgate structure.

Notable constituent elements:

- ***Warm Water:*** The Florida Power & Light Riviera Beach Power Plant in Lake Worth is an important warm water source, with a high count of 409 manatees during the winter of 2001. There is also a small basin connected to the Earman Canal called South Lake where small numbers of manatees consistently aggregate in cold weather. Manatees are also seen in the C-18 Canal during cold spells.

- ***Food sources:*** Shoal grass, manatee grass, and turtle grass are important food sources in Hobe Sound (Martin County) and Jupiter Sound (Martin and Palm Beach counties). Manatees graze in the seagrass beds in Lake Worth Lagoon near the Port of Palm Beach, including around Peanut Island, and in Jupiter and Hobe Sounds (Packard 1981). In Palm Beach County, there are many seagrass beds in Lake Worth lagoon with particularly dense beds located around Munyon and Little Munyon Islands and on the east shore north of Singer Island; on the west shore of the lagoon, both north and south of the Palm Beach Inlet and northwest of Peanut Island; and in portions of Lake Boca Raton and Lake Wyman, which are wider areas of the ICW in southern Palm Beach County. In Martin County, Hobe Sound and Jupiter Sound have dense seagrass beds. Seagrass is also available in Great Pocket and Peck Lake; around the tip of Sewalls Point and along the western shore of the lagoon north of the St. Lucie Inlet; and along the eastern shoreline bordering Hutchinson Island. There are many seagrass beds outside of the channels in the Crossroads. Some seagrasses can be found in narrow strips along the shoreline in the narrower portions of the ICW in both counties.

- ***Travel corridors:*** The ICW is used as a migration corridor by the entire Atlantic coast subpopulation. Manatees also travel between the FPL Riviera Beach power plant and feeding areas in Hobe Sound to the north and Biscayne Bay to the

south. Multiple trips may be made by individual manatees throughout the winter season, depending on temperatures between cold spells. All of the ICW, including Lake Worth lagoon, Jupiter Sound, and the Indian River lagoon, including Hobe Sound, is a travel corridor south to Biscayne Bay or north to Hobe Sound for seasonal migrations and feeding forays during winter season.

- ***Shelter:*** The eastern shoreline of Lake Worth lagoon behind Munyon Island is used for shelter and resting. The Earman Canal (C-17) and North Lake, including all associated residential canals are heavily used as shelter and resting sites. All other residential canal systems are used for resting and calving. Manatee Pocket and Manatee Creek in Martin County are also shelter areas.

- ***Fresh water:*** In Palm Beach County, fresh water is available in the Earman Canal (C-17), which has high manatee use; the Hillsboro Canal, which also has high manatee use; the C-15 canal, the C-16 canal, and the C-51 canal, all of which connect to the ICW; and the C-18 canal in the Southwest Fork of the Loxahatchee River. In Martin County fresh water is available in the North and South Forks of the St. Lucie River. Fresh water is also available at the floodgate structure of C-23 Canal, Bessey Creek, and the lock structure (S-80) on the St Lucie Canal.

Currently designated Critical Habitat: the Loxahatchee River and its headwaters, Martin and West Palm Beach Counties,

Proposed revision of geographic area: Omit reference to West Palm Beach County (as there is no such place) and replace with Palm Beach County. Add reference to include the North Fork, Southwest Fork, and Northwest Fork of the Loxahatchee and the C-18 canal.

Notable constituent elements:

- ***Feeding areas***: Discontinuous seagrasses are found at the mouth of the North Fork and along the north, south, and eastern shorelines of the main river stem. They are also found in patches in the center of the main river. The Northwest and Southwest Forks are dark and do not contain much SAV except for patches of hydrilla.

- ***Travel corridors:*** Manatees travel up the North Fork and Northwest Fork of the Loxahatchee River on a regular basis except in the coldest weather . The entire river and both forks are used as travel corridors.

- ***Shelter:*** The North Fork and Northwest Fork of the Loxahatchee River are used for resting and calving.

- ***Fresh water:*** The Loxahatchee River, and the North and Northwest Forks of the Loxahatchee River all provide sources of fresh water.

St. Lucie and Indian River Counties

Currently designated Critical Habitat: the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Seawalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between Indian and Banana Rivers, Brevard County.
Proposed revision of geographic area: The most important waterways, many of which are included in the designation, should be mentioned by name with each of their constituent elements identified. The Indian River is actually an estuarine lagoon, through which the ICW channel runs north and south. In St. Lucie County, include by name: the North Fork of the St. Lucie River, Big Mud Creek, Little Mud Creek, Moore's Creek, Taylor Creek, St. Lucie Inlet, and Harbor Branch Oceanographic Institute (HBOI) canal. In Indian River County, add Vero Shores residential canals, River Shores canals, the North, Main, and South canals in Vero Beach, Johns Island Creek, Jungle Trail Narrows, Bethel Creek, McCullers Cove, and the Sebastian River into Brevard County.

Notable Constituent Elements

- ***Warm water:*** The Henry D. King power plant, in Ft. Pierce in St. Lucie County, had a high count of 99 manatees in 1996 during the cold season. The Vero Beach municipal power plant in Indian River County had a high count of 65 manatees in 1999 (Laist and Reynolds 2005). Both of these plants operate intermittently, depending on power needs. Big Mud Creek and the HBOI canal in St. Lucie County have been identified as passive warm water sites (U.S. Fish and Wildlife Service 5-Year Review 2007).

- ***Travel Corridors:*** Manatees travel throughout the ICW in the Indian River Lagoon in St. Lucie and Indian River counties during seasonal migration and to and from warm water and feeding sites during the cold season. They also travel in and out of the inlets. Jungle Trail Narrows is an important travel corridor in Indian River County (Sandra Clinger, *personal communication*).

- ***Food sources:*** The Indian River lagoon provides most of the seagrass forage in St. Lucie and Indian River counties. Grassbeds are dense in the lagoon north of St. Lucie Inlet and just south of the inlet. Further south seagrasses have been in decline due to water quality issues but still exist along both shorelines of the lagoon. There are still healthy beds on the east shore of the IRL at Little and Big Mud Creeks. Manatees frequent the North Fork of the St. Lucie River suggesting that freshwater SAV is available; however, it has not been mapped. In Indian

River County, significant feeding occurs on the west shore of the lagoon immediately south of the Sebastian River.

- ***Shelter:*** The North Fork of the St. Lucie River to Ten-mile Creek is an important calving and resting area. The Big Mud and Little Mud Creeks are also important for this purpose. Taylor Creek is a shelter area. Manatees use Moore's Creek (Henry D. King power plant effluent canal) for resting during migrations even if the warm water is not available. They also use HBOI canal for resting. In Indian River County, the upper Sebastian River is an important calving and resting area, as are Bethel Creek and McCullers Cove. Grand Harbor, Crawford Creek, Vero Shores, River Shores, the Moorings area, and other residential canals off of the Indian River Lagoon are important resting areas. Johns Island Creek is a resting and calving area (Sharon Tyson, *pers. comm.*).

- ***Fresh water:*** In St. Lucie County, Taylor Creek, north of the Ft. Pierce, is an important fresh water source with documented heavy use. Other sources of fresh water include Moore's Creek, which, while primarily a warm water attractant, also provides fresh water; HBOI canal, which receives fresh water from surface water and ground water seeps; Queen's Cove, a residential subdivision located on North Hutchinson Island on the east side of the IRL; and the North Fork of the St. Lucie River. In Indian River County important fresh water sources are: the Sebastian Stormwater Park, the North, Main, and South canals in Vero Beach, and the sewer plant near 17th Street in Vero Beach (Sharon Tyson, *pers. comm.*).

Brevard County

Currently designated Critical Habitat: the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Seawalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between Indian and Banana Rivers, Brevard County.

Proposed revision of geographic area: Add by name the Sebastian River, C-54 Canal, Mullet Creek, Turkey Creek, Crane Creek, Berkeley Canal, Grand Canal and the Cocoa Beach residential canals, Newfound Harbor, Sykes Creek, the Canaveral Barge Canal, Rinkers Canal, Banana Creek, Haulover Canal, Bair's Cove, and the Mosquito Lagoon in Brevard and Volusia Counties (much of which is part of the Canaveral National Seashore), and all other associated waterways.

Notable Constituent Elements:

Brevard County is the most important area for manatees on the Atlantic coast (Deutsch *et al* 2003; Provancha & Provancha 1998). Within this area, the Banana and northern Indian Rivers are heavily-used year round habitats (Deutsch *et al* 2003). Relative quiet

and protection from boats is provided within manatee protection areas. In recognition of the importance of this habitat, watercraft are required by federal law to proceed at slow speed year-round in the federally-designated Barge Canal Manatee Refuge, the Sykes Creek Manatee Refuge, and the Haulover Canal Manatee Refuge. (Precise coordinates for boundaries are listed at 50 C.F.R. 17.108).

- ***Warm water:*** In the Indian River in northern Brevard County, two power plants are important warm water sources: the Frontenac FP&L plant near Titusville and the Reliant Energy plant in Delespine. Manatee counts at the FP&L plant have ranged as high as 585 on a single day count in the winter season. The Sebastian River and the C-54 Canal are a warm water refuge, with 107 manatees counted during the 2007 synoptic survey. Berkeley Canal is an important passive thermal basin. Grand Canal and associated residential canals are passive thermal basins, as are the canals at Banana River Marine and along Newfound Harbor Drive and North Banana River Drive (Sandra Clinger, *pers. comm.*).

- ***Food sources:*** Brevard County contains 72% of the seagrass in the four counties of the central region (Deutsch *et al* 2003). The seagrass meadows in the Banana and Indian Rivers are primary feeding areas. With the heightened protections afforded to manatees by the No Motor and No Entry zones in the northern Banana River and the relatively wide areas of seagrass coverage, this area is a key manatee feeding area. Food sources in the northern Banana River include the seagrasses: shoal grass, manatee grass, and widgeon grass, and the macroalgae, Caulerpa prolifera. Important features of the northern Banana River that are frequented by aggregations of manatees include deeper waters bordered by dense aquatic vegetation where the Hangar AF channel intercepts the Banana River barge channel, a large cove with dense vegetation and a deep dredged basin just north of the NASA causeway, a dredged basin bordered by seagrass flats along the eastern side of the river, seagrass flats including a particularly dense area of manatee grass in the northwest corner of Pepper Flats at the intersection of the barge channel, and the barge channel which is bordered by shallow seagrass flats at the northernmost end of the Banana River (Provancha & Provancha 1998). Seagrass in the Banana River is an important food source that attracts large numbers of manatees in the spring (Deutsch *et al* 2003). Seagrass beds on the eastern shore of the Indian River lagoon across from the power plants are heavily used in winter. Manatees also feed in Newfound Harbor (Sandra Clinger, *pers. comm.*).

- ***Travel corridors:*** Due to Brevard County's location in the center of the east coast, the presence of the power plant warm water refuges, the federal north Banana River "motorboats-prohibited" and "no entry" zones, the abundance of seagrass, fresh water sources, and shelter areas, manatee use of Brevard County is unparalleled. Navigation locks and the inlet at Port Canaveral are used as a travel corridor by manatees moving between the Banana and Indian Rivers and, less frequently, into the Atlantic Ocean. The Canaveral Barge Canal is a travel

corridor between the Banana and Indian River lagoons. It also intersects Sykes Creek, a waterway that is heavily used by manatees for resting and calving (and is also a travel corridor). The ICW, which runs the length of the Indian River through Haulover Canal and into Mosquito Lagoon is a very significant travel corridor. The Banana River channel leading from the Indian River to the north Banana River motorboats-prohibited and no entry zones is another significant travel corridor.

- ***Shelter:*** Many areas in Brevard County are used for shelter, resting, and calving. The Sebastian River and C-54 Canal, Cade's Cove at Sebastian Inlet State Park, Mullet Creek, Turkey Creek, Crane Creek, Berkeley Canal, the Banana River residential canals including Grand Canal, the Cocoa Beach canals, the canals along Newfound Harbor Drive and Banana River Drive, the Canaveral Sewer Canals, Sykes Creek and its associated canals, Port Canaveral, Banana Creek (a "no entry" area due to NASA security), the entire Banana River lagoon north of the Canaveral Barge Canal, Haulover Canal boat ramp basin, Bair's cove, and Rinker's Canal are among the many sheltering areas in Brevard County (Sandra Clinger, *pers. comm.*).

- ***Fresh water:*** The Sebastian River is an important freshwater site, including the North Prong drainage system of the C-54 canal, the Fellsmere Canal and the Blackwater Creek/seepage slope east of Fellsmere Canal. Turkey Creek and Crane Creek are both important freshwater sources. The Canaveral Sewer Plant discharge in the Banana River lagoon is a freshwater source. Rinker's Canal on the Indian River lagoon has an artesian spring from an aquifer breach when dredged. Melting ice from fish houses and stormwater discharges at Port Canaveral provide freshwater.

- ***Other habitat features:*** Manatees are routinely attracted to the northern shore of Haulover Canal for unknown reasons. They rest in the shallow waters and display a foraging-like behavior in the sediment, which lacks vegetation.

Volusia County

Currently designated Critical Habitat: the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Seawalls Point, Martin County, and the entire inland section of water known as the Banana River and all waterways between Indian and Banana Rivers, Brevard County.

Proposed revision of geographic area: In Volusia County, north of the Mosquito Lagoon, several waterways should be identified by name, including Ponce de Leon Inlet, Ponce de Leon Inlet Cut, Spruce Creek, Strickland Bay, Rose Bay, Turnbull Bay, the

Halifax River, the Tomoka River, Strickland Creek, Thompson Creek, Bulow Creek, and all connected waterways.

Notable Constituent Elements:

In recognition of the importance of this habitat, watercraft are required by federal law to proceed at no more than 25 miles per hour in some areas and at slow speed in others of the Halifax and Tomoka Rivers Manatee Refuge in Volusia County. (Precise coordinates for boundaries are listed at 50 C.F.R. 17.108).

- ***Food sources:*** Manatees forage on seagrass in Mosquito Lagoon. The northern Mosquito Lagoon is effectively the northernmost limit of seagrass on the Atlantic Coast. Once north of Mosquito Lagoon, manatees graze mostly on shoreline and emergent vegetation such as smooth cordgrass.

- ***Travel corridors:*** The ICW runs from southern Volusia County in the Mosquito Lagoon through northern Volusia County, making the entire Halifax River/Indian River Lagoon system an important migratory travel corridor. Manatees also use Ponce Inlet for travel.

- ***Shelter:*** The Tomoka River system, including Strickland Creek and Thompson Creek, is an important calving and resting area. It is also used for cavorting, feeding, and resting. The downtown Daytona Beach marina area of the Halifax River is used for calving and resting. The Smyrna Creek/Hunter Creek system south of Ponce de Leon Cut is a calving area.

- ***Fresh water:*** Spruce Creek, Strickland Bay, Rose Bay, Turnbull Bay, the downtown Daytona Beach marinas, and the Tomoka River are freshwater sources.

Flagler, St. Johns, Duval, Clay, and Nassau Counties, FL, and southern Georgia

Some of the areas in this section are well studied while others are not as well known. Manatees in the St. Johns River in Duval and the northern portion of Clay County waters are very well documented. In recognition of the importance of this area to manatees, watercraft cannot exceed slow speed year round in shoreline buffer areas and no more than 25 miles per hour in other areas of the Lower St. Johns River Manatee Refuge. (Precise coordinates for the boundaries of this area are listed at 50 C.F.R. 17.108). The St. Johns River down to Putnam County is less well studied.

In the ICW, the south Georgia and Nassau, Flagler, and St. Johns counties' shorelines are less well studied than from Volusia County southward. However, telemetry studies document manatee use of these areas as a major travel corridor and the mortality data, limited aerial survey data, and anecdotal sighting information confirm the consistent use of these waterways by manatees.

Currently designated Critical Habitat: that section of the Intracoastal Waterway from its confluences with the St. Marys River on the Georgia-Florida border to the Florida State Highway A1A bridge south of Coastal City, Nassau and Duval Counties.

Proposed revision of geographic area: The entire ICW from the Volusia/Flagler County line up to the Savannah River in Georgia should be designated Critical Habitat, with specific mention of the various waterways that the ICW runs through or connect with, including but not limited to: Bulow Creek, Smith Creek, the Palm Coast canals, the Matanzas River, San Sebastian Creek, Pellicer Creek, the Tolomato River, the Guana River, Pablo Creek, Sisters Creek, the Nassau River, the Amelia River, and the St. Mary's River in Florida. In southern Georgia, specifically mention Cumberland Sound and River, Kings Bay, the Satilla River, and the Savannah River. In the lower St. Johns River the Mayport Basin, Dames Point Cutoff, the Broward River, the Trout River, the Ortega River, the Arlington River, Goodby's Creek, the Jacksonville NAS marina basin at Mulberry Cove, Julington/Durbin Creeks, Doctors Lake (and Swimming Pen Creek), Black Creek, Green Cove Springs, Governors Creek, and Trout Creek/Sixmile Creek should be mentioned by name and their elements delineated.

Notable constituent elements:

- **Warm water:** Industrial sources of warm water have been eliminated in the counties in the northern portion of this region over the past decade. Over the years, manatees continue to stop at the sites that previously offered warm water. Several manatees have been rescued after monitoring showed the animals continued to loiter in the area of the previous warm water effluent and that water temperatures were low enough to cause distress. In Duval County, known warm-water discharges were from three power generating stations and two paper mills. Area power plants include: St. Johns River Power Park and Southside and J.D. Kennedy Generating Stations. Seminole Kraft and Jefferson Smurfit Containerboard Corporation are the two paper mills in Duval County. Also, Container Board Corporation of America, Fernandina, Nassau County provided warm water that attracted manatees. Currently, none of these sources generates enough warm water to be sufficiently protective in winter. In 2003, a warm water source in the Ortega River was discovered as a result of having to rescue six manatees from the river. After studying the area, it was determined that a significant thermocline existed at the bottom of a basin on the river. In the 2006/2007 winter season, manatees were observed using several sewage treatment outfalls in the ICW (Pablo Creek) in the Jacksonville Beach area. The extent of the thermal benefits is not yet known, however there may be as many as five effluents in the area providing some level of warm water and perhaps fresh water, as well (Jim Valade, *pers. comm.*).

- ***Feeding areas:*** Smooth cordgrass and other Spartina *spp.* are among the most prevalent and important food sources in the more northern portions of this area (Lefebvre *et al* 2001). In the ICW, the farthest south that Spartina occurs is at

approximately the Volusia/Flagler county line (Jim Valade, *pers. comm.*). In the St. Johns River some smooth cordgrass is found around Exchange Island and around Tallyrand Docks. Small patches of widgeon grass are available in the estuarine areas of Flagler and St. Johns counties but it is not known if manatees feed on them. In the lower St. Johns River, manatees primarily feed on submerged beds of brackish or freshwater SAV such as eelgrass, while further north of the river mouth they feed on emergent shoreline vegetation such as smooth cordgrass in salt marshes, which may be sought out by manatees because it is particularly rich in nitrogen (Deutsch et al 2003). The areas of the lower St. Johns River shoreline most heavily used for feeding habitat are within the 6' contour upstream of the Fuller Warren Bridge and along the southeast shoreline of Doctors Lake. There is some eelgrass around the mouth of the Ortega River and around Piney Point by Jacksonville NAS, and along the shoreline in Goodby's Creek; however, the extensive eelgrass beds in the St. Johns River occur south of the Buckman Bridge. Hydrilla is most prevalent south of the Buckman Bridge, as well (Jim Valade, *pers. comm.*). Essentially, the entire the St. Johns River within the 6' contour and south of Buckman Bridge is feeding habitat.

- ***Travel corridors:*** The entire ICW (which includes Bulow Creek, Smith Creek, the Matanzas River, the Tolomato River, Pablo Creek, Sisters Creek, the Nassau River, the Amelia River, the St. Mary's River, Cumberland Sound and River) is a well-documented migratory corridor. The ICW between Volusia County, Florida and Brunswick, Georgia was heavily used by manatees in one study of tagged individuals (Deutsch *et al* 2003). Similarly, the lower St. Johns River is a migratory corridor for manatees continuing south to the upper St Johns River or out to the ICW, where they then travel north into Georgia or south to other areas of coastal Florida. On the St Johns River, the town of Palatka, in Putnam County, is considered the dividing line between the Atlantic region and the Upper St. Johns region; however manatees from both subpopulations have been documented in both regions, as might be expected since they are contiguous and there is no barrier between them.

- ***Shelter:*** Residential canals in the Flagler Beach area have essentially become an extension of the Tomoka River in terms of providing shelter for manatees moving along the east coast in this area (Jim Valade, *pers. comm.*). The Palm Coast canals are very heavily used for resting and calving. Seventeen perinatal mortalities have been documented in these canals, indicating the importance of the shelter these canals provide and the level of calving that occurs here. San Sebastian Creek appears to be a shelter area. In the Duval County portion of the lower St. Johns River, the Broward River, the Trout River, Goodby's Creek, Julington and Durbin Creeks, Jacksonville NAS basin (and Mulberry Cove), the Ortega River and its tributaries are used for shelter, resting and calving. In Clay County, Doctors Lake and Swimming Pen Creek are used for shelter, resting and calving. Black Creek, Governors Creek, and Green Cove Springs appear to be shelter areas. In St. Johns County, Trout Creek and Sixmile Creek appear to be shelter areas.

- ***Fresh water:*** Fresh water is available from various creeks and rivers found along the ICW from Flagler County to southern Georgia, including but not limited to the Palm Coast canals and Pellicer Creek (Flagler). The St. Johns River below Buckman Bridge is more or less brackish water depending on tides and rainfall, so manatees may still seek fresh water in the named tributaries. Above the Buckman Bridge, the St. Johns is essentially a freshwater system.

Upper St. Johns River Region

This area encompasses the upper St. Johns River from Palatka in Putnam County to Lake Monroe in Seminole County. Commonly referred to as the Blue Spring population because of the importance of Blue Spring as a warm water refuge, the subpopulation in this region is doing very well in terms of growth (Langtimm *et al.* 2004, Runge *et al.* 2007b). This is partly due to the fact that Blue Spring is a reliable source of warm water, there is relatively little boat traffic, good speed zone protection, and large tracts of undeveloped shoreline, much of which is in public ownership. This is a changing scenario, however. As the human population grows, more demand for water will affect the spring flows and more marinas and boat ramps will follow, with a corresponding increase in vessel traffic. Blue Spring Run is particularly important as a manatee wintering site (Powell & Waldron 1981). They are observed consistently once the water temperature in the St. Johns River drops below the approximately 23° C temperature of the spring, and they remain all winter, except for some midday excursions to feed, until the average temperature of the River rises again (Powell & Waldron 1981). They will attempt to avoid the layer of cold, turbid river water that intrudes into the spring run, though they seldom get very close to the spring boil (Powell & Waldron 1981).

New information: The area around Blue Spring is one that was relatively well-studied at the time of Critical Habitat designation. However, there are now more than 30 years of additional information that must be considered. More is known about manatee use of areas of the St. Johns River away from Blue Spring both to the north and the south.

- ***Increased use:*** The number of manatees using this area has increased dramatically since the species was listed. It is also now known that this subpopulation of manatees is increasing at a healthy rate (Langtimm *et al.* 2004, Runge *et al.* 2007b).

- ***New data:*** The Blue Spring manatee population is the best studied in Florida. Thanks to the dedication of the staff at Blue Spring State Park where the manatees over-winter, particularly Ranger Wayne Hartley, a continuous data base of the life histories of manatees using Blue Spring is available. Staff at DeLeon State Park have begun collecting data on manatee use of DeLeon Springs. Ongoing research by Sirenia Project and Wildlife Trust personnel will provide better information on manatee use of other springs in the upper St. Johns River. Research in 1979-1980 documented the movements of 22 radio-tagged manatees from Blue Spring during the spring and through the summer. In late February and early March, manatees left the spring when

the river temperature rose to 20° C, initially staying in close proximity to the spring. As the weather and water temperature warmed, manatees increasing ranged further from Blue Spring. The majority of the tagged individuals moved north to the Ocklawaha area each spring, staying there for several weeks. They then moved to south of Lake George in the summer, primarily to the area between Lake Dexter and Lake Beresford, and most returned to Blue Spring in the winter (Bengtson 1981).

Manatee use has been documented in the portion of the Ocklawaha River below Rodman Dam and Rodman Reservoir in Putnam and Marion Counties. In spite of some opposition from local government and recreational users of the Rodman Reservoir, there is an ongoing effort to restore the Ocklawaha River by partially dismantling the Rodman Dam and allowing the river to revert back to its original course. This action is deemed an important one by the Service in the context of providing warm water habitat for a growing Upper St. Johns River subpopulation and in anticipation of the loss of artificial warm water sources utilized by the Atlantic Coast subpopulation. Currently, the Buckman Lock, which provided access to the reservoir, is permanently closed to prevent further manatee deaths from occurring in the lock and dam structures. It is highly probable that manatees would utilize the Ocklawaha River and the drowned springs that formerly fed it if the river were restored.

Currently designated Critical Habitat: the St. Johns River including Lake George, and including Blue Spring and Silver Glen Springs from their points of origin to their confluences with the St. Johns River;

Proposed revision of geographic area: The State of Florida has recognized the importance of this area by creating Blue Spring State Park to provide a manatee sanctuary (Powell & Waldron 1981). However, several important waterways should be specifically named. In Volusia County, the Lagoon, Lake Beresford, the Zeigler Dead River, Daisy Lake, Highland Park Canal, Lake Woodruff, DeLeon Spring, Spring Garden Creek, the Norris Dead River, Tick Island Creek, Lake Dexter, the Hontoon Dead River (including the northernmost logging canal that connects to the St. Johns River), and Lake Monroe (portions of which are in Seminole County) should be mentioned by name. In Putnam County, the Ocklawaha River and Welaka Spring should be mentioned by name. In Marion County, Salt Springs should be mentioned.

Notable Constituent Elements:

- ***Warm water:*** Blue Spring, DeLeon Springs, Silver Glen Spring, Salt Springs, and Welaka Spring are known warm water sites. In 2003, Blue Spring had been estimated to provide warm-water habitat for 120 animals, but it was thought that it could accommodate almost twice as many (Runge 2003). A nearly 200% increase in the use of this area was found in just the first few years following designation (Powell & Waldron 1981). At present, the high count in Blue Spring is more than 180 manatees. As many as 25 manatees have been counted at DeLeon Springs. Manatee use of other springs in the St. Johns system is less well known but all the

springs mentioned in this section have been used by manatees, albeit in much lower numbers. Current research efforts to better document use of these springs may provide information that will lead to better management practices in these locations. This in turn may lead to higher use of these springs as the Upper St. Johns manatee population grows beyond the capacity of Blue Spring. For example, Silver Glen Springs regularly has large numbers of people and boats in the spring run. The boats are often rafted together for weekend parties, where people also swim and engage in other recreational activities that would discourage manatees seeking warm water from entering the spring run. As mentioned above, restoration of the Ocklawaha River could provide manatees access to other springs that are currently difficult, if not impossible, to reach. In fact, the reservoir pool has drowned some known springs that may re-emerge when the dam structure is removed. Anecdotal sightings of an occasional manatee near Silver Spring, Florida's largest artesian spring, have occurred in the past even though it is more than 50 kilometers upstream from the St. Johns River.

- ***Food sources:*** In the Upper St. Johns River, manatees feed on submerged beds of freshwater SAV such as native eelgrass and exotic hydrilla. The Blue Spring Run contains almost no SAV, despite Florida state efforts to replant the area, so manatees must leave the warm water of the spring run and enter the river to feed (Powell & Waldron 1981). The Lagoon near the mouth of Blue Spring run, the Hontoon Dead River, Lake Beresford, Lake Woodruff, Lake Dexter, and the Norris Dead River (in Volusia County) are among the many feeding sites in the St. Johns River in proximity to Blue Spring. Invasive species such as water hyacinth have prospered at the expense of native SAV in the Ocklawaha River since the construction of the Rodman Dam in 1971 (Smith 1997).Water hyacinth, water lettuce, eelgrass, hydrilla, and Southern naiad (*Najas guadalupensis*) are consumed by manatees in the upper St. Johns River (Smith 1993). Manatees have been observed grazing on eelgrass adjacent to the two deepest areas of the Silver Glen Spring run (Pandion Systems, Inc. 1993).

- ***Travel Corridors:*** Manatees use the St. Johns River extensively as a travel corridor. Lake Monroe in Volusia and Seminole counties appears to be the southern limit of their range in the river, although a few individuals have been documented farther upstream when the river is at a very high stage. The Norris Dead River is a travel corridor from Blue Spring to Lake Woodruff.

- ***Shelter:*** Aerial surveys indicate that Blue Spring manatees feed, rest, and mate in the Barge Canal east of Buckman Lock/St. John's Bridge (Smith 1997). The Hontoon Dead River, Lake Woodruff, the Norris Dead River, Lake Dexter, and Lake Beresford are resting and calving sites.

- ***Fresh water:*** This entire river system is fresh water.

Lake Okeechobee Region

Lake Okeechobee is not a "region" associated with a manatee subpopulation. Although a few individual manatees may have crossed the vast lake, in practical terms manatees using the western portions of the lake and the associated canals leading to it are likely part of the Southwest Florida subpopulation and manatees using the eastern portions of the lake and associated canals are likely part of the Atlantic subpopulation. However, since much less is known about manatee use of Lake Okeechobee habitats compared to Florida's coastal regions, it seems practical to address it separately. This approach acknowledges manatee use of the lake and the need to include it in the revision of Critical Habitat, yet also allows flexibility for managers' decisions, acknowledging the lack of complete information.

For the purpose of this petition, the Lake Okeechobee Region is composed of Glades, Hendry, Palm Beach, Martin, and Okeechobee counties, whose boundaries include portions of the lake. Based on sightings and mortality data, there is no question that Lake Okeechobee and the associated canals and lakes, such as the Caloosahatchee Canal and the St. Lucie Canal, are used by manatees in significant numbers. The number of watercraft-related and lock-related manatee deaths illustrate the high manatee use, with at least 29 watercraft-related manatee deaths and 56 lock-related deaths since 1974. The 35 undetermined, seven perinatal, six other natural, five other human, and three cold stress deaths (at a minimum) further illustrate the high level of manatee use in the Lake Okeechobee region and support its designation as Critical Habitat.

Proposed geographic area to be added: All of Lake Okeechobee, the Caloosahatchee Canal from the Lee County/Hendry County line to Lake Okeechobee, including Lake Hicpochee and the Moorehaven Canal; the Rim Canal; the Harney Pond Canal; Fisheating Creek; Taylor Creek and the St. Lucie Canal.

Notable Constituent Elements:

- ***Food sources:*** The western side of Lake Okeechobee generally has more SAV coverage than the eastern side. The lake contains thousands of acres of SAV, such as hydrilla, eelgrass, coontail, and southern naiad, and macroalgae, such as muskgrass (SFWMD 2004). Presumably, manatees feed on both submerged and emergent vegetation in the lake.

- ***Shelter:*** Taylor Creek is possibly a manatee calving area, as perinatal deaths have been documented there. The many canals in the Lake Okeechobee system presumably provide shelter for resting and from unfavorable weather.

- ***Travel Corridors:*** The Caloosahatchee Canal and the St. Lucie Canal are important travel corridors from the lake to the west and east coasts, respectively.

- ***Fresh water:*** The entire Lake Okeechobee and its canal systems are fresh water.

VII. ECONOMIC BENEFITS OF A REVISED, UPDATED CRITICAL HABITAT DESIGNATION FOR THE MANATEE

In addition to promoting the conservation of the manatee – the principal purpose of any critical habitat designation – revising the designation in accordance with this petition would also result in a number of economic and practical benefits for the citizens of Florida, as well as federal, state, and local regulators.

Ensuring That Public and Private Resources Are Expended on Areas of Actual Importance to Manatees

A critical habitat designation based on the best available scientific information concerning the current biological needs of the manatee will ensure that both public and private resources are efficiently expended on habitat protections that will in fact conserve the manatee, rather than on areas that may now be of lesser importance.

Similarly, once critical habitat is correctly identified as required by law, and the federal government takes reasonable measures to minimize the impact of federal actions on constituent elements of manatee critical habitat, this may ease the burden on the state of Florida and local governments. Florida's springs, for example, are a critical natural resource for tourism and municipal use as well as for manatee habitat. The state expends substantial funds to identify best management practices to reduce the impact of development on these warm springs. These include comprehensive land use planning; standards for road construction, golf courses, agriculture and silviculture, and wastewater treatment; and voluntary stewardship and public education programs. Once the federal government begins to properly consider the effect of its actions on this resource, it may adopt some of the measures that the state has identified as best management practices or employ similar means to reduce its impact on exhaustible natural resources like springs. This will make the problems that state and local governments face that much less challenging and perhaps will result in fewer restraints required on private individuals.

Increased property values

By decreasing incursions from development and noise from speed boats, manatee speed zones and sanctuaries have been shown to increase property values. Indeed, as the FWS has itself explained, studies have "shown that speed zone enforcement may provide an economic benefit to adjacent landowners" and the "authors [of one study] find no evidence that slow speed zones have a negative impact on home sale price. Slow speed zones were found to correlate with as much as a 15 to 20 percent increase in sale price [and] . . . speed zones may increase property values by reducing noise and traffic, as well as making it easier for boats to enter and leave primary waterways." FWS, Draft Environmental Impact Statement, Proposed Rulemaking for the Incidental Taking of Small Numbers of Florida Manatees Resulting From Government Programs Related to Watercraft Access and Watercraft Operation in the State of Florida, at 116 (November 2002) (citing

Bell and McLean (1997)); see also Bell, McLean, The Effect of Manatee Speed Zones on Property Values 35-36 (April 1997) ("In the case extensively analyzed in this paper, we found that no such evidence was available to foster the idea that property values decline after the imposition of the posted manatee speed zones in Fort Lauderdale, Florida. The findings suggest that in addition to protecting the manatee, there is what economists call a positive externality. That is, there is a positive side effect of this regulation and that is to increase property values where such [zones] are imposed . . . If these results can be generalized to other manatee counties, there is a massive increase in wealth accruing as an indirect effect of the effort by the state of Florida to protect the manatee.") (emphasis in original).

Contingent valuation

It is difficult to value natural resources in monetary terms. These resources are not exchanged on any market and are very prone to being undervalued.[5] Nonetheless, it is clear that such resources (and particularly manatees) do have significant economic values.

One approach to valuing natural resources that has been employed by the federal government is contingent valuation. See Percival et al., Environmental Regulation: Law, Science, & Policy 30 (4th ed., 2003). Contingent valuation attempts to measure the public's willingness to pay to obtain a particular benefit. In this case, the benefit is the conservation of manatees. A 1995 study by scientists from the Florida Department of Environmental Protection and Florida State University indicated that Floridians alone placed a total asset value on the protection of the manatee population at ***$2.6 billion***, or $14.78 per year per household, amounting to as much as $1.4 million per manatee. See Bradley J. Bendle & Frederick W. Bell, An Estimation of the Total Willingness to Pay by Floridians to Protect the Endangered West Indian Manatee through Donations ii (November 1995).[6]

This number reflects the value of direct use (for example, viewing manatees in the wild) as well as indirect use of manatees, such as looking at photos or videos. Bendle & Bell at 9. People may also derive option value, by having the option to either travel to see manatees or view them indirectly, existence/preservation value, by knowing that the species' existence is being preserved, or bequest value, by knowing that the resource is being preserved for future generations. Id.

Professors Bendle and Bell's estimate can be multiplied to account for the additional contingent value of protecting manatee critical habitat to residents of the other

---

[5]For a comprehensive critique of traditional cost-benefit analysis in environmental regulation, see FRANK ACKERMAN & LISA HEINZERLING, PRICELESS: ON KNOWING THE PRICE OF EVERYTHING AND THE VALUATION OF NOTHING (2004).

[6] This study is consistent with public opinion surveys which reflect that the vast majority of Floridians support increased efforts to conserve manatees. See, e.g., Beldon Russonello & Stewart (2001) (indicating, among other findings, that 65% of Floridians believe that more steps should be taken to protect manatees).

49 states. People who may not be in a position to ever see a manatee would nevertheless be able to take full advantage of many of the values included above.

Hedonic Valuation

Evidence of actual expenditures related to manatee preservation and tourism provide evidence of the value of manatees to some individuals, even if they do not capture the full value of the survival of the species. Florida residents do opt to spend significant funds for manatee conservation, for example by purchasing manatee license plates, by making donations when registering a boat, and by donating to the Save the Manatee Club directly. By charging an additional $20 per year to purchasers, the license plate program alone has generated $31,222,762 over the past decade.[7]

Visits to observe manatees are another type of expenditure demonstrating the value of manatees. Visits by over 750,000 Floridians and non-Floridians each year to the four state parks that provide opportunities to view manatees in the wild and captivity result in expenditures on travel and in park concessions. Bendle & Bell at 15-16. Visits to Sea World and other aquaria can be traced at least in part to their notable manatee exhibits. Bendle & Bell at 16.

The Waterfronts Florida program also demonstrates, at least in part, the value Floridians place on manatees. This state program has targeted 13 waterfront areas for two years of assistance with seed funding and technical assistance to aid waterfront revitalization. This includes environmental resource protection and hazard mitigation. This program has attracted over 7,000 hours in volunteer service from citizens, over $143,000 in private funding, and over $7.1 million in additional public funding to these waterfront areas. This is further evidence of the high value Floridians place on the preservation of their marine resources, including manatees.[8]

Efficient land acquisitions

Accurate Critical Habitat definitions will help private and public groups that use federal critical habitat designation for guidance to make wise land acquisitions. See Florida DEP, Protecting Florida's Springs: Land Use Planning Strategies and Best Management Practices 28 (2002) for a description of the use of various land acquisition programs used to protect spring flow.

---

[7] Florida State Department of Motor Vehicles, *available at* http://www.hsmv.state.fl.us/specialtytags/Manatee.html. Despite the myriad options available, the manatee plate was the second-highest seller for the past three years, with another endangered species, the Florida panther in first place. http://www.hsmv.state.fl.us/specialtytags/tagsales.html. Florida residents also have the option to purchase plates supporting wild dolphins, sea turtles, whales, large mouth bass, the Everglades, Tampa Bay Estuary, reefs, Indian River, and wildlife generally. Together, these expenditures reflect an extraordinary degree of support for manatee habitat and all the wildlife that share it.

[8] Florida planning 2003 report at 13.

VIII. CONCLUSION

For all of the foregoing reasons, there are compelling legal, conservation, economic, and practical reasons to grant this petition to revise the manatee's critical habitat designation. Accordingly, we urge the FWS to process this petition as promptly as possible and certainly within the time frames mandated by the ESA.

Scientific Citations

Bengtson, J. L. 1981. Ecology of manatees (*Trichechus manatus*) in the St. Johns River, Florida. Ph.D. Thesis, University of Minnesota, Minneapolis, MN. 126 pp.

Campbell, H. W. 1976. An Evaluation of Manatee (*Trichechus manatus*) Populations in the Vicinity of the Proposed Cross Florida Barge Canal with Assessment of Potential Impacts. National Fish and Wildlife Laboratory, U.S. Fish and Wildlife Service. Gainesville, FL. 42 pp.

Deutsch, Charles J. 2000. Winter movements and use of warm-water refugia by radio-tagged West Indian manatees along the Atlantic coast of the United States. Final Report Prepared for: Florida Power and Light Company and U.S. Geological Survey.

Deutsch, C.J., J.P. Reid, R.K. Bonde, D.E. Easton, H.I. Kochman, and T.J. O'Shea. 2003. Seasonal Movements, Migratory Behavior, and Site Fidelity of West Indian Manatees Along the Atlantic Coast of the United States, *The Wildlife Society*, Wildlife Monographs No. 151.

Fertl, D., A.J. Schiro, G.T. Regan, C.A. Beck, N. Adimey, L. Price-May, A. Amos, G.A.J. Worthy, and R. Crossland. 2005. Manatee occurrence in the northern Gulf of Mexico, west of Florida. *Gulf and Caribbean Research* 17: 69-94.

Garrott, R.A., Ackcerman, B.B., Cary, J.R., Heisey, D.M., Reynolds, J.M., III, Rose, P.M., Wilcox, J.R. 1994. Trends in Counts of Florida Manatees at Winter Aggregation Sites. J. Wildl. Manage. 58(4):642-654.

Hartman, D.S. 1979. Ecology and behavior of the manatee (*Trichechus manatus*) in Florida. Special Publication No. 5. The American Society of Mammalogists, Pittsburg, PA.

Irvine, A.B. 1983. Manatee metabolism and its influence on distribution in Florida. *Biological Conservation* 25: 314-334.

King, J.M., and J.T. Heinen. 2004. An assessment of the behaviors of overwintering manatees as influenced by interactions with tourists at two sites in central Florida. *Biological Conservation* 117: 227-243.

Laist, D.W. and J.E. Reynolds. 2005. Influence of power plants and other warm water refuges on Florida manatees. *Marine Mammal Science* 21(4): 739-764 (October 2005).

Langtimm, C.A., C.A. Beck, H.H. Edwards, K.J. Fick-Child, B.B. Ackerman, S.L. Barton, and W.C. Hartley. Survival estimates for Florida manatees from the photo-identification of individuals. 2004. *Marine Mammal Science* 20(3): 438-463.

Learmonth, J.A., MacLeod, C.D., Santos, M.B., Pierce, G.J., Crick, H.Q.P., Robinson, R.A. 2006. Potential Effects of Climate Change on Marine Mammals. *Oceanography and Marine Biology: An Annual Review*, 44:431-464.

Lefebvre, L.W., M. Marmontel, J.P. Reid, G.B. Rathbun, and D.P. Domning. 2001. Status and Biogeography of the West Indian Manatee. In *Biogeography of the West Indies: Patterns and Perspectives*, 2nd ed., edited by C.A. Woods and F.E. Sergile. CRC Press LLC.

Mann, David A., Debborah E. Colbert, Joseph C. Gaspard, Brandon M. Casper, Mandy L. H. Cook, Roger L. Reep and Gordon B. Bauer. 2005. Temporal resolution of the Florida manatee (*Trichechus manatus latirostris*) auditory system. Journal of Comparative Physiology191 (10):903908.

Marmontel, M., S.R. Humphrey, and T.J. O'Shea. 1997. Population viability analysis of the Florida manatee (*Trichechus manatus latirostris*), 1976-1991. Conservation Biology 11(2): 467-481.

Mayo, Keven E. and S. M. Markley.1995. Dade County Manatee Protection Plan. DERM Technical Report 95-5. 94 pp. + appendices.

Moore, J.C. 1951. The range of the Florida manatee, *Quarterly Journal of the Florida Academy of Sciences* 14:1-19.

Natural Resources Defense Council and Florida Climate Alliance. 2001. Feeling the Heat in Florida: Climate Change on the Local Level. Accessed 8 February 2008 at http://www.nrdc.org/globalwarming/florida.pdf.

Neumann, J.E., Yohe, G. Nicholls, R., Manion, M. 2000. Sea Level Rise and Global Climate Change: A Review of Impacts to U.S. Coasts. Pew Center on Global Climate Change, Arlington, VA. Accessed 11 February 2008 at http://www.pewclimate.org/docUploads/env sealevel.pdf.

Nowacek, S.M., R.S. Wells, E.C.G. Owen, T.R Speakman, R.O. Flamm, and D.P. Nowacek. 2004. Florida manatees, *Trichechus manatus latirostris*, respond to approaching vessels. Biological Conservation 119:517-523.

Ortiz, R.M., G.A.J. Worthy, and D.S MacKenzie. 1998. Osmoregulation in wild and captive West Indian manatees (*Trichechus manatus*). *Physiological Zoology* 71 (4): 449-457.

O'Shea, T.J. 1986. Mast foraging by West Indian manatees (*Trichechus manatus*). *Journal of Mammalogy* 67(1): 183-185.

Packard, J.M. 1981. Abundance, distribution and feeding habits of manatees (*Trichechus manatus*) wintering between St. Lucie and Palm Beach Inlets, Florida. U.S. Fish & Wildlife Service Contract Report No. 14-16-004-80-105.

Packard, J.M., Frohlich, R.K., Reynolds, J.E., III, Wilcox, J.R.. 1989. Manatee response to interruption of a thermal effluent. J. Wildl. Manage. 53:692-700.

Packard, J.M., Mulholland, R. 1983. Analysis of manatee aerial surveys: a compilation and preliminary analysis of winter aerial surveys conducted in Florida between 1977 and 1982. Manatee Popul. Res. Rep. 2. Coop. Fish and Wildl. Res. Unit, Univ. Florida, Gainesville. 119 pp.

Pandion Systems, Inc. 1993. Carrying Capacity Study of Silver Glen Spring and Run. Report submitted to the Florida Department of Environmental Protection.

Powell, J.A., and G.B. Rathbun. 1984. Distribution and abundance of manatees along the northern coast of the Gulf of Mexico. *Northeast Gulf Science* 7(1): 1:1-28.

Powell, J.A., and J.C. Waldron. 1981. The Manatee Population in Blue Spring, Volusia County, Florida. In: R. Brownell and Ralls, Eds. The West Indian manatee in Florida. Fl. Nat. Res. 154 pp.

Provancha, J.A. & M.J. Provancha. 1998. Long-Term Trends in Abundance and Distribution of Manatees (Trichechus Manatus) in the Northern Banana River, Brevard County, Florida, Marine Mammal Science, 4(4): 323-338.

Rathbun, G. B., J.P. Reid, and G. Carowan. 1990. Distribution and Movement Patterns of Manatees (*Trichechus manatus*) in Northwestern Peninsular Florida. *Florida Marine Research Publications*, No. 48.

Rose, P.M. 1978 and 1979; Rose, P.M., and McCutcheon, S.P. 1980; Raymond, P.W. 1981; McGehee, M.A. 1982; Reynolds, J.E., III. 1983 to 2007. Distribution and abundance of the West Indian manatee (*Trichechus manatus*) around selected Florida power plants following winter cold fronts: 1977-2007. Final reports prepared for the Florida Power and Light Co.

Runge, M.C. 2003. A Model for Assessing Incidental Take of Manatees Due to Watercraft-Related Injuries. MMPA Florida Manatees Final EIS, Incidental Take Manual Technical Appendix I.

Runge, M.C., C.A. Langtimm, and W.L. Kendall. 2004. A Stage-based Model of Manatee Population Dynamics. *Marine Mammal Science* 20(3): 361-385.

Runge MC, Sanders-Reed CA, Langtimm CA, Fonnesbeck CJ. 2007. A quantitative threats analysis for the Florida manatee (Trichechus manatus latirostris). U.S. Geological Survey Open-File Report 2007-1086. 34 pp.

Runge, M.C., C.A. Sanders-Reed, and C.J. Fonnesbeck. 2007b. A core stochastic population projection model of Florida manatees (*Trichechus manatus latirostris*). U.S. Geological Survey Open-File Report 2007-1082. 41 pp.

Sargent, F.J., W.B. Sargent, T.J. Leary, D.W. Crewz, and C.R. Kruer. 1995. Scarring of Florida's Seagrass: Assessment and Management Options. FMRI Technical Report TR-1.

Smith, K.N. 1993. Manatee habitat and human-related threats to seagrass in Florida: A review. Report developed for Department of Environmental Protection, Division of Marine Resources.

Smith, K.N. 1997. The effects of proposed restoration of the Ocklawaha River in the vicinity of the Rodman Basin on manatees and manatee habitat. Report developed for Bureau of Protected Species Management, Florida Department of Environmental Protection.

Smith, K.N. 2000. Manatee reliance on non-industrial warm water sites. *In*: Florida manatees and warm water: Proceedings of the Warm-water Workshop, Jupiter, Florida, 24-25 August 1999. U.S. Fish and Wildlife Service. Jacksonville, FL. Multi pp.

South Florida Water Management District. 2004. Submerged aquatic vegetation report card for the Lake Okeechobee Protection Program (LOPP).

Stith, B.M., D.H. Slone, and J.P. Reid. 2006. Review and Synthesis of Manatee Data in Everglades National Park. USGS Administrative Report. USGS Florida Integrated Science Center, Gainesville, FL. 126 pp.

Twilley, R.R., E. Barron, H.L. Gholz, M.A. Harwell, R.L. Miller, D.J. Reed, J.B. Rose, E. Siemann, R.G. Welzel and R.J. Zimmerman. 2001. Confronting Climate Change in the Gulf Coast Region: Prospects for Sustaining Our Ecological Heritage, Union of Concerned Scientists, Cambridge MA and Ecological Society of America, Washington, D.C. 82 pp.

U. S. Fish & Wildlife Service. Florida Manatee Recovery Plan, Third Revision. 2001.

Weigle, B.L., Irene E. Wright, Monica Ross, and Richard Flamm. 2001. Movements of radio-tagged manatees in Tampa Bay and along Florida's west coast 1991-1996. FMRI Technical Report TR-7.

Wooding, J. 1997. An assessment of manatee behavior relative to interactions with humans at Three Sisters Springs, Crystal River, Florida. A report submitted to the U.S. Fish and Wildlife Service. Florida Cooperative Fish and Wildlife Research Unit. University of Florida, Gainesville, Florida.

Worthy, G.A., T.A. Miculka, S.D. Wright. 1999. Manatee response to cold: How cold is too cold? In Florida Manatees and Warm Water: Proceedings of the Warm Water Workshop. August 24-25, 1999, Jupiter, Florida. U.S. Fish and Wildlife Service. Jacksonville, Florida.