WEST INDIAN MANATEE *(Trichechus manatus)*

FLORIDA STOCK
(Florida subspecies, *Trichechus manatus latirostris*)

U.S. Fish and Wildlife Service, Jacksonville, Florida

STOCK DEFINITION AND GEOGRAPHIC RANGE

The West Indian manatee (*Trichechus manatus*) is found in coastal and riverine areas of North America, Central America, and South America and in islands in the Caribbean basin. Two subspecies are recognized. In 1934, Hatt (1934) identified an Antillean and a Florida subspecies, *Trichechus manatus manatus* and *Trichechus manatus latirostris*, respectively, and Domning and Hayek (1986) subsequently reported that the two subspecies could be identified based on cranial characteristics. They suggested that this subspeciation could reflect reproductive isolation brought on by the intemperate northern coast of the Gulf of Mexico and characteristically strong currents found in the Straits of Florida (Domning and Hayek 1986). Within the jurisdictional waters of the United States (US), Florida manatees are found throughout the southeastern US and Antillean manatees are found in Puerto Rico and perhaps the US Virgin Islands (Lefebvre *et al.* 2001).

Genetic differences between the Antillean and Florida subspecies have been identified (García-Rodríguez *et al*. 1998, Vianna *et al.* 2006, and Tucker *et al*. 2012). García-Rodríguez *et al.* (1998) compared mitochondrial DNA (mtDNA) from eight locations and identified three geographic clusters: 1) Florida and the West Indies; 2) the Gulf of Mexico to the Caribbean rivers of South America; and 3) the northeast Atlantic coast of South America. Vianna *et al.* (2006) assessed relatedness between the Florida and Puerto Rico populations and identified a gene flow barrier. This was further confirmed by Hunter *et al.* (2012), who used microsatellite Bayesian cluster analyses to detect two populations (K = 2) and noted no admixture or recent migrants between Florida (q = 0.99) and Puerto Rico (q = 0.98).

Florida manatees are generally restricted to the inland and coastal waters of peninsular Florida during the winter, when they shelter in and/or near warm-water springs, heated industrial effluents, and other warm water sites (Hartman 1979, Lefebvre *et al.* 2001, Laist and Reynolds 2005, Stith *et al.* 2006, Laist *et al.* 2013). In warmer months, manatees leave these sites and can disperse great distances (Figure 1). Individuals have been sighted as far north as Massachusetts, as far west as Texas, and in all states in between (Rathbun *et al.* 1982, Rathbun *et al*. 1990, Schwartz 1995, Fertl *et al.* 2005). On rare occasions, known Florida manatees have been sighted in Cuba and the Bahamas (Alvarez-Alemán *et al.* 2010, Melillo-Sweeting *et al.* 2011). Warm weather sightings are most common in Florida, coastal Georgia, and Alabama (Rathbun *et al.* 1982, Rathbun *et al.* 1990, Schwartz 1995, Fertl *et al.* 2005, Pabody *et al.* 2009).

Previous studies of the manatee in Florida identified four, relatively distinct, regional management units (formerly referred to as subpopulations): an Atlantic Coast unit that

occupies the east coast of Florida, including the Florida Keys and the lower St. Johns River north of Palatka; an Upper St. Johns River unit that occurs in the river south of Palatka; a Northwest unit that occupies the Florida Panhandle south to Hernando County; and a Southwest unit that occurs from Pasco County south to Whitewater Bay in Monroe County (USFWS 2001 and 2007). See Figure 2.

Each of these management units includes individual manatees that tend to return to the same warm-water site(s) each winter and have similar non-winter distribution patterns. The exchange of individuals between these units is limited during the winter months, based on data from telemetry studies (Rathbun *et al*. 1990, Reid *et al.* 1991, Weigle *et al*. 2001, Deutsch *et al*. 1998 and 2003) and photo-identification studies (Rathbun *et al*. 1990, Higgs, pers. comm. 2007a, b). During non-winter months, movements occur between the Northwest and Southwest units and between the Upper St. Johns River and Atlantic Coast units (Laist *et al.* 2013). Movements between Florida's Atlantic Coast and Gulf Coast are relatively unknown (Laist *et al.* 2013). Low levels of genetic diversity and little sub-structuring exist among the four management units in Florida (Bonde 2009).

While the Florida manatee population has been separated into management units, the Service identifies the Florida manatee population as a single stock. As stated above, the management unit construct was originally based on studies of regional manatee wintering sites. The management units are a useful construct for assessing unit-specific population trends and threats; the Service and its collaborators evaluate these parameters for each unit using a core biological model (CBM) developed by Runge *et al.* (2004). Consistent with requirements of the Endangered Species Act of 1973, as amended, threats are then appropriately addressed through methods identified in Service recovery plans (and the State of Florida's Manatee Management Plan). This approach has been successful for efforts to manage Florida manatees throughout their range.

POPULATION SIZE

There is currently no statistically robust estimate of total population size for the Florida manatee stock. However, the State of Florida, pursuant to a State legislative mandate, conducts winter counts of manatees at warm water sites throughout peninsular Florida each year. Each winter count includes a summation of counts from each warm water site to produce a total count that describes the number of manatees seen at all warm water sites during the survey. Survey methods limit any quantitative interpretation of these counts. The Florida Fish and Wildlife Conservation Commission (FWC) has conducted these counts since 1991, as survey conditions permit (FWC FWRI Manatee Synoptic Surveys 2011b). Because these counts do not provide statistically significant estimates of abundance, these counts are not used to describe population trends (Lefebvre *et al.* 2009, Laist *et al*. 2013). Instead, information from photo-identification studies is used to accurately describe population trends as they relate to growth rates, adult survival rates, and reproductive rates. Management decisions are based on these more accurate, scientifically supportable numbers and trends.

Minimum Population Estimate

Absent a minimum population estimate of the number of manatees in this stock that incorporates precision and variability, the current, best available information suggesting a minimum population size includes FWC's January 2011 count of 4,834 Florida manatees (Laist *et al.* 2013). The single highest count to date was 5,076 animals, based on a single synoptic survey of warm-water refuges in January 2010 (Laist *et al.* 2013). No synoptic surveys have been flown since January 2011 because the winters have been too warm to survey, per survey protocols (Laist *et al.* 2013).

Current Population Trends

Demographic analyses indicate that the Florida stock of manatees is increasing or stable throughout much of Florida (Runge *et al.* 2004, 2007a). The analyses rely on photo-ID based mark-recapture analyses using a manatee-specific core biological model. A recent adult survival rate analysis for the Florida manatee, through the winter of 2005 – 2006, identifies a range-wide survival rate of 96% (C.A. Langtimm, USGS, pers. comm., 2011). The fastest growing segment of this stock is found in the St. Johns River, with a growth rate of 6.2% (95% CI 3.7 to 8.1%) (Runge *et al.* 2004).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Current and maximum net productivity rates have not been determined for the Florida manatee. In the absence of maximum net productivity rates for this stock, the aforementioned maximum growth rate for the St Johns River segment of this stock (6.2% with a 95% CI of 3.7 to 8.1%), which incorporates both reproductive and adult survival rates, is identified as $R_{max.}$ This rate describes a maximum rate of increase and reflects both additions and losses to this population, including losses due to both natural and human-causes.

POTENTIAL BIOLOGICAL REMOVAL (PBR)

PBR is the product of three elements: the minimum population estimate (N_{min}), half of the maximum net productivity rate (0.5 R_{max}), and a recovery factor (F_r). Recovery factor values range between 0.1 and 1.0 and population simulation studies demonstrate that a default value of 0.1 should be used for endangered (depleted) stocks and a default value of 0.5 should be used for threatened stocks or stocks of unknown status (NMFS 2005). Absent a true estimate of population size and a maximum net productivity rate, we are using FWC's January 2011 count of 4,834 Florida manatees and the highest calculated growth rate to calculate PBR.

$$N_{min} = 4{,}834$$
$$R_{max} = 6.2\%$$
$$F_r = 0.1$$

$$PBR = (4{,}834)\ (0.031)\ (0.1) = 14.98 \text{ (or 14)}$$

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Sources of human caused manatee mortality and injury (whether serious or non-serious) include watercraft, water control structures, recreational and commercial fishing gear, and others. These sources were identified and are documented through manatee carcass salvage and rescue programs (Bonde *et al.* 1983, O'Shea *et al.* 1985, Ackerman *et al.* 1995, Wright *et al*. 1995, Pitchford *et al.* 2005, Lightsey *et al.* 2006, Rommel *et al.* 2007, FWC FWRI Manatee Mortality Statistics 2012, USFWS Manatee Rescue, Rehabilitation, and Release Program Reports 2012).

Human-caused Mortality

Data on manatee mortality in the southeastern United States have been collected since 1974 by the Manatee Carcass Salvage Program (O'Shea *et al.* 1985, Ackerman *et al.* 1995, Lightsey *et al.* 2006, FWC FWRI Manatee Mortality Statistics 2012). Based on these data, the primary sources of human-caused injury and death include watercraft-related strikes (direct impact and/or propeller) (Rommel *et al.* 2007, Lightsey *et al.* 2006), entrapment and/or crushing in water control structures (gates, locks, *etc*.), entanglement in fishing gear, and ingestion of marine debris. Natural factors that affect this stock include exposure to cold and red tide. Mortality associated with these natural factors includes cold stress syndrome and brevetoxicosis, respectively.

Causes of death for many salvaged carcasses cannot be determined. These "undetermined" causes can be the result of a carcass that is too decomposed to diagnose, a carcass that was reported but never retrieved, or when no specific factor or set of factors can be identified as a cause of death. In addition, small manatees (less than or equal to 150 cm in length) that die at or near the time of birth and whose deaths cannot be attributed to one of the known human-related causes are described as "perinatal" deaths, an undetermined cause. No estimate of the true number of manatee deaths exists because the number of carcasses not found or unreported is unknown.

From 1978 through 2012, 8,791 manatee carcasses were salvaged in the southeastern United States. Of these carcasses, 2,372 were animals that died from human causes. Eighty-four percent of manatees (1,980) that died from human causes were killed by watercraft. Water control structures (including flood gates and navigation locks) killed 204 manatees and the deaths of the remaining 188 manatees were attributed to other human causes (including entanglement in and ingestion of marine debris [including fishing gear], etc.) (MMC In press).

During the most recent 5-year period (2008 to 2012), 2,404 manatee carcasses were salvaged in the southeastern United States (Table 1). Of these carcasses, 493 were of animals that died from human causes. Based on this, the annual estimated average human-caused mortality is 99 manatees per year. Eighty-nine percent of manatees (440) that died from human causes were killed by watercraft. Water control structures (including flood gates and navigation locks) killed 22 manatees and the deaths of the

remaining 31 manatees were attributed to other human causes (including entanglement in and ingestion of marine debris [including fishing gear], entrapment in pipes and culverts, etc.) (MMC In press). A more detailed listing of annual manatee deaths by County in Florida can be found on the FWC website at http://myfwc.com/research/manatee/rescue-mortality-response/mortality-statistics/.

Runge *et al.* (2007b), in their 2007 quantitative threats analysis, state that "watercraft-related mortality is having the greatest impact on manatee population growth and resilience" and "elimination of this threat alone would greatly reduce the probability of quasi-extinction. Anticipated losses of winter warm-water habitat could also be a significant, long-term threat."

Human-caused Serious Injury

The Service and its manatee recovery partners maintain a manatee rescue and rehabilitation network to treat distressed manatees (including seriously injured manatees) and return to them to the wild. This program, in existence since at least the 1950s, responds to public reports of distressed manatees (Zeiller 1992). These reports are verified and, if warranted, are addressed through the manatee rescue and rehabilitation network.

Rescued manatees are distressed due to both human-related and natural causes. Sources of distress include watercraft, marine debris, entrapment in water control structures and tide pools, exposure to brevetoxin and cold, disease, calf abandonment, and others. Not all distressed animals are physically injured, that is, are damaged, harmed, or experience loss(es) due to trauma ("injury", as defined in Merriam-Webster at http://www.merriam-webster.com/dictionary/injury; retrieved August 22, 2012).

Examples of distressed animals without injuries include orphaned calves, animals exposed to cold and red tides, diseased animals, entrapped animals (stranded due to high tides, caught behind water control structures, etc.) and others. Some examples of distressed animals with injuries include animals cut by watercraft propellers, animals with broken bones due to watercraft collisions, animals with cuts from embedded marine debris, etc. Some injuries, but not all, are superficial and non-life threatening. For example, some marine debris entangled animals are minimally tangled with minor entanglement-related scrapes.

Upon rescue, responders determine the condition of the rescued animal. Animals with non-life threatening injuries and distressed animals without injuries may be addressed in the field and released on-site. When responders conclude that, in the absence of medical treatment, an animal will die, the animal is taken to a critical care facility for treatment. Distressed animals with or without injuries may be treated. In the case of animals with injuries taken to a facility for treatment, we consider these animals to be seriously injured.

During the most recent 5- year period (2008 to 2012), the manatee rescue and

rehabilitation network rescued 479 distressed manatees. Of this number, 88 distressed manatees with life-threatening injuries were taken to critical care facilities for treatment. Seventy-five of these animals were injured by boats and 13 were entangled in marine debris. See Table 2. (USFWS Manatee Rescue, Rehabilitation, and Release Program Reports 2012)

Fisheries-related Mortality and Injury

Manatees are known to entangle in and/or ingest fishing gear used in commercial and recreational fisheries as well as in gear used in scientific research projects. As reported in mortality and rescue reports, fishing gear used by commercial fishers known to entangle or be ingested by manatees includes shrimp trawls, shrimp nets, crab traps (traps and/or associated buoys and lines), seines, shiner nets and hoop nets, trot lines, and monofilament fishing line and associated tackle. Similarly, recreational fishery gear known to either entangle or be ingested by manatees includes monofilament fishing line and/or associated tackle, cast nets, and crab traps. Fisheries, marine mammal, and sea turtle researchers have entangled manatees in shrimp trawls, seines, and hoop nets.

Manatees also become entangled in ropes and lines, possibly related to recreational and commercial fisheries (*e.g*., float lines detached from traps, etc.) (Nill 1998, Smith 1998, FWC FWRI Manatee Mortality Statistics 2012, USFWS Manatee Rescue, Rehabilitation, and Release Program Reports 2012). Manatees are struck and killed or injured by a variety of watercraft, including watercraft of a size and type comparable to those used by commercial and recreational fishers (Beck and Barros 1991, Pitchford *et al.* 2005, Lightsey *et al.* 2006, Rommel *et al.* 2007).

Commercial Fishing Gear-related Interactions

The National Marine Fisheries Services' (NMFS) 2012 List of Fisheries (NMFS 2011) identifies three commercial fisheries known to take Florida manatees: the Atlantic blue crab trap/pot fishery, the Gulf of Mexico blue crab trap/pot fishery, and the Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery. NMFS (2011) estimates 4,950 vessels/persons participate in the Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery, 4,113 vessels/persons participate in the Gulf of Mexico blue crab trap/pot fishery, and 10,008 vessels/persons participate in the Atlantic blue crab trap/pot fishery.

From 2008 to 2012, there were no gear-related interactions with the Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery. However, there were manatee-crab fishery interactions within the area of the Gulf of Mexico blue crab trap/pot fishery (32 rescues of manatees entangled in crab fishery gear, including 2 seriously injured manatees) and in the area of the Atlantic blue crab trap/pot fishery (16 rescues of manatees entangled in crab fishery gear, including 2 seriously injured manatees). All seriously injured manatees entangled in crab fishery gear were successfully treated and returned to the wild (USFWS Manatee Rescue, Rehabilitation, and Release Program Reports 2012). Because both commercial and recreational crab pot fisheries use the same types of gear, it is difficult to attribute specific crab trap entanglement events to commercial crab fisheries.

Other interactions associated with known commercial fisheries not listed in the NMFS' 2012 List of Fisheries include a manatee death associated with a Georgia in-shore bait shrimp fishery (George 2010).

While the threats posed by watercraft and the anticipated loss of wintering habitat on the Florida manatee are significant, the threat posed by commercial fishery activities is likely very small with a comparatively lesser impact on the persistence of the Florida manatee population. The previously cited quantitative threats analysis describes mortality associated with fisheries interactions as "noticeable" and, when compared to other anthropogenic threats, these interactions are thought to have less of an impact on the persistence of the manatee population (Runge *et al*. 2007b). In over 20 years of observations in the Atlantic and Gulf of Mexico, the NOAA fishery observer program documented a single manatee death in a research trawl (not commercial fisheries-related) (NMFS 2013). Given this, the single death attributed to an in-shore bait shrimp fishery in Georgia, and the fact that all seriously injured manatees were successfully treated and returned to the wild, total commercial fishery mortality and serious injury for this stock can be considered insignificant and approaching a zero mortality and serious injury rate.

Non-commercial Fishing Gear and Other Marine Debris-related Interactions

Manatees interact with fishing gear and other marine debris from non-commercial fishery sources, as well. Of the 14 deaths attributed to fishing gear and other marine debris, 8 are attributable to fishing line and/or associated tackle of unknown origin, 1 to rope of unknown origin, 1 to a fisheries research net, and 4 to other sources. Of the 63 rescues attributed to non-commercial fisheries related gear and marine debris, 35 are attributable to fishing line of unknown origin, 12 to rope of unknown origin, 10 to nets, and 6 to other sources. The 10 net entangled manatees were entangled in cast nets (4), fisheries research-related nets (2), sea turtle research-related nets (3), and a manatee rescue net (1).

In most cases, it is difficult to attribute entangling and ingested fishing gear to specific fisheries, and it is particularly difficult to ascribe them to commercial, as opposed to recreational, fisheries. Gear and marine debris collected from carcasses and rescued manatees rarely provide information as to its source. As such, the role of recreational and commercial fishers in manatee fisheries interactions is hard to define. With this said, there were 8 manatee deaths and 3 serious injuries (subsequently treated and released) attributable to fishing gear of largely unknown origin and marine debris between 2008 and 2012 (refer to Table 1 and Table 2 for annual estimates). Although we are unable to ascribe these mortalities and serious injuries to specific fisheries, given this small number of deaths and the fact that all seriously injured manatees were returned to the wild, it is unlikely that these losses had a significant effect on the stock.

Efforts have been made to reduce the incidence of lethal and non-lethal entanglements in and ingestion of marine debris, including fishing gear (Spellman 1999, Spellman *et al.* 2003). Manatees entangled in or ingesting marine debris are rescued each year by the manatee rescue and rehabilitation program and manatee mortalities and serious injuries

are minimized as a result of this activity (Nill 1998, Smith 1998, FWC FWRI Manatee Mortality Statistics 2012, USFWS Manatee Rescue, Rehabilitation, and Release Program Reports 2012). The Service has funded studies to assess manatee behavior in the presence of fishing gear and to identify "manatee-safe" crab fishing gear that, if used, will minimize the number of manatee-crab trap entanglements (Bowles 2000, Bowles *et al.* 2003). Derelict crab trap removals and monofilament removal and recycling programs are helping to reduce the likelihood of manatee interactions with this gear (Koelsch *et al.* 2003). In February 2009, FWC adopted regional blue crab harvest closures across the state; derelict crab traps are removed during the closures, further reducing the likelihood of crab trap gear entanglements (FWC 2009).

Cold Weather-related Mortality Events

An unprecedented cold weather event in 2009-2010 was largely responsible for a record annual total number of manatee deaths documented by FWC for that year. In 2010, FWC reported 766 manatee deaths in Florida; this number included 282 deaths directly attributed to the cold. It is thought that a significant proportion of the 275 deaths described as "undetermined" and "unrecovered" are also attributable to the cold. Most of the cold-related manatee deaths occurred in southwest Florida and in that area of Florida's east coast between Cape Canaveral and Sebastian Inlet (Barlas *et al.* 2011, Laist *et al.* 2013). In 2011, FWC reported the second highest number of cold-stress related mortality with 112 deaths directly attributed to the cold (FWC FWRI Manatee Mortality Statistics 2012).

STATUS OF STOCK

The Florida manatee is protected by the State of Florida under the Florida Manatee Sanctuary Act of 1978, as amended (§ 379.2431(2), FS). Federally, Florida manatees were originally listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966. The original listing was subsequently adopted under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended, and manatees continue to be identified as a federally endangered species. As an endangered species under the Endangered Species Act, manatees are considered to be a "strategic stock" and "depleted" under the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq.*).

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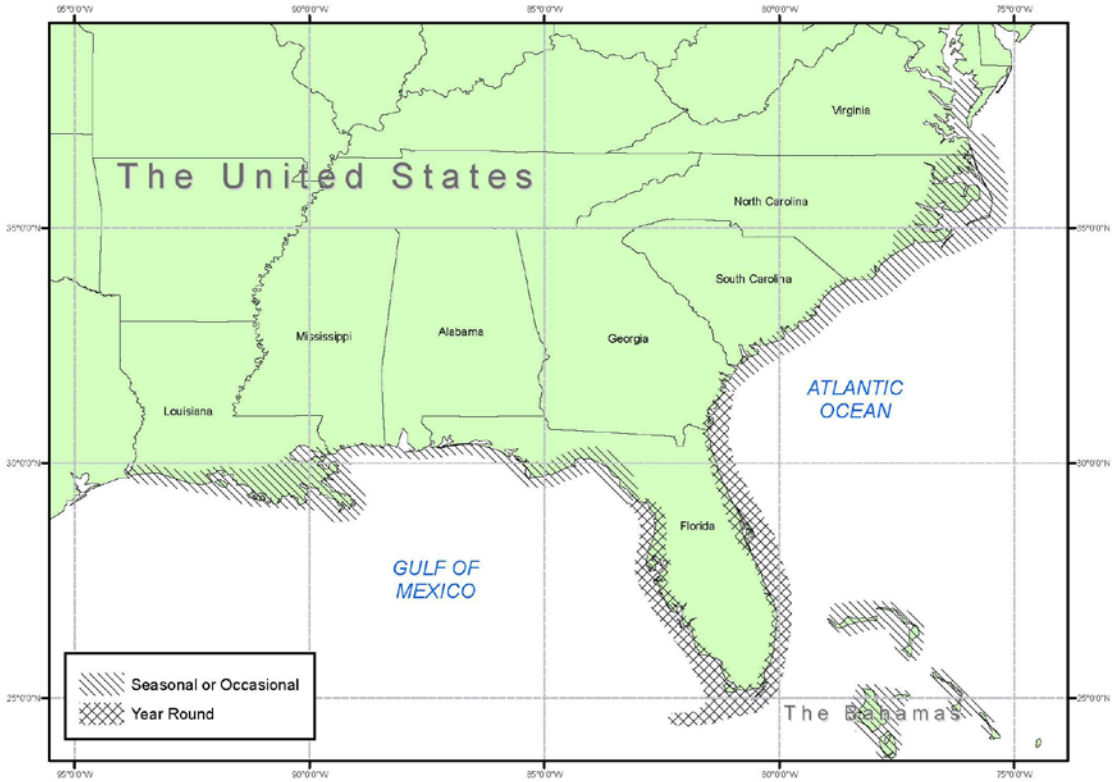

Figure 1. Range of the Florida manatee

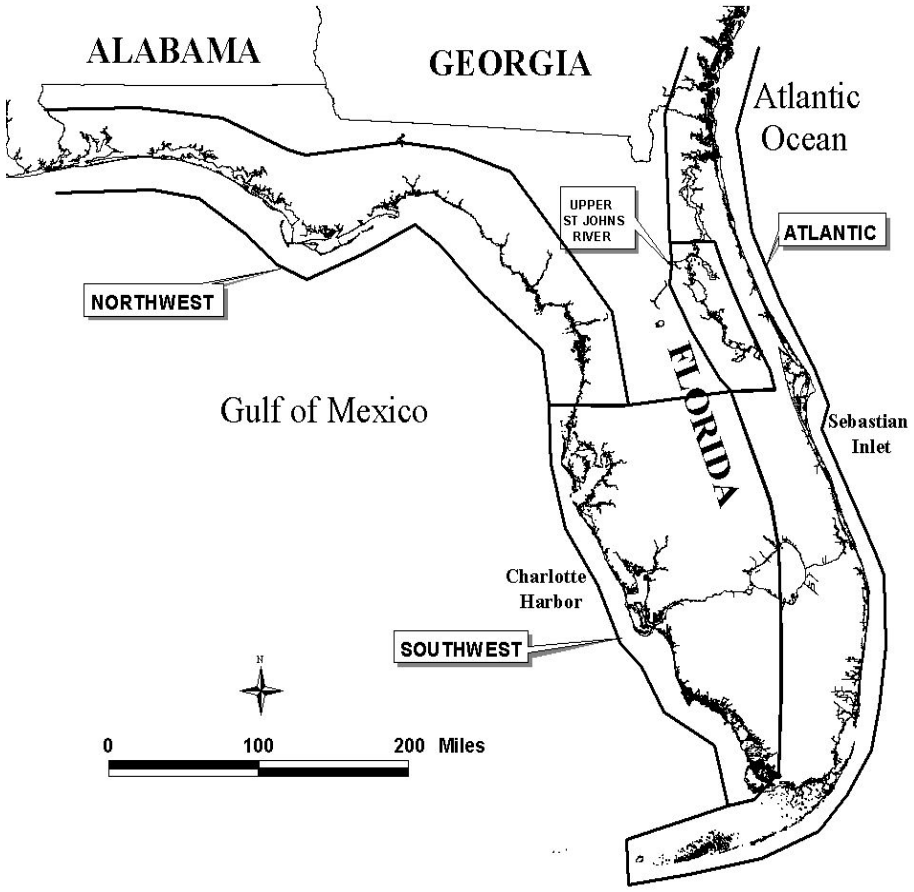

Figure 2. Florida manatee distribution within the four designated regional management units. USFWS (2001).

Table 1. All manatee deaths (number of deaths, percent of annual total), 2008 through 2012. (Source: MMC In press). Numbers include reported, dead manatees that were salvaged and confirmed/verified carcasses that were not salvaged (included in "Other").

Year	Human-caused Mortality	Perinatal	Cold Stress	Other	Total
2008	99 (29%)	101 (30%)	27 (8%)	110 (33%)	337
2009	109 (25%)	114 (27%)	56 (13%)	150 (35%)	429
2010	89 (12%)	97 (13%)	282 (37%)	298 (39%)	766
2011	93 (20%)	77 (17%)	112 (25%)	171 (38%)	453
2012	101 (26%)	68 (17%)	29 (7%)	197 (50%)	395
TOTAL	493 (21%)	460 (19%)	510 (21%)	941 (39%)	2,404
5-Year Avg.	98.6	92.0	102.0	188.2	480.8

Table 2. All manatee rescue responses (total number of responses and number of distressed manatees with injuries taken into critical care facilities for treatment, 2008-2012. (USFWS Manatee Rescue, Rehabilitation, and Release Program Reports 2012)

YEAR	No. of Rescue Responses	Manatees with Significant Injuries taken to Critical Care Facilities	Type of Significant Injury	
			Entanglements	Watercraft
2008	95	21 (22%)	3	18
2009	94	18 (19%)	4	14
2010	117	13 (11%)	1	12
2011	107	24 (22%)	3	21
2012	93	21(23%)	3	18
TOTAL	479	88 (18%)	13	75
5-yr Avg.	95.2	17.6	2.6	15