

APPENDIX VI: West Indian Manatee Stock Assessments – Florida and Antilles stocks

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WEST INDIAN MANATEE (*Trichechus manatus*) FLORIDA STOCK (Florida subspecies, *Trichechus manatus latirostris*)

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STOCK DEFINITION AND GEOGRAPHIC RANGE

Florida manatees are found throughout the southeastern United States. Because manatees are a sub-tropical species with little tolerance for cold, they 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, industrial effluents, and other warm water sites (Hartman 1979, Lefebvre *et al.* 2001, Stith *et al.* 2007). In warmer months, manatees leave these sites and can disperse great distances. Individuals have been sighted as far north as Massachusetts, as far west as Texas, and in all states in between (Rathbun *et al.* 1982, Schwartz 1995, Fertl *et al.* 2005, USFWS Jacksonville Field Office, unpub. data 2008a). Warm weather sightings are most common in Florida and coastal Georgia.

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 1. 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, USGS FISC Sirenia Project, unpubl. data 2007, Higgs, pers. comm. 2007a, b).

While the Florida manatee population has been separated into management units, the Service identifies the Florida manatee population as a single stock. As stated, 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 and the Service believes that using SARs for each of the management units would provide little added benefit to existing efforts.

Significant genetic differences between the manatees of Florida and Puerto Rico do exist and, as a result, these populations are identified as separate stocks (Vianna *et al.* 2006). Vianna *et al.* (2006) identified a gene flow barrier between Florida and Puerto Rico using mtDNA analyses.

POPULATION SIZE

One to three times each winter, a coordinated series of statewide aerial surveys and ground counts, known as the synoptic surveys, are conducted by the Florida Fish and Wildlife Conservation Commission (FWC) to count wintering manatees (FWC FWRI Manatee Synoptic Aerial Surveys 2009). These counts, conducted since 1991, identify a number of animals observed in wintering sites at the time of the count and suggest that there is at least this number of manatees in the population, if not more. Because the counts do not include the number of manatees located away from the wintering sites on the day of the count, the counts do not accurately represent the total number of manatees in the population. Weather and other environmental factors influence count conditions, adding

additional variability. Furthermore, survey methods preclude any analysis of precision and variability in the counts. In the absence of a comprehensive count, these counts cannot be used to describe population trends. Information based on Florida manatee population demographic data obtained 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

The best available count of Florida manatees is 3,802 animals, based on a single synoptic survey of warm-water refuges in January 2009 (FWC FWRI Manatee Synoptic Aerial Surveys 2009).

Current Population Trends

Recent demographic analyses indicate that, with the exception of the Southwest management unit, manatee populations are increasing or stable throughout much of Florida. See Table 1. The analyses are based on photo-ID based mark-recapture analyses using a manatee-specific core biological model. Population growth rates reported by Runge *et al.* (2004 and 2007a) are as follows: the Northwest Region 4.0% (95% CI 2.0 to 6.0%), the Upper St. Johns River Region 6.2% (95% CI 3.7 to 8.1%), the Atlantic Coast Region 3.7% (95% CI 1.1 to 5.9%), and the Southwest Region -1.1% (95% CI -5.4 to +2.4%). In three of the four management units, reproductive rates and adult survival rates are cited as positive (Runge *et al.* 2007a, Kendall *et al.* 2004, Langtimm *et al.* 2004, and Koelsch 2001). In southwest Florida, estimates of adult survival and reproduction are less precise than for manatees in other regions of Florida because the data time series is comparatively shorter for this unit and no demographic data is available for manatees in the southernmost part of this region. Craig and Reynolds (2004) additionally suggested that populations of wintering manatees in the Atlantic Coast Region have been increasing at rates of between 4 and 6% per year since 1994. Growth rates for each management unit are current through 2000.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Marine Mammal Protection Act defines net productivity rate as “the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to natural mortality.” Recently published information on Florida manatee population demographics include studies by Runge *et al.* (2004 and 2007a), Craig and Reynolds (2004), Kendall *et al.* (2004), and Langtimm *et al.* (2004). Per Runge *et al.* (2004), the maximum growth rate for Florida manatees (incorporating reproductive and adult survival rates), is 6.2% (95%, CI 3.7 to 8.1%). This rate, reported for the Upper St. Johns River management unit, is identified as R_{\max} inasmuch as it 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).

$$N_{\min} = 3,802$$

$$R_{\max} = 6.2\%$$

$$F_r = 0.1$$

$$PBR = (3,802) (0.031) (0.1) = 11.80 \text{ (or 12)}$$

HUMAN CAUSED MORTALITY AND SERIOUS INJURY

Sources of human caused manatee mortality and injury 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 (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Rommel *et al.* 2007, Lightsey *et al.* 2006, Pitchford *et al.* 2005, Wright *et al.* 1995, Ackerman *et al.* 1995, O'Shea *et al.* 1985, Bonde *et al.* 1983). The Service elected to use data describing the 2003 through 2007 period inasmuch as this data had been verified for completeness and accuracy. (Verifications of the 2008 injury and mortality datasets were incomplete at the time of writing.)

From 1978 through 2007, 6,373 manatee carcasses were salvaged in the southeastern United States. Of these carcasses, 1,877 were of animals that died from human causes. Eighty-two percent of manatees (1,538) that died from human causes were killed by watercraft. Water control structures (including flood gates and navigation locks) killed 182 manatees and the deaths of the remaining 157 manatees were attributed to other human causes (including entanglement in and ingestion of marine debris [including fishing gear], entrapment in pipes and culverts, etc.) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data, 2008c). For the period 2003 – 2007, annual estimated average human-caused mortality was 86.6 or 87 manatees per year (FWC FWRI Manatee Mortality Statistics 2008).

While “serious injury” has been described by the National Marine Fisheries Service “as any injury that will likely result in mortality” (NMFS 2005), the Service has not defined “serious injury.” Absent a definition, the Service receives reports of distressed or injured manatees that may or may not meet the NMFS definition of “serious injury” and responds to these reports through a manatee rescue, rehabilitation, and release program. Responses to reports of distressed or injured manatees can include assisting a superficially injured manatee *in situ* or may involve transporting a more than superficially injured animal to a rehabilitation center for further treatment. It is assumed that animals treated *in situ* have not been seriously injured.

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). Based on these data, primary human-related threats include watercraft-related strikes (direct impact and/or propeller) which cause injury and death (Rommel *et al.* 2007, Lightsey *et al.* 2006), entrapment and/or crushing in water control structures (gates, locks, etc.), and, as previously described, entanglement in fishing gear, and ingestion of marine debris. Natural threats include exposure to cold and red tide. Mortality associated with these natural threats 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.

During the most recent five year period for which data have been verified (2003 – 2007), 1,805 manatee carcasses were salvaged in the southeastern United States. See Table 2. Of these carcasses, 433 were of animals that died from human causes. Based on this, the annual estimated average human-caused mortality is 87 (86.6) manatees per year. Eighty-nine percent of manatees (386) that died from human causes were killed by watercraft. Water control structures (including flood gates and navigation locks) killed 18 manatees and the deaths of the remaining 29 manatees were attributed to other human causes (including entanglement in and ingestion of marine debris [including fishing gear], entrapment in pipes and culverts, etc.) (FWC FWRI Manatee Mortality Statistics 2008).

Fisheries-related Mortality and Injury

Manatees are known to entangle in and/or ingest fishing gear used by both commercial and recreational fisheries. As reported in death 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, and trot lines. 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. Manatees also become entangled in ropes and lines, possibly related to recreational and commercial fisheries (*e.g.*, float lines detached from traps, etc.) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Smith 1998, Nill 1998). 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 (Rommel *et al.* 2007, Lightsey *et al.* 2006, Pitchford *et al.* 2005).

Mortalities

For the most recent five year period (2003 - 2007), at least 10 manatees died due to entanglements in/ingestion of marine debris; six of these deaths were associated with fishing line and/or associated gear, two deaths were attributed to research nets, and two to other sources (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b, Nill 1998, Smith 1998). See Table 3. There were no known sources of commercial fishery gear implicated in these deaths.

Injuries

The Service's manatee rescue, rehabilitation, and release program has rescued injured or distressed manatees since 1973. From 2003 to 2007, there were 80 rescues associated with fishing gear and other sources of marine debris. Thirty-five of these were related to crab trap entanglements, 15 to fishing line and/or associated gear, and 5 were due to net entanglements. Nine of the 35 crab trap-related rescues required treatment at rehabilitation centers and the remaining 26 were resolved in the field (USFWS Jacksonville Field Office, unpub. data 2008b). See Table 4. Crab trap- related rescues likely involve gear from both commercial and recreational fishers, who use the same type of gear.

Commercial Fishing Gear-related Interactions

The majority of known fishing gear interactions have occurred in Florida waters (280 of 290 known deaths and rescues, including interactions that occurred before 1978). Prior to 1995, when the State of Florida adopted a statewide, in-shore net ban, manatees were known to entangle in a variety of fishing gear used by commercial fishers, including blue crab fishery gear. Subsequent to 1995, entanglements in non-blue crab fishery gear used by commercial fishers are virtually unknown, both in the State of Florida and elsewhere (there is a single record of a manatee being rescued from commercial fishing gear in 1997 in Georgia, when a manatee was rescued from an inshore bait shrimp trawl) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Nill 1998, Smith 1998). However, blue crab fishery gear entanglements continue in Florida. From 2003 to 2007, no manatee deaths and 35 rescues are attributable to the blue crab fisheries.

Given greater fishing effort by commercial blue crab fishers in contrast to blue crab fishing efforts by recreational fishers (which suggests more commercial fishing gear in the water than recreational gear in the water), it's thought that a majority of manatee entanglements in blue crab fishing gear should be attributed to the commercial blue crab fisheries. In the past, efforts to distinguish between animals entangled in commercial blue crab trap gear versus recreational blue crab trap gear were hindered by a lack of gear data collection protocols for rescuers and salvagers and state gear identification requirements were not necessarily adequate to identify gear ownership. Protocols have subsequently been modified, as have state regulations requiring better identification of gear owners, and the attribution of entangling gear to its source has significantly improved.

Two commercial blue crab fisheries identified in NMFS' "2009 List of Fisheries" (73 FR 73032; December 1, 2008) known to entangle Florida manatees include:

Atlantic blue crab trap/pot fishery

The Category II Atlantic blue crab trap/pot fishery targets blue crabs using pots baited with fish or poultry typically set in rows in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. The fishery occurs year round and involves more than 16,000 vessels/persons. Twenty-seven percent of Florida's 2006 blue crab landings came from Florida's Atlantic Coast Region, within the operational area of the Atlantic blue crab trap/pot fishery (FWC FWRI 2007).

Gulf of Mexico blue crab trap/pot fishery

The Category III Gulf of Mexico blue crab trap/pot fishery targets blue crabs using pots baited with fish or poultry typically set in rows in shallow water. The pot position is marked by either a floating or sinking buoy line attached to a surface buoy. The fishery occurs year round and involves more than 4,113 vessels/persons. Seventy-three percent of Florida's 2006 blue crab landings came from Florida's Gulf

Coast Region, within the operational area of the Gulf of Mexico blue crab trap/pot fishery (FWC FWRI 2007).

Fifty-five percent of known Florida manatee-crab fishery interactions occurring between 2003 and 2007 were documented within the area of the Gulf of Mexico blue crab trap/pot fishery. The majority of these interactions occurred in southwest Florida, with most occurring in Lee County (seven rescues occurred in this county alone) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b). Within the area of the Atlantic blue crab trap/pot fishery, most interactions occurred in east central Florida (Brevard County) (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b).

The NMFS' "2009 List of Fisheries" (73 FR 73032; December 1, 2008) also identifies the Category III "Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery" as a fishery known to take Florida manatees.

Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery

The Category III Southeastern U.S. Atlantic/Gulf of Mexico shrimp trawl fishery targets a variety of pelagic shrimp species (brown, pink, white, rock, etc.) by means of a large trawl net towed behind a single shrimp trawler. Nets, held open by paired doors, are towed on coastal bottoms for varying lengths of time. This fishery occurs year round and involves more than 18,000 vessels/persons. Shrimp trawling occurs along Florida's Atlantic and Gulf coasts, well outside of Florida shoreline areas regulated pursuant to Florida net ban regulations.

From 2003 to 2007, no manatee deaths or injuries attributable to this fishery have been reported from the Atlantic and Gulf coasts in the southeastern U.S. Furthermore, this commercial fishery is not known to have taken any manatees since 1987, when the last confirmed report of a manatee captured and drowned in this fishery was recorded. (Three unconfirmed deaths were documented in 1990. Necropsy findings and/or circumstances associated with these cases suggested that an inshore bait shrimp fishery may have been responsible for the deaths but definitive information was lacking. A manatee that died in a shrimp trawl in 1997 was captured by a research trawler investigating excluder devices; the researchers used a shrimp trawl, identical to those used by commercial fishers, but they were not engaged in commercial fishing operations.)

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, manatees are considered by default to be a "strategic stock" and "depleted" under the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq.*).

The recent threats assessment (Runge *et al* 2007b) states 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." The threats assessment describes mortality associated with fisheries interactions and red tides as "noticeable" and, when compared to other anthropogenic threats, is thought to have less of an impact on the persistence of the manatee population (Runge *et al* 2007b).

The Service and its recovery partners have taken significant steps to reduce the number of human caused manatee mortalities and injuries. To address the threat of watercraft collisions, the most significant source of human-caused mortality and injury, the Service and FWC have adopted manatee protection areas (Federal manatee refuges and sanctuaries and State manatee protection zones) in areas of high manatee use and potential watercraft conflict. Water control structures have been retrofitted with devices that eliminate crushings and many culverts and pipes have been grated to prevent manatee entrapment.

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

injuries are minimized as a result of this activity (FWC FWRI Manatee Mortality Statistics 2008, USFWS Jacksonville Field Office, unpub. data 2008b and 2008c, Nill 1998, Smith 1998). 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 *et al.* 2003 and Bowles 2000). 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).

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 very small and has a comparatively lesser impact on the persistence of the Florida manatee population. The number of lethal and live takes of manatees in blue crab trap/pot fishery gear during the past year (no lethal takes and nine live takings) is well below the calculated PBR level of 12 takings. Over the past five years, there have been no lethal takings of manatees in the blue crab fishery and a total of 35 non-lethal takings of crab fishery gear-entangled manatees (rescued by the manatee rescue and rehabilitation program), an average of 6.8 takes per year. Similarly, there are no known lethal or non-lethal takes of manatees in the shrimp trawl fishery for this period. Therefore, the annual estimated level of incidental mortality and serious injury due to the shrimp trawl fishery is zero. Given the largely non-lethal effect of these takings, total commercial fishery mortality and serious injury for this stock is less than the calculated PBR and, therefore, can be considered insignificant and approaching a zero mortality and serious injury rate.

Inasmuch as an optimal sustainable population (OSP) level has not been identified for the Florida manatee, we do not know what this stock’s status is in relation to OSP. In the face of existing threats, “the Florida manatee population is exhibiting positive growth, good reproductive rates, and high adult survival throughout most of the state” (USFWS 2007).

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Figure 1. Florida manatee distribution within the four designated regional management units. USFWS (2001).

Table 1. Demographic indicators for Florida manatees by management unit.

Management Unit	Population Growth Rate (per year)	Minimum Population Size	Annual Conditional Reproductive Rate	Adult Survival Rates	Comments
Northwest	4.0% (95% CI 2.0 to 6.0%) 1986 – 2000 (Runge <i>et al.</i> 2007a)	377 (FWC Manatee Synoptic Aerial Surveys 2009)	0.43 (95% CI 0.22 – 0.54) 1982 – 1999 (Kendall <i>et al.</i> 2004)	0.959 SE 0.006 1986 – 2000 (Runge <i>et al.</i> 2007a)	The number of manatees throughout the region, including Crystal River and Kings Bay, has been increasing since the 1960s. A recent high count of 274 manatees was documented in 2005 (Kleen, <i>pers. comm.</i> 2006).
Upper St. Johns River	6.2% (95% CI 3.7 to 8.1%) 1990 – 1999 (Runge <i>et al.</i> 2004)	112 (FWC Manatee Synoptic Aerial Surveys 2009)	0.61 (95% CI 0.51 – 0.71) 1980 – 2000 (Runge <i>et al.</i> 2004)	0.960 SE 0.011 1990 – 1999 (Langtimm <i>et al.</i> 2004)	The number of manatees using Blue Spring has increased significantly. A recent high count of manatees (182) was documented during the 2005 – 2006 winter season (Hartley, <i>pers. comm.</i> 2006). At this site, survival of 1 st year calves was estimated at 0.810 (0.727 – 0.873) and 2 nd year calves at 0.915 (0.827-0.960) (Langtimm <i>et al.</i> 2004).
Atlantic Coast	3.7% (95% CI 1.1 to 5.9%) 1986 – 2000 (Runge <i>et al.</i> 2007a)	1447 (FWC Manatee Synoptic Aerial Surveys 2009)	0.38 (95% CI 0.29 – 0.47) 1982 – 1999 (Kendall <i>et al.</i> 2004)	0.963 SE 0.010 1986 – 2000 (Runge <i>et al.</i> 2007a)	In contrast to FWC’s estimate, Craig and Reynolds (2004) estimated the population size of animals using Atlantic Coast power plants in 2001 at 1606 (Bayesian credible interval: 1353 – 1972) They also identified trends in corrected aerial counts: 1982-1989, 5 to 7%;1990-1993, 0 to 4%; and, since 1994: 4 to 6%.
Southwest¹	-1.1% (95% CI -5.4 to +2.4%) 1995 – 2000 (Runge <i>et al.</i> 2004)	1364 (FWC Manatee Synoptic Aerial Surveys 2009)	0.60 (95% CI 0.42 – 0.75) 1993 – 1997 (Koelsch 2001)	0.908 SE 0.019 1995 – 2000 (Langtimm <i>et al.</i> 2004)	Estimated conditional, annual reproductive rate based on warm weather data from Sarasota Bay only, may not be representative of other regions.

¹Parameter estimates for the Southwest have broader confidence intervals than those for the other management units. This is due to a number of factors, including: fewer years of photo-identification monitoring data, turbid water making photography difficult, and warmer weather in the south reducing the number of cold days when manatees are available for photography. Nonetheless, the current parameter estimates are the first published for this region and therefore reflect the best available information. More reliable information is expected for this management unit as geographic coverage, sample size, and years of study increase over time.

Table 2. All manatee deaths (number of deaths, percent of annual total), 2003-2007. (Source: FWC FWRI Manatee Mortality Statistics 2008)

Year	Human-caused Mortality	Perinatal	Cold Stress	Other ²	Total
2003	85 (22%)	72 (19%)	48 (13%)	178 (46%)	383
2004	76 (27%)	72 (26%)	52 (18%)	82 (29%)	282
2005	94 (24%)	89 (22%)	29 (7%)	186 (47%)	398
2006	96 (23%)	70 (17%)	21 (5%)	233 (55%)	420
2007	82 (25%)	59 (18%)	19 (6%)	162 (50%)	322
TOTAL	433 (24%)	362 (20%)	169 (9%)	841 (47%)	1805
5-Year Avg.	86.6	72.4	33.8	168.2	361

¹Numbers include reported, dead manatees that were salvaged and confirmed/verified carcasses that were not salvaged (included in "Other").

²Includes known and/or suspected red tide deaths, including 96 in 2003, 92 in 2005, 62 in 2006, and 38 in 2007.

Table 3. Manatee mortality due to marine debris, 2003-2007. (Source: FWC FWRI Manatee Mortality Statistics 2008)

Year	Crab trap(s) and associated gear	Net(s) and associated gear	Fishing line, tackle, and associated gear	Rope and miscellaneous marine debris	Total no. of deaths
2003		1	1	1	3
2004			1		1
2005					0
2006			3		3
2007		1	1	1	3
TOTAL	0	2	6	2	10
5-Year Avg.	0.00	0.40	1.20	0.40	2.00

Note: numbers only include reported dead manatees that were salvaged. Numbers do not include reported, dead manatees that were not salvaged.

Table 4. Manatee rescue, rehabilitation, and release, 2003-2007. (Source: USFWS Jacksonville Field Office, unpub. data 2008b)

Year	Crab trap(s) and associated gear		Net(s) and associated gear		Fishing line, tackle, and associated gear		Rope and miscellaneous marine debris		Total no. of rescues
	Rescues	Assist and Releases	Rescues	Assist and Releases	Rescues	Assist and Releases	Rescues	Assist and Releases	
2003	3	5			1	3	3	1	16
2004	4	4	1		1	4	1	1	16
2005	1	4				3	3	2	13
2006		5		2		3		5	15
2007	1	8		2		1	1	7	20
TOTAL	9	26	1	4	2	14	8	16	80
5-Year Avg.	1.80	5.20	0.20	0.80	0.40	2.80	1.60	3.20	16.00

Note: numbers only include reported, distressed manatees that were either rescued or assisted and released. Numbers do not include reported, distressed manatees that were not rescued.

WEST INDIAN MANATEE (*Trichechus manatus*)
PUERTO RICO STOCK
(Antillean subspecies, Trichechus manatus manatus)

U.S. Fish and Wildlife Service, Caribbean Field Office, Boquerón, Puerto Rico

STOCK DEFINITION AND GEOGRAPHIC RANGE

Manatees belong to the Order Sirenia with two known families. Family Dugongidae is represented by the extant genera *Dugong* that is found in the Indo-Pacific region and the extinct genera *Hydromalis* the only member of the order adapted to cold water. Family Trichechidae is represented by one genus *Trichechus* and three species: *T. senegalensis*, the West African manatee, *T. inunguis*, the Amazonian manatee, and *T. manatus*, the West Indian manatee. The West Indian manatee is distributed in Caribbean coastal areas and river systems from Virginia, USA to Espiritu Santo, Brazil (Shoshani 2005).

Hatt (1934) recognized two *T. manatus* subspecies: the Antillean manatee (*Trichechus manatus manatus*) and the Florida manatee (*Trichechus manatus latirostris*). Domning and Hayek (1986) tentatively divided the West Indian manatee into the Florida manatee *T. m. latirostris* and the Antillean manatee *T. m. manatus* based on cranial characters. They suggested that such subspeciation may 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.

García-Rodríguez *et al.* (1998) compared mitochondrial DNA (mtDNA) from eight locations of *T. manatus* and found that despite the sharing of sixteen haplotypes (a segment of DNA containing closely linked gene variations that are inherited as a unit) among these locations, there was a strong geographic structuring of mtDNA diversity in three sites: Florida and the West Indies, the Gulf of Mexico to the Caribbean rivers of South America, and the northeast Atlantic coast of South America; units which are not concordant with the previous sub-species designations. Vianna *et al.* (2005) studied 291 samples mtDNA from the four Sirenia species, including samples of *T. manatus* from 10 countries. Colombia has the highest diversity of haplotypes with eight, while Puerto Rico has three haplotypes and the Dominican Republic only has two. Although Puerto Rico and the Dominican Republic share haplotype A with Florida, Vianna *et al.* (2005) found a high differentiation between the manatees in Florida, and the manatees in the Dominican Republic and Puerto Rico.

Slone *et al.* 2006 indicates that haplotype (mitochondrial DNA) distribution is further geographically divided in Puerto Rico. For example, only the A haplotype (haplotype also unique to Florida) was found along the north of the island and B haplotype was observed from the south shore. The authors found a mixture of A and B haplotype located along the eastern and western ends of the island, suggesting mixing between the south and north groups. Furthermore, the mitochondrial DNA is maternally inherited and is not reflective of the additional gene flow from males. Radio-tagging techniques in Puerto Rico have documented general behavior of manatee populations, in which males seem to move more extensively than females (Slone *et al.* 2006). Males may travel hundreds of kilometers while mother/calf distribution patterns could be more restricted. The authors state that if male movements are made during the breeding season, then relatively healthy mixing between geographical areas established by females might be expected. Further research by Kellogg (2008) indicates that nuclear DNA subpopulation separation was not as severe, suggesting that the manatees in Puerto Rico do travel and breed throughout the population to some degree.

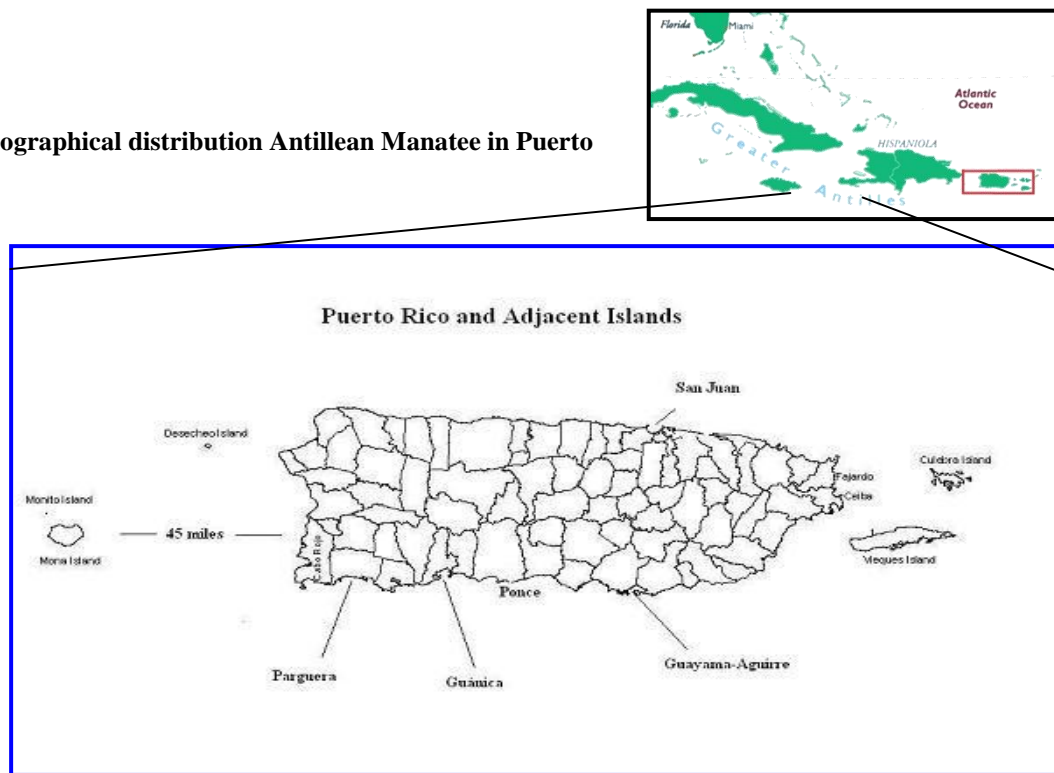
The Antillean manatee is found in eastern Mexico and Central America, northern and eastern South America, and in the Greater Antilles (Lefebvre *et al.* 1989). It inhabits riverine and coastal systems in the subtropical Western Atlantic Coastal Zone from the Bahamas to Brazil, including the Gulf of Mexico. The distribution of the Antillean manatee extends eastward only to Puerto Rico, except for one 1988 report in St. Thomas, U.S. Virgin Islands; however, transient animals are known to occur in the Lesser Antilles (Lefebvre *et al.* 2001).

Genetically, the Puerto Rico population is isolated from the Florida manatee and has an additional haplotype when compared to the Dominican Republic. Antillean manatees occur around Hispaniola. While only a 90-mile stretch separates the two islands, manatee sightings have only occurred in areas close to the coast in Puerto Rico. The prevailing winds and currents are mostly from the northeast. This possibly creates a barrier to regular migration. Mona Island is located mid-way between Hispaniola and Puerto Rico. Extensive studies of Taino Indian archeological evidence did not reveal manatee bones, suggesting that manatees were not readily available as a food item here. Additionally, threats by commercial and artisanal fisheries and conservation efforts are different between islands. For these reasons, we have made a determination to treat the Puerto Rico population of the Antillean manatee as a separate stock.

Powell *et al.* (1981) describes the manatee population in Puerto Rico as small and widely distributed. Rathbun *et al.* (1985) states that the population of manatees in Puerto Rico was not even and that distribution did not vary from 1976-78, when Powell conducted his studies. All studies suggest that manatees in Puerto Rico are most often detected in protected areas around cays, in secluded bays and shallow seagrass beds east of San Juan, the east, south, and southwest coasts, and not far from fresh water sources. The manatees are most consistently detected in two areas: Jobos Bay area between Guayama and Salinas, Fajardo and Roosevelt Roads Naval Station, Ceiba (Powell *et al.* 1981; Rathbun *et al.* 1985; Freeman and Quintero 1990; Mignucci-Giannoni *et al.* 2004; US Fish and Wildlife Service 2007, USFWS unpublished data 2007). Manatees are not abundant on the north coast, although they are seen in areas immediately to the west of San Juan (Powell *et al.* 1981; Mignucci-Giannoni 1989).

Five offshore islands are the most significant biogeographic features in Puerto Rico: (west to east) are Desecheo, Mona, Caja de Muertos, Culebra, and Vieques islands (Figure 1). Manatees have not been detected in the first three. Manatees have not been seen in the Mona Passage or Mona Island, 45 miles west of Puerto Rico. This passage may constitute a migratory barrier to the area since it is permeated by a strong east to west current and high surfs. Although there is available habitat in Caja de Muertos Island, manatees have not been detected by any of the authors suggesting they prefer available habitat closer to the coast. The island lacks fresh water, and easterly strong currents and high surf are prevalent between Caja de Muertos and the south coast of Puerto Rico that may hinder traveling to this island. Vieques Island seems to be within the range of the species (14 miles) and manatees have been seen traveling to and from the east coast (Magor 1979). This suggests that the manatees in Vieques may be a subset of the east coast populations as increased numbers were detected from the east coast and there were often decreased detection around Vieques and vice versa. Manatees have been reported irregularly in Culebra Island through the years; the individuals usually staying only for a couple of weeks. In 2006, a 5-foot manatee was photographed close to Tamarindo Beach on the east side of Culebra (Teresa Tallevast 2006 pers. com.). Although Culebra Island has available habitat, it lacks fresh water, which may hinder longer stays by manatees. The U.S. has jurisdictional responsibilities for the Antillean subspecies only in Puerto Rico and the U.S. Virgin Islands.

Figure 1. Geographical distribution Antillean Manatee in Puerto Rico



POPULATION SIZE

Barrett (1935) suggests that in pre-columbian times manatees in Puerto Rico were so plentiful along the coast, swamps, and bayous that the Spaniards gave the Arawak name Manatí to a locality. He noticed that when he visited the island that silting-up of the waters behind the town of Manatí drove the manatees out to sea. Evermann (1900) describes the manatee in Puerto Rico as rare. Erdmann (1970) describes that manatees were rare around Puerto Rico and absent from the Virgin Islands. In the absence of replicable population estimates, it is unclear if population size was greater in the past than today. Manatees are seen in groups of up to 8 individuals but never in large aggregations. With 350 miles of coastline and fresh water readily available, manatees appear to exploit most protected nearshore shallow bays and coves and move between sites. This makes them more difficult to detect from shore or during

surveys.

Minimum Population Estimate

Deutsch *et al.* (2007) estimated the population levels of mature Antillean manatees at 2,600 in all of the 41 countries of the wider Caribbean but, optimistic ‘estimates’ from researchers and peers suggests the it may actually be in the range of 5,600 individuals. Deutsch *et al.* (2007) describes the population size in Puerto Rico at a minimum of 128 with a projected population estimate of 300. The exact number of Antillean manatees known to occur in Puerto Rico is unknown. Aerial surveys have been used to obtain distribution patterns or determine minimum population counts in some areas (Magor 1979, Rice 1990, and Mignucci-Giannoni *et al.* 2003, 2004) or throughout the island (Powell *et al.* 1981; Freeman and Quintero 1990; Rathbun *et al.* 1985; USFWS 2007 unpublished data). Each survey was different, with surveys conducted several months in various years, surveys every month for a year, and surveys of unequal number of months for 12 years. In spite of the high variability between and within surveys, the data can be used to determine the highest number of manatees sighted within a time period (one island survey).

Powell *et al.* (1981) detected an average of 22.6 manatees during ten surveys with the highest count of 51. They found that manatee population in Puerto Rico appears to be small and widely distributed. Rathbun *et al.* (1985) determined that manatees sighted per survey averaged 43.6 (S.D. = 13.1) with a minimum count of 20 and a maximum of 62, higher than previously reported. The Service conducted 23 aerial surveys from 1991 to 2002 and one survey in 2009. The average number of manatees sighted was 67 (S.D. = 20) per survey, with a high of 117, a low of 22. The average number of adults was 63.40 per survey and calf numbers averaged 4.72 per survey. The 2009 survey counted a total of 72 manatees, including 64 adults and eight calves. We have determined 72 is the most current minimum population estimate for the Puerto Rico stock of the Antillean manatee.

Current Population Trends

Quantitative information is limited regarding trends in the abundance of the Antillean manatee in Puerto Rico and the U.S. Virgin Islands. In Puerto Rico, Deutsch *et al.* (2007) describes the manatee as stable. USFWS (2007) also suggests that the Puerto Rico population of the West Indian manatees is at least stable and possibly slightly increasing due to increasing numbers detected in annual surveys. Plotted data from all surveys through time suggest an increase in detection in spite of differences in observer experience (Figure 2). Detection conditions varied between surveys and within surveyed areas mostly due to heterogeneous habitats. However, since mass mortality and numbers of stranded/dead manatees have not exceeded 13 per year (Mignucci-Giannoni 2006, DNER 2009 unpublished data), high variability between surveys may be related to detection rather than actual numbers of manatees.

The mean number of manatees per survey increased from 22.6 manatees (Powell *et al.* 1981) to 43.6 manatees per survey (Rathbun *et al.* 1985). From 1994 to 2009, surveys produced a mean of 68.12 manatees per survey. The proportion of calves detected per survey was about the same with 6.4% in 1979-1980 (Powell *et al.* 1981), 7.6% in 1984-1985 (Rathbun *et al.* 1985), and 6.9% in 1991–2009. In 2009, seven years since the 2002 survey, one synoptic survey detected a total of 72 manatees sighted, eight of which were calves; this figure is closer to the average detection levels of previous surveys. Although the average manatee sighted per survey has increased by about 40% since 1985, the average number of manatees per surveys has been maintained relatively stable since 1991.

Synoptic Aerial Surveys of Puerto Rico Stock Antillean Manatee

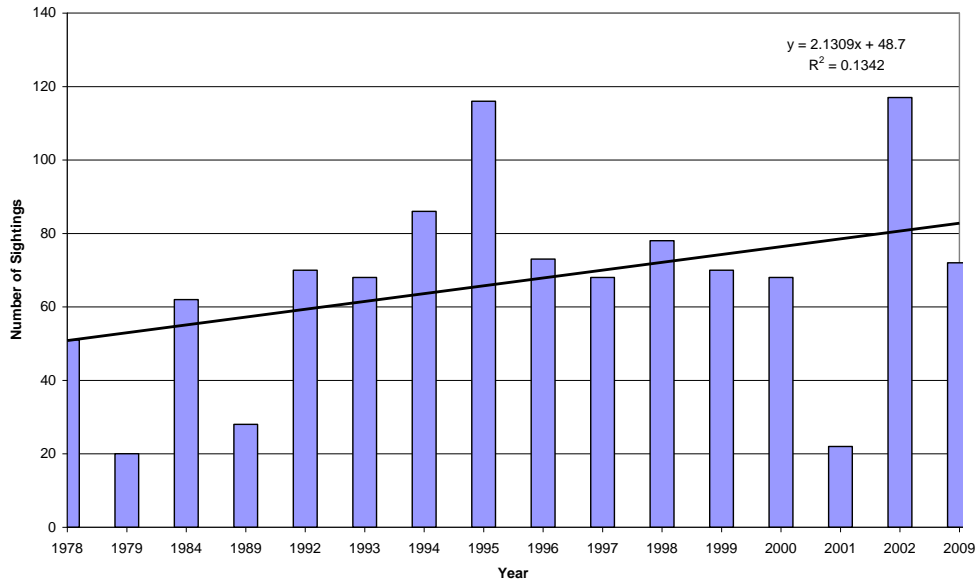


Figure 2. Synoptic Aerial Surveys Puerto Rico Stock of Antillean Manatee

Efforts to quantify population levels and trends are ongoing as part of a cooperative agreement between North Carolina State University, Puerto Rico’s Department of Natural and Environmental Resources (DNER), and the U.S. Fish and Wildlife Service, Caribbean Field Office. The cooperators will conduct aerial surveys and develop a statistically robust population model incorporating factors such as detection probability of manatees in heterogeneous habitats.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

The Marine Mammal Protection Act (MMPA) defines net productivity rate as “the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to natural mortality.” Since 1994 to 2009, an average of 63.22 adults and 4.96 calves has been reported from synoptic surveys. Mignucci-Giannoni (2006) reports that 23.9% of all mortality detected were those of dependent calves. For instance, in 2002, aerial surveys detected 6 calves, while mortality records only show 1 dependent calf. At present, we do not have clear data on recruitment; however, based on previously reported data, the mortality rates of dependent calves from natural causes remains the same. Similarly, the natural death for all ages remains at about 43%. The number of calves detected per year has not changed dramatically and they usually are in concordance to the total number of sightings. However, in the absence of a statistical value on net productivity rates we have followed the recommendation of using a 0.04 value for manatees and cetaceans (NMFS 2005).

POTENTIAL BIOLOGICAL REMOVAL

The West Indian manatee is federally listed as endangered. The Service has recent survey data, which indicate the Puerto Rico stock of the West Indian (Antillean manatee) is relatively stable.

The potential biological removal (PBR) formula was developed during the 1994 amendments to the MMPA as a tool to reduce incidental commercial fisheries-related marine mammal mortalities and serious injuries to insignificant levels. 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).

The recovery factor for the Puerto Rico stock of the Antillean manatee should be between 0.1 and 0.5. Though the population is stable, the default value of 0.1 is used due to the small size of the population and the current endangered status. Given a minimum population estimate of 72 and an R_{max} of 0.04 (because it is unknown) the PBR for Puerto Rico stock of the Antillean manatees is as follows:

$$\text{PBR} = (N_{\min}) (\frac{1}{2} \text{ of } R_{\max}) (F_r)$$

$$N_{\min} = 72$$

$$R_{\max} = 4.0\%$$

$$F_r = 0.1$$

$$\text{PBR} = (72) (0.02) (0.1) = 0.144 \text{ (or 0)}$$

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Rescues

From 1990 to 2005 a total of 23 manatees were rescued by the Caribbean Stranding Network (CSN) (Mignucci-Giannoni 2006). Of these, 21 were calves; one was a sub-adult and one an adult. Two were rehabilitated and released, two were released immediately after rescue, 17 died in rehabilitation, and one died in transport, and one is currently in rehabilitation. Of the four manatees that were released, only one has died; one year after its release. Since 2005, only two manatees were rescued, one adult died in transport and a calf was in rehabilitation at the Juan A. Rivero Zoo in Mayaguez for almost a year. This manatee died in July 2009 due to an intestinal infection. An average of 1.4 calves is rescued every year, but most have died due to illness (Mignucci-Giannoni 2006; DNER 2009 unpublished data).

Mortality

Carcass salvage efforts were initiated in April 1974 by the Service and local entities and continued through 1989. The CSN then initiated a dedicated salvage, rescue, and rehabilitation program, assuming responsibility for all carcass recovery efforts in Puerto Rico. Currently, carcass salvage efforts are performed by DNER. From 1990 through 2008, a total 130 manatees have been found dead (Mignucci-Giannoni 2006; DNER 2009 unpublished data).

There is no record in Puerto Rico of serious injury to manatees by propellers, except the mortality of a mating herd impacted by a big vessel in 2006. In Puerto Rico, single Antillean manatee strandings are the rule. Only one multi-individual manatee death was recorded in 2006 when 5 adult individuals, 4 males and one female, were impacted by a big vessel in San Juan Bay. Unlike Florida, mass mortality does not occur in Puerto Rico since the etiological cause, red tide, or need for warm water habitats do not present an issue to a coastal tropical marine species. Moreover, except for mating herds, manatee groups detected during aerial surveys are small, mostly single sightings or 2-3 individuals (e.g., mother, year calf, and immature adult).

Year	Natural		Human	Undetermined	Total
	Dependent Calves/Perinatal	Illness	Watercraft		
2004	2	1		5	8
2005	4	1	2	1	8
2006	2	3	5	2	12
2007	2	1		2	5
2008	1	1	2	4	8
Totals	11 (27%)	7 (17%)	9 (22%)	14 (34%)	41
5-Year Avg.	2.2	1.4	1.8	2.8	8.2

Table 1. Manatee mortality from 2004 to 2008. (Mignucci-Giannoni 2006. Data 2000-2005; DNER 2009. Data 2006-2008)

During the 2004-2008 period a total of 41 manatees were reported dead (Table 1). Natural Causes comprised most of reported cases 18 (44%) while watercraft related death were 9 (22%). In most cases, manatees are killed by a blunt trauma to the head, which produces an internal hemorrhage and subsequent death. In 2006, an unusual manatee death was reported when a mating herd was impacted by the propellers of a big vessel. Other than this event, necropsies did not report propeller marks like in Florida. The cause of death in most of cases, i.e., 14, was deemed as Undetermined (34%). The Undetermined cause of death (COD) category means that assessment of a

natural or human related cause was negative (no evidence that COD can be assigned to any of the available categories, either natural or human related).

In most cases, the reporting of a stranded manatee takes days. Warm water and remote locations of stranding may hinder recovery of manatee carcasses, making it difficult to conduct a timely determination of mortality. The DNER's Marine Mammal Stranding Program has developed a protocol to report and quickly act on marine mammal strandings, mostly manatees. This program is institutionalized and first responders are usually DNER rangers that have the mandate and capacity to quickly act to increase detection and prevent death of animals. Because of this system, the number of strandings currently reported by DNER may help to provide a better estimate of manatee mortality in Puerto Rico. We will continue to support their efforts to determine if this mortality trend continues and what relationship it has to other population parameters.

Until the mid 1980's, some coastal families captured manatees for special events. Manatees were captured in gill and/or turtle nets purposely or inadvertently during fishing activities. Mignucci-Giannoni *et al.*, (1993) indicates that from 1974 until 1988, 41.5 percent of the documented mortality was attributed to poaching. He indicated that meat was sold to ready buyers, although the extent to which this occurred was unknown. After the rescue of a baby manatee in 1991, and subsequent media uproar because its mother was poached, capture by fisherman has been virtually eliminated.

Fisheries

The fisheries in the U.S. Caribbean are multi-species, multi-gear, artisanal in nature, and principally coral reef-based (NOAA 2004). Boats used are wooden or fiberglass, 17-21 feet long. Traps are the most common used gear but line is almost as common now. Traps are deployed in the shallow nearshore zone around coral reefs in algal plains, sand, and seagrass beds but, not on top of corals at depths ranging from 20-62 meters. Among fishers, 68% use buoys to mark the trap line and 32% use none at all. Matos-Caraballo (2004) reported that, of interviewed commercial fishers, 36% were full time and 64% part time fishers. A total of 17% fished in the shore, 83% on the continental shelf. Within gears, 5% use beach seines, 36% gillnets, 14% trammel, and 45% used cast nets.

Seventeen species of marine mammals have been described from Puerto Rican and U.S. and British Virgin Island waters (Mignucci-Giannoni 1989). However, NOAA (2004), reports that the commercial and recreational fisheries under jurisdiction of the Caribbean Council are listed as Category III fisheries, the category with the lowest level of serious injury and mortality to marine mammals. The two Category III commercial fisheries that have been identified in NMFS' "2009 List of Fisheries" (73 FR 73032; December 1, 2008) as known to take Antillean manatees are the Caribbean gillnet, which involves more than 991 vessels/persons and the Caribbean haul/beach seine fishery, which involves 15 vessels/persons. However, neither the DNER nor the Service has data to support that there is take by these commercial/artisanal fisheries, including entanglement with fishing gear, collisions with fishing vessels, and bycatch.

In the past, the carcass recovery program described few fisheries interaction incidents with manatees and several reports were anecdotal. Nets have been banned altogether in the U.S. Virgin Islands except for shallow small nets for bait fish. In Puerto Rico Regulation 678 of the 2004 Fisheries Law have prohibited some types of nets and limit the deployment and size of others. All haul/beach seine nets have been prohibited in Puerto Rico. Gill and trammel nets have been prohibited from use in river mouths, rivers and lagoons (DNER 2004). Mesh size should not be less than 2 inches or more than 6 inches when stretched. This measure, although targeted to prevent sea turtle poaching, may further prevent the accidental entanglement of manatees. Commonwealth, NMFS and Service law enforcement measures currently in place are curtailing turtle poaching with a positive effect to manatees. We believe that fisheries interactions, either intentional or accidental, may not significantly affect the status of the Puerto Rico stock of the Antillean manatee. We acknowledge that there may be limits to the data available because, although unlikely, it is possible take could occur and may not be observed or reported. However, protocols for necropsies and assigning probable cause of death categories are reviewed thoroughly. Table 1 of this SAR shows watercraft as the only human related deaths. The only possible evidence for commercial fisheries interaction would be within the 34% undetermined COD category. In addition, we believe that manatees injured by commercial fisheries interactions would most likely present signs of the activity and every necropsy includes a specific evaluation of human interactions. From 1990-2008, only one manatee had a COD potentially related to commercial fisheries interaction. In 2006, one freshly dead manatee was found with its right flipper entangled in monofilament; however the COD was undetermined. In accordance with the previous statements and the presence of current bans and restrictions in place prohibiting the use of nets, the Service believes that incidental mortality and serious injury related to commercial fisheries in Puerto Rico and the U.S. Virgin Islands should be considered minimal or approaching zero.

STATUS OF STOCK

The West Indian manatee is listed as endangered under provisions of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended and a Recovery Plan developed in 1986 for the Puerto Rico population of the Antillean subspecies (USFWS 1986). As an endangered species, the Puerto Rico stock of Antillean manatees is

considered a strategic stock and depleted as defined in Section 3(19) of the Marine Mammal Protection Act of 1972, as amended.

We currently do not have sufficient information on the Puerto Rican manatee population to determine the Optimum Sustainable Population (OSP). The Antillean manatee is not impacted by cold spells and red tide like Florida manatees and it is mostly a coastal species. This precludes the use of Florida data on survival rates and reproduction to reach an OSP.

The main threats to the species in Puerto Rico are watercraft collisions and habitat degradation (e.g., marine construction activities, propeller scarring on sea grass beds, impacts on sea grass beds related to anchoring, oil spills, and availability of fresh water sources). A number of mechanisms are in place to lessen the impact of these factors. There is a strong outreach and education effort and a gill net prohibition in place. Most development activities within the water are reviewed by the Corps of Engineers and the Service based on provisions in the Endangered Species Act and the Marine Mammal Protection Act. Therefore, the U.S. Fish and Wildlife Service, when engaged in consultation under the ESA related to manatees, will provide recommendations to consulting agencies to avoid a take.

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