Stock Assessment Report

WEST INDIAN MANATEE (*Trichechus manatus*)

PUERTO RICO STOCK
(Antillean subspecies, *Trichechus manatus manatus*)

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

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).

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).

Previous studies in Puerto Rico suggest that manatees favor habitats that are protected from severe wave action, harbor submerged aquatic vegetation, and have some source of fresh water (Powell *et al*. 1981, Rathbun *et al*. 1985, Mignucci-Giannoni 1989). Manatees are sighted more frequently in protected coastal areas having any three of the above characteristics.

Aerial surveys have shown that manatees are consistently detected more on the eastern and southern coast than on the northern coast of the main island. Manatees are found from Dorado to Fajardo along the north coast, from Fajardo to Yabucoa on the east coast, from Patillas to Cabo Rojo on the south coast, and from Cabo Rojo to Mayagüez on the west coast (UNEP 2010)(Figure 1). Relatively higher concentrations of manatees are found in four areas: Ceiba on the east coast, Jobos Bay area between Guayama and Salinas on the southeast coast, Guayanilla and Guánica Bay area on the southwest coast, and between Cabo Rojo and Mayagüez (Guanajibo River mouth) in the west coast (Powell *et al.* 1981, Rathbun *et al.* 1985, Freeman and Quintero 1990, Mignucci-Giannoni *et al.* 2004, USFWS 2007, USFWS unpublished data).

Five offshore islands are significant biogeographic features in Puerto Rico: (west to east) Desecheo, Mona, Caja de Muertos, Culebra, and Vieques islands (Figure 1). Manatees do not use the western offshore islands of Mona and Desecheo. Mona Passage constitutes a migratory barrier to these islands since it is characterized by strong currents and high surf. There have been few sightings in Caja de Muertos and Culebra Island. In contrast, Vieques Island is within the range of the species, and manatees have been seen traveling to and from the east coast (Magor 1979).

García-Rodríguez *et al.* (1998) compared manatee mitochondrial DNA (mtDNA) from eight locations and found that, despite the sharing of sixteen haplotypes among these locations, there was a strong geographic structuring of mtDNA diversity into three clusters: 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.* (2006) studied 291 of mtDNA samples from *T. manatus* from 10 countries. Colombia had the highest diversity of haplotypes with eight, while Puerto Rico had three haplotypes and the Dominican Republic only had two. Although Puerto Rico and the Dominican Republic share haplotype A with Florida, Vianna *et al.* (2006) found a high differentiation between the manatees in Florida, and those in the Dominican Republic and Puerto Rico. Differentiation between the manatees in Florida and Puerto Rico is further supported by the recent findings in Hunter *et al*. 2012.

Slone *et al*. (2006) indicated that mtDNA haplotype distribution was further geographically divided in Puerto Rico. For example, only the A haplotype 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 haplotypes at 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. Additional research by Kellogg (2008)

indicated 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. 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.

Based on the above, the Puerto Rico and Florida population are identified as separate stocks. The Puerto Rico manatee population should be considered a single population with minimal, if any, subdivisions within the island. The U.S. has jurisdictional responsibilities for the Antillean manatee subspecies only in Puerto Rico and the U.S. Virgin Islands.

POPULATION SIZE

Efforts to quantify the size of the Antillean manatee population in Puerto Rico have historically been made through a series of synoptic aerial surveys. 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 unpublished data). Not all surveys were equal in terms of the area covered and time of year in which they were done. These counts identify a number of animals observed at the time of the survey and suggest that there are at least a specified number of manatees in the population. The U.S. Fish and Wildlife Service (USFWS) recognizes that the counts do not accurately represent the total number of manatees in the population. Weather, other environmental factors (e.g., water clarity in Puerto Rico), observer bias, and aerial survey space restrictions, influence count conditions and affect detection probability and final count. Furthermore, as in the Florida manatee aerial surveys, survey methods preclude any analysis of precision and variability in the counts, and do not allow for the estimation of the apparent detection probability. In spite of the high variability between and within surveys, the data can be used to specify the minimum population estimate (direct count) within a time period (one island-wide survey).

Powell *et al.* (1981) detected an average of 22.6 manatees during ten surveys with the highest count of 51. They found that the 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 (SD = 13.1) with a minimum count of 20 and a maximum of 62, higher than previously reported. The most consistent historical manatee counts for Puerto Rico are from 1992-2003, and in 2009 (Table 1, USFWS unpublished data). The USFWS conducted 27 island wide surveys for an average of 68.4 (SD 20.05) manatees.

Table 1. USFWS Antillean manatee aerial survey counts from 1992-2003 and 2009.

DATE	MANATEE COUNT	DATE	MANATEE COUNT
APR 1992	53	NOV 1997	66
SEP 1992	70	MAY 1998	78
NOV 1993	68	NOV 1998	45
MAR 1994	73	MAR 1999	70
MAY 1994	51	MAR 2000	68
JUL 1994	86	MAY 2000	51
SEP 1994	65	DEC 2000	35
NOV 1994	62	AUG 2001	22
DEC 1994	82	MAR 2002	79
MAR 1995	62	DEC 2002	112
MAY 1995	87	FEB 2003	106
OCT 1995	98	DEC 2003	64
MAY 1996	49	APR 2009	72
AUG 1996	73		

In 2010, two island-wide surveys were completed, another in 2011, and others in 2012-2013 (Table 2). Additional surveys are planned for 2013 and possibly 2014. These surveys (2010-2013) include a specific methodology that includes repetitions in "manatee hot spots" or high density areas. Also, since 2011, the surveys include repetitions at certain low density areas. This new method will provide a statistically robust population estimate with a calculated detection probability and confidence intervals. The survey method and analysis were developed by the U.S. Geological Survey (USGS) North Carolina Cooperative Research Unit in North Carolina State University.

Table 2. USFWS Antillean manatee new aerial survey counts from 2010-2013.

DATE	MANATEE COUNT
JUN 2010	120
OCT 2010	140
SEP 2011	178
MAR 2012*	76
JAN 2013	142

*incomplete census due to weather

The USGS analyzed the data for the June 2010 survey. This survey counted a total of 120 manatees (80 in high density areas and 40 in low density areas). The apparent detection probability mean estimate was 0.2. This detection probability was used for both the high and low density area population estimate calculations, and is much lower than typical manatee estimates of 0.4-0.7 (Krachney 2010). The total population estimates for the June 2010 aerial survey was 338 (SD 35.2) with a lower confidence limit of 273 and a higher confidence limit of 410. Further analysis of the October 2010 survey estimate a population size of 531.85 (SD 118.98) individuals with a 95% credible interval of 342 to 802 (Pollock *et al.* 2013).

Record numbers of manatees are being detected using the new repetition method. The new results and methods are still being verified and tested in order to provide the best unbiased estimates and consistent methodology of collecting information to accurately assess the Puerto Rico Antillean manatee population. Until further analysis, the USFWS will continue to use the most recent manatee direct count as the more reliable number.

Minimum Population Estimate (N_{min})

The most recent available count of Antillean manatees in Puerto Rico is 142 animals (Table 2), based on the January 2013 complete island-wide aerial survey with repetitions in specific high and low density manatee areas. This number serves as the minimum population estimate.

Current Population Trends

The best we can say with the available information is that the Antillean manatee population in Puerto Rico is at least stable. In addition, quantitative information is limited regarding trends in the abundance of the Antillean manatee in Puerto Rico. In Puerto Rico, Deutsch *et al.* (2007) describes the manatee population as stable. USFWS (2007) also suggests that the Puerto Rico population of the West Indian manatee is at least stable and possibly slightly increasing due to increasing numbers detected in annual surveys. Nevertheless, the information from direct counts cannot be used to determine population trends. Detection conditions varied between surveys and within surveyed areas mostly due to heterogeneous habitats. In addition, available information suggests that the minimum population estimate (342) is not within the range of a viable population (Hunter *et al.* 2012).

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

Actual current and maximum net productivity rates for the Puerto Rico Antillean manatee population have never been calculated due to the lack of the necessary data. 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”. From the 1992 to 2009 surveys (Table 1), an average of 63.85 (SD 28.48) adults and 4.56 (SD 3.62) calves has been observed (USFWS unpublished data). 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 rate of dependent calves from natural causes remains the same. 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 as the maximum net productivity rate (NMFS 2005).

POTENTIAL BIOLOGICAL REMOVAL (PBR)

Potential Biological Removal (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 stocks and a default value of 0.5 should be used for threatened stocks or stocks of unknown status (NMFS 2005).Because the West Indian manatee is listed as endangered under the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*), as amended (ESA), the recovery factor for the Antillean subspecies is 0.1. The minimum population estimate is 142. The maximum net productivity rate is 0.04, the default value for sirenians. PBR for the Puerto Rico stock of the manatee is 0.

$$PBR = (N_{min})\ (½ \text{ of } R_{max})\ (F_r) = (142)\ (½0.04)\ (0.1) = 0.284 \text{ or } 0$$

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Carcass salvage efforts were initiated in April 1974 by the USFWS and local entities and continued through 1989. The Caribbean Stranding Network (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 led by the Department of Natural and Environmental Resources (DNER) with help from the CSN and the Puerto Rico Zoo. From 1990 through 2012, 167 manatees have been found dead (Mignucci-Giannoni 2006, DNER and CSN unpublished data).

Manatee carcasses that show evidence of serious injuries that may have been human-caused, e.g., struck by watercraft, are reported as mortalities in Table 3. Otherwise, for the time period of 2008 through 2012, we have no record of serious injury to manatees in Puerto Rico. Therefore, annual serious injury during this time period is estimated to be zero. In Puerto Rico, most manatee stranding events consist of single individuals. 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). There is only one mass mortality case in 2006 when a mating herd (4 males and one female) was impacted by a large vessel in the San Juan Bay.

During the 2008-2012 period, a total of 47 manatees were reported dead (Table 3). Undetermined cases comprised most of the reported mortalities examined (22 or 47%), followed by natural causes (15 or 32%), and watercraft related death (5 or 11%). In most cases of watercraft deaths, manatees are killed by a blunt trauma to the head, which produces an internal hemorrhage and subsequent death. One case in 2008 found a manatee with blunt trauma to the

head and a puncture wound as if penetrated by a spear. The cause of death in most of the cases was deemed as undetermined (47%). The undetermined cause of death (COD) category means that there is no evidence that COD can be assigned to any of the available categories, either natural or human related. Unfortunately, at the time this document was completed, we had not received information for 5 manatee mortality cases from 2011 and, therefore, these 5 mortalities were included in the undetermined category.

Table 3. Manatee mortality from 2008 to 2012 (DNER and CSN unpublished data).

Year	Natural		Human	Undetermined	Total
	Dependent Calves / Perinatal	Illness	Watercraft		
2008	1	1	2	4	8
2009	1	0	0	6	7
2010	1	3	1	5	10
2011	5	2	0	8	15
2012	2	1	2	3	8
Totals	**10 (20.8%)**	**7 (14.6%)**	**5 (10.4%)**	**26 (54.2%)**	**48**
5-Year Avg.	**2**	**1.4**	**1**	**5.2**	**9.6**

In most cases, the reporting of a stranded manatee takes days and most causes of deaths are deemed undetermined because the carcass is too decomposed. 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, which are 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 and killed manatees for special events. Manatees were captured in gill nets and/or turtle nets purposely or inadvertently during fishing activities. Mignucci-Giannoni *et al.* (1993), indicates that from 1974 until 1988, 41.5% 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 Antillean subspecies of the West Indian manatee was removed from the list of species/stocks

incidentally killed or injured in the Category III "Caribbean gillnet" and "Caribbean haul/beach seine" fisheries (NMFS 2010). There are no other commercial fisheries listed to take manatees in Puerto Rico.

In July 2009, the DNER reported one case of an adult manatee that was caught in a beach seine net. Fortunately, the persons involved were aware of the situation and were able to pull the manatee on shore, untangle it from the net and release the manatee back into the water. USFWS notified NMFS for consideration under their 2012 List of Fisheries (LOFs), but the manatee remained off the list (NMFS 2011).

In November 2010, the DNER (2010) issued the new Puerto Rico fishing regulations under Regulation 7949 which supersedes the former Regulation 6768. Under this new regulation, beach seine gear is permitted except within Puerto Rico inner water and rivers mouths. This type of gear may affect and cause take of Antillean manatees in Puerto Rico. Since the use of beach seine nets was approved with the new regulation, manatee net entanglements may increase, but will depend on the intensity and areas were this type of gear will be used. The DNER and USFWS manatee education programs should target fishermen and address the possible effects of this type of gear on manatees. The USFWS will work with NMFS to ensure any future takes that occur in this fishery are considered in the future LOFs.

The fisheries in the U.S. Caribbean are multi-species, multi-gear, artisanal in nature, and principally coral reef-based (CFMC 2004). A total of 670 active fishing vessels and 868 active commercial fishers were reported in Puerto Rico during 2008 (Matos-Caraballo and Agar 2011). They also reported that 75% of interviewed commercial fishers fished full-time and 25% part-time. A total of 49.7% of the fishing vessels are 20-29 feet in length followed by 47.6% from 10-19 feet. A total of 32% fished along the shoreline, 82% on the continental shelf, 59% on the shelf edge, and 36% on oceanic waters. Most commercial fishers used hook and line gear to obtain their catch, followed by traps, nets, and skin/scuba. Since the beach seine was banned at the time of interview (2008), data from this gear was not asked (Matos-Caraballo and Agar 2011). Of the total net gears used by commercial fisheries in Puerto Rico, lobster trammel nets, gill nets, fish trammel nets, and cast nets represented 44%, 21%, 6 %, and 29% respectively.

Matos-Caraballo (2009) described changes in the fisheries from 1988 to 2008; the most dramatic was the reduction in the number of fish traps (52% reduction in 20 years). On the other hand, an increasing trend was observed in the use of hand lines and rod and reel. Another significant change observed was a 42% reduction in active commercial fishing vessels from 1996 to 2008. Boats larger than 30 feet also decreased from 44 in 1988 to only 16 in 2008 (Matos-Caraballo 2009).

The USFWS believes that incidental mortality and serious injury of manatees related to commercial fisheries in Puerto Rico and the U.S. Virgin Islands should be considered minimal or approaching a zero mortality and serious injury rate, except for the possible effects of beach

seine net gear, as described above. The USFWS acknowledges that there may be limits to the data available because it is possible take could occur and may not be observed or reported, as some may occur in remote areas or person involved may be hesitant to report to authorities However, the USFWS considers that public manatee awareness has increased as most of the stranding cases or manatee sightings in common areas have been reported by the general public. In addition, protocols for necropsies and assigning probable cause of death categories are reviewed thoroughly. Table 3 shows watercraft as the only source of human-caused deaths. The only possible evidence for commercial fisheries interaction would be within the 47% undetermined COD category. The COD category means that there is no evidence that COD can be assigned to any of the available categories, either natural or human related. 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 1990-2012, only one manatee had COD related to a fishery interaction; however, it was not possible to determine if it was due to a commercial or recreational fishery. In 2006, one freshly dead manatee was found with its right flipper entangled in monofilament and still this COD was deemed undetermined.

STATUS OF STOCK

The West Indian manatee is listed as an endangered species under the ESA, and the Recovery Plan (USFWS 1986) for the Puerto Rico population of the Antillean subspecies is currently under review. As an endangered species under the ESA, the Puerto Rico stock of Antillean manatees is considered a to be a “strategic stock” and “depleted” under the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq*.).

We currently do not have sufficient information about the Puerto Rico manatee population to determine the 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.

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Figure 1. Puerto Rico map referencing coastal Municipalities and offshore islands mentioned in this document.