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Stock Assessment

WEST INDIAN MANATEE *(Trichechus manatus)*

PUERTO RICO STOCK
(Antillean subspecies, Trichechus manatus manatus)

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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 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 in 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.

Recent research indicates that haplotype distribution is further geographically divided in Puerto Rico with A haplotype (found in Florida) only found in the north and haplotype B found in the south of the island. East and western ends represent a mixing of the two, clearly suggesting a distinction between the Florida manatee and the Antillean manatee. Until this research is completed, we will follow Domning and Hayek (1986) in the subspeciation and account manatees within the Puerto Rico and U.S. Virgin Islands as Antillean manatees.

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 know to occur in the Lesser Antilles (Lefebvre *et al*. 2001).

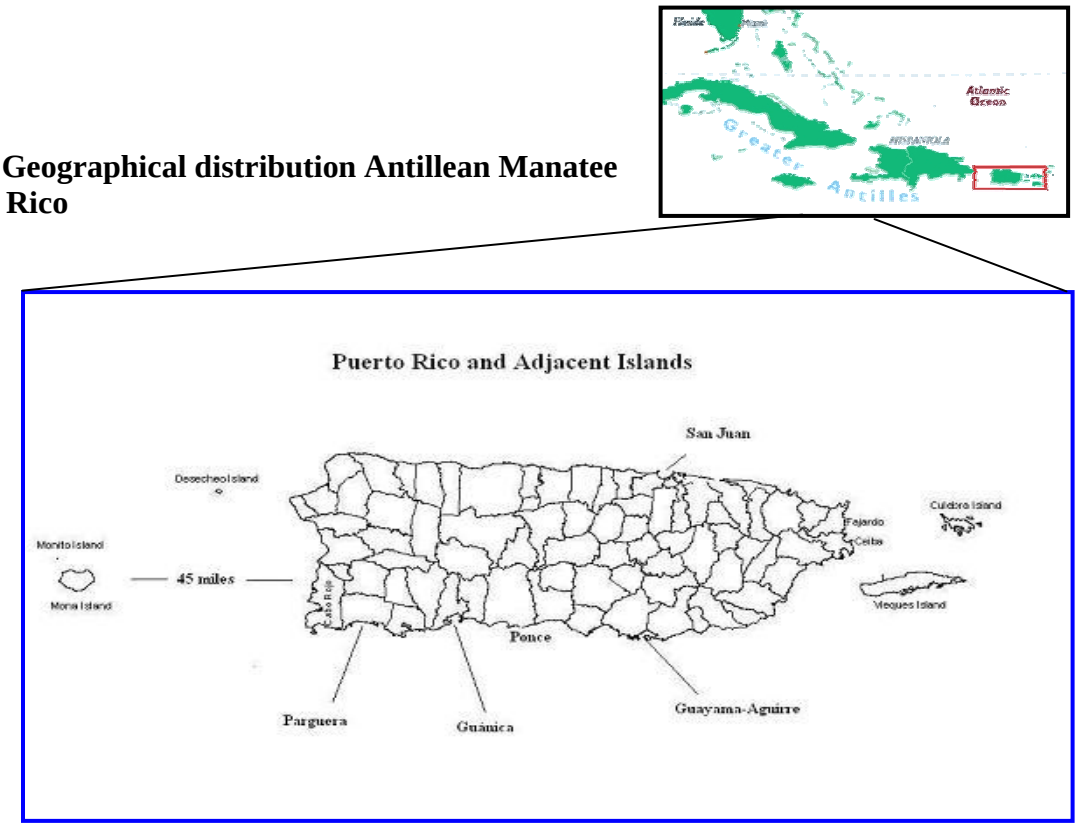
Genetically, the Puerto Rico population is isolated from the Florida manatee and has an additional haplotype when compared to the Dominican Republic. Antillean manatees occur around Hispaniola. While only a 90-mile stretch separates the two islands, manatee sightings have only occurred in areas close to the coast in Puerto Rico. The prevailing winds and currents are mostly from the north east. 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. Therefore, we conclude that the Puerto Rico population of the Antillean manatee is geographically and reproductively isolated and represents a separate stock. 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 any 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 vise versa. Manatees have been seen 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 a longer stay 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 survey.

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 a 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. Average manatee sighted was 67 (S.D. = 20) per survey, with a high of 117, a low of 22. The average adult was 63.40 per survey and calves were 4.72 per survey. The 2009 survey counted 64 adults and eight calves. These findings indicate that the population may have increased over the seven year period between aerial surveys and 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 stable and possibly increasing due to increasing numbers detected in annual surveys. Plotted data from all surveys through time suggest an increase in detection in spite of a difference in observer's 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.

Mean manatee 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 68.12 manatees per survey. The proportion of calves detected was about the same with 6.4% in 1979-1980 (Powell *et al.* 1981), 7.6% in 1984-1985 (Rathbun *et al.* 1985), and 1991 to 2009 6.9% calves detected per survey. 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. These findings lead us to conclude that the manatee population seems stable and perhaps increasing during this time.

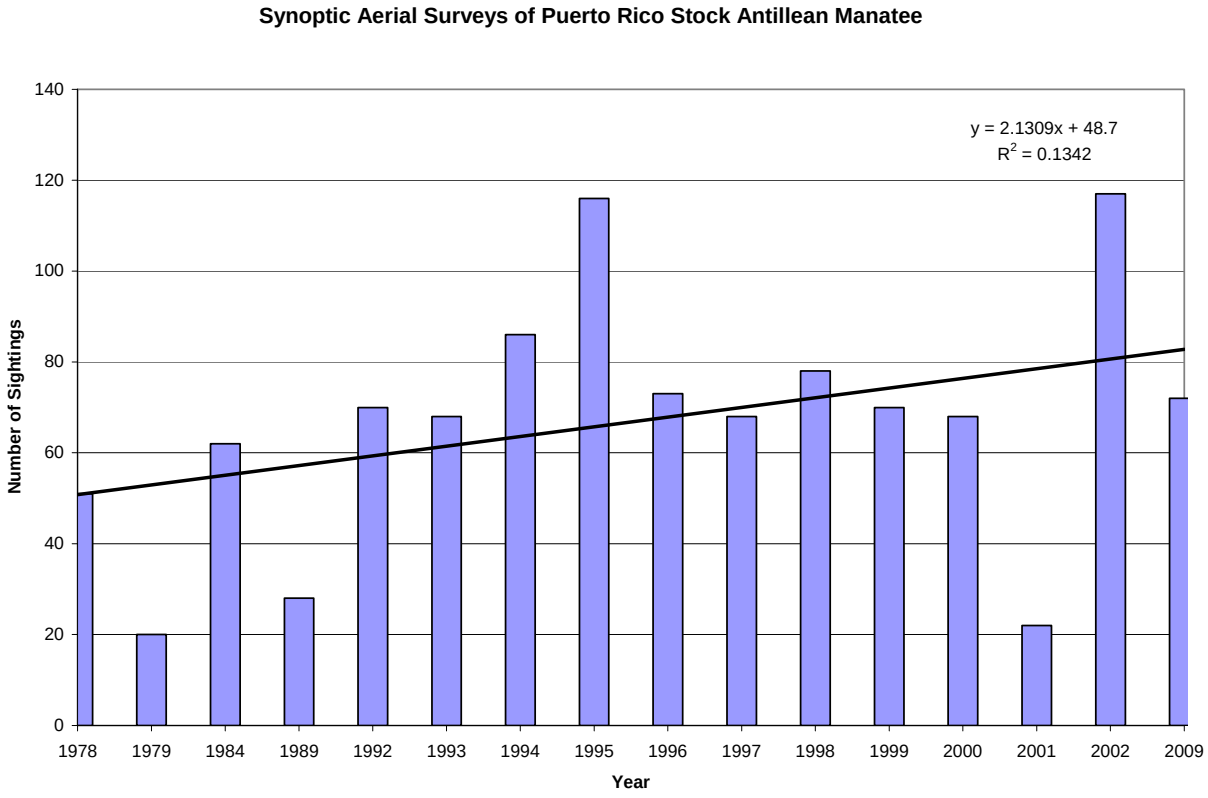


Figure 2. Synoptic Aerial Surveys Puerto Rico Stock of Antillean Manatee

Efforts to quantify population levels and trends are ongoing as part of a cooperative agreement whose signatories are 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 probability of detection 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 0.04 values for manatees and cetaceans (NMFS 2005).

POTENTIAL BIOLOGICAL REMOVAL

The West Indian manatee is federally listed as endangered. Based on the most recent review, the Service (USFWS 2007) has recommended the reclassification of the species to 'threatened' throughout its range. The Service has recent survey data which suggest the Puerto Rico population of the West Indian (Antillean manatee) is stable, if not increasing.

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, or perhaps increasing, 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:

$$\mathbf{PBR = (N_{min})\ (½\ of\ R_{max})\ (F_r)}$$

$N_{min} = 72$
$R_{max} = 4.0\%$
$F_1 = 0.1$

$$\mathbf{PBR = (72)\ (0.02)\ (0.1) = 0.\ 144\ (or\ 0)}$$

HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Rescues

From 1990 to 2005 a total of 23 manatees were rescued by the Caribbean Stranding Network (Mignucci-Giannoni 2006). Of these, 21 were calves; one was a sub-adult and one an adult. Two were rehabilitated and released, 17 died in rehabilitation, and one died in transport. Currently one manatee is in rehabilitation. Of four manatees that were released, only one manatee is still alive. Since 2005, only two manatees were rescued, one adult died on route and a calf is being rehabilitated at the Juan A. Rivero Zoo in Mayaguez. An average of 1.4 calves are rescued every year, but mostly all die due to illness (Mignucci-Giannon1 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 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 performed by Puerto Rico 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).

	Natural		Human	Undetermined	Total
	Dependent Calves/Perinatal	Illness	Watercraft		
Year					
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. 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 blow in the head which produces an internal hemorrhage and subsequent death. In 2006, an unusual manatee death was reported when a mating heard 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%).

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, 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 represent a true value of mortality. 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 in 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 a total 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 any data to support that there is take by these commercial/artisanal fisheries. Therefore, the Service believes that the estimated annual level of incidental mortality and serious injury due to these commercial fisheries is zero.

In Puerto Rico, fisheries interaction with manatees is poorly documented. In the past, a few incidents were described through the carcass recovery program and in numerous anecdotal reports. 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 conclude that fisheries interactions, either intentional or accidental, do not significantly affect the status of the Puerto Rico stock of the Antillean manatee. Because of the bans and restrictions placed on the use of nets and the lack of mortality data reporting that take by these commercial fisheries has occurred, the Service believes that the rate of incidental mortality and serious injury is insignificant and at or approaching zero. However, 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.

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 about 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. 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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