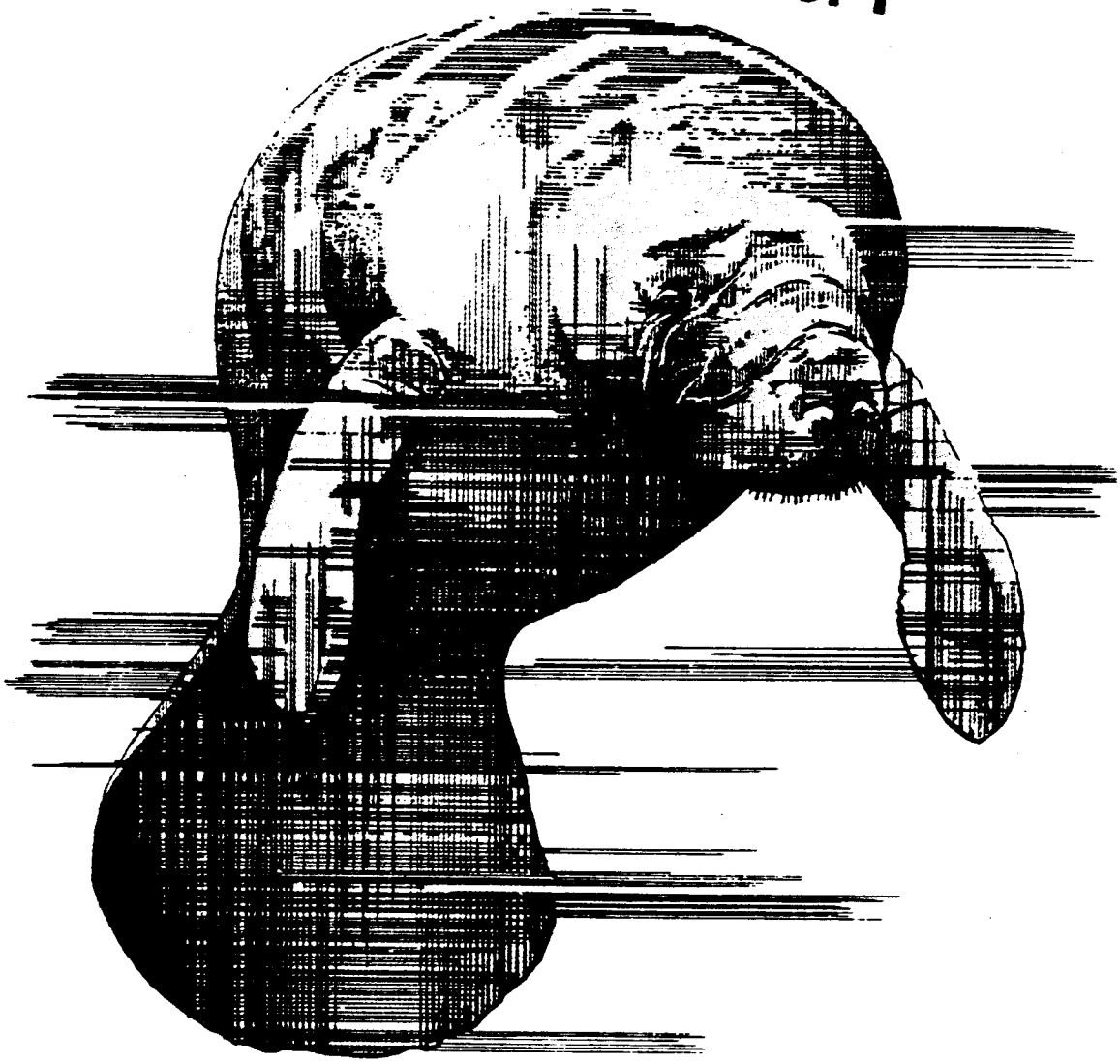
RECOVERY PLAN

PUERTO RICO POPULATION OF THE WEST INDIAN (ANTILLEAN) MANATEE



RECOVERY PLAN FOR THE PUERTO RICO POPULATION

OF THE

WEST INDIAN (ANTILLEAN) MANATEE (*Trichechus manatus manatus* L.)

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Approved: _____
Regional Director

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DISCLAIMER

This is the completed recovery plan for the Puerto Rico population of the West Indian (Antillean) manatee. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent official positions or approvals of cooperating agencies and does not necessarily represent the views of all individuals who played a role in preparing this plan. This plan is subject to modification as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other constraints.

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EXECUTIVE SUMMARY

1. Point or condition when the species can be considered recovered?

The three objectives of the recovery process are: 1) to identify, assess, and reduce human-related mortalities, 2) to identify and minimize alteration, degradation, and destruction of important manatee habitats, and 3) to develop the criteria and biological information necessary to determine whether and when to declassify the Puerto Rico population.

Delisting should occur when the population is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes and stochastic or catastrophic events.

2. What must be done to reach recovery?

Determine and reach the recovery criteria that are based on mortality and abundance trends, a minimum population size, and assurance that adequate habitat protection and anti-poaching measures are implemented.

3. What specifically must be done to meet the needs of #2?

Major tasks for recovery are reduction of human-caused mortality, habitat protection, identification and control of any contaminant problems, and research into manatee behavior and requirements to direct future management.

These tasks can be accomplished by the following:

A. Identification and management of habitat important to the species' survival. Management plans for important habitats should address boat densities, the need for sanctuary areas, boat speed regulatory zones, information and education, and data needs.

B. Assess human-caused mortality by expansion and improvement of the carcass salvage project (including contaminant analysis) and mortality surveys. Such mortality may be reduced through public education, increased law enforcement, and careful Section 7 review of coastal developments.

4. What management/maintenance needs have been identified to keep the species recovered?

Long-term habitat protection and adequate mechanisms must be in force to ensure that poaching and boating conflicts will remain under control once the species is recovered.

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PART I: INTRODUCTION

A. INTRODUCTION

The Order Sirenia is a well-defined group of obligate aquatic herbivores that have a tropical and subtropical distribution. The Dugongidae is represented by a single species, the dugong (Dugong dugon), which is distributed throughout the Indopacific. The Trichechidae has three allopatric species in a single genus, Trichechus. The West African manatee (T. senegalensis) is found along the Atlantic coast of Africa, the Amazonian manatee (T. inunguis) is restricted to the Amazon River basin, and the West Indian manatee (T. manatus) is found in the Caribbean and Gulf of Mexico (Husar, 1977). All species are considered threatened or endangered throughout their range by the U.S. Department of Interior (Federal Register, July 22, 1985. Vol. 50(140):29900-29909). The International Union for Conservation of Nature and Natural Resources (IUCN) lists all manatees as vulnerable (Thornback, 1978). Virtually all countries that contain dugongs or manatees within their territorial waters protect them (Husar, 1977).

The body of the West Indian manatee is fusiform, although unlike most other marine mammals it is dorso-ventrally, instead of laterally, compressed. The pectoral flippers are well developed, there are no pelvic appendages, and the tail is modified into a large rounded

spatulate paddle. Hair is very sparse, except for vibrissae on the muzzle. The facial region is specialized for foraging on submerged aquatic plants. Large specimens can attain lengths of over 3.8 m (12.5 ft) and weight over 1,600 kg (3,500 lbs), although most adults do not exceed 3 m and 1,000 kg (Sirenia Project, U.S. Fish and Wildlife Service, unpubl. data).

Hatt (1934) originally described two subspecies of T. manatus (T. m. manatus and T. m. latirotris) based on several morphological characters. The validity of these taxa, however, was not universally accepted (for example see Lowery, 1974). Recently Domning and Hayek (1986) completed a revision of the subspecies and concluded that there are, in fact, two distinguishable races based on several morphological features. The Florida manatee, T. m. latirotris, is restricted to the southeastern United States, principally Florida. T. m. manatus (Domning and Hayek, 1986, propose the common name: Antillean manatee) occurs from northern South America through the larger Antillean islands and up the west coast of the Gulf of Mexico through Texas. The Antillean manatee population in Puerto Rico represents the only group of manatees from this subspecies under United States jurisdiction.

The biological basis of these subspecies may be due to restricted gene flow that results from the cool winters along the northern coast of

the Gulf of Mexico and the deep water and strong currents of the Straits of Florida (Domning and Hayek, 1986).

B. DISTRIBUTION AND ABUNDANCE

Historical accounts: The earliest accounts of Puerto Rico include references to manatees and their use as a food resource by the aborigines and by the Spaniards, who considered them a fish and edible on Fridays (Acosta, 1590; Stahl, 1883). Later accounts also indicate that the aborigines used manatee ribs to carve ceremonial objects, such as upchuck-sticks (Fewkes, 1907). Unfortunately, there is no indication from these early reports as to the precise distribution or abundance of manatees around the island. True (1884) indicated that they occurred "...more or less abundantly in the West Indies, particularly about Cuba, San Domingo, and Puerto Rico..." The account by Latimer (1864) of capturing and shipping specimens to Britain for display at the Regent's Park Zoological Gardens also indicates a certain degree of abundance around the island.

Recent accounts: Virtually no new information about the status of manatees in Puerto Rico was gathered until Powell, et al. (1981) completed ten aerial surveys around the island between August 1976 and March 1979. The average number seen was 21.1 (S.D.=11.6) with a range of 11-51. The average percent calves sighted was 6.4. Slightly over 37 percent of the sightings were made at the eastern end of Puerto

Rico and around Vieques Island, while nearly 45 percent were sighted along the southern shore. No manatees were seen along the northwestern coast.

Based mainly on interviews, manatees apparently are not found around Mona or Culebra islands off the western and eastern ends of Puerto Rico, respectively (Powell, et al., 1981; Rathbun, unpubl. data). Manatees are virtually never seen around the Virgin Islands (Erdman, 1970; D. W. Nellis, pers. comm.), which are about 75 km east of Puerto Rico, although fossils have been found in middens on St. Croix (Miller, 1918). Manatees are seen fairly frequently in the Dominican Republic, on the eastern side of the island of Hispaniola (Belitsky and Belitsky, 1980), which is about 110 km west of Puerto Rico. They seem to be rarer in Haiti on western Hispaniola (Rathbun, et al., 1985).

Between March 1984 and March 1985 monthly aerial surveys around Puerto Rico were again conducted, as well as weekly aerial surveys of Roosevelt Roads Naval Station (RRNS) and Vieques Island (Rathbun, et al., 1986). The mean sightings per survey around Puerto Rico was 43.6 (S.D.=13.1) with a range of 20-62. The average percent calves seen was 7.6. It is tempting to conclude that the number of manatees in Puerto Rico has increased since the 1970's (Powell, et al., 1981 and Rathbun, at al., 1986). Unfortunately the surveys were designed to determine distribution and not abundance, so valid comparisons between the counts are difficult. The principal problem is the difficulty of

spotting manatees and the resulting high degree of variation obtained between surveys (see Packard, 1985, for a full discussion of census techniques for manatees). The distribution of manatees around Puerto Rico and Vieques Island during the 1984 and 1985 study (Rathbun, et al., 1986) was very similar to that documented by Powell et al. (1981), with most of the manatees sighted on the eastern end of the island (in association with RRNS) and along the southern coast (Table 1). Sightings were not distributed evenly around the Naval Base and Vieques Island (Table 2). Sightings were most frequent in shallow, protected bays and on the dense seagrass beds along the protected northwestern shore of Vieques Island (Rathbun et al., 1986).

C. NATURAL HISTORY

The information presented in this section draws heavily on what is known about manatees in Florida. Even though the Puerto Rico population is a different subspecies, the information probably will not be substantially different. Where data are available for Puerto Rico, they are cited as such. There are several species accounts that should be referred to for more information, including Husar (1977, 1978), Ronald, et al., (1978), U.S. Fish and Wildlife Service (1980), Odell (1982), Van Meter (1982), and Rathbun (1984).

Habitat: Manatees generally are restricted to large slow-moving rivers, river mouths, and shallow low-energy coastal areas, such as

Table 1. Distribution of manatees around Puerto Rico by coastal segment. Data compiled from twelve monthly aerial surveys from March 1984 through March 1985. (From Rathbun, et al., 1986)

	COASTAL SEGMENT											
	1	2	3	4a*	4b*	5	6	7	8	9	10	11
Total manatees sighted (523)	25	14	138	50	2	63	158	37	21	15	0	0
Average no. of manatees sighted per survey (standard deviation)	2.1 (3.8)	1.2 (1.7)	11.5 (3.3)	4.5 (2.1)	0.2 (0.4)	5.3 (4.5)	13.2 (5.7)	3.4 (2.1)	1.8 (2.0)	1.3 (1.7)	0 (0)	0 (0)
Percent manatees sighted of grand total sightings (523)	4.8	2.7	26.4	9.6	0.4	12.0	30.2	7.0	4.0	2.9	0	0
Percent manatee calves sighted of total calves (40)	5.0	0	32.5	15.0	0	20.0	20.0	2.5	2.5	2.5	0	0

*Only eleven aerial surveys were completed in these segments due to U.S. Navy restrictions.

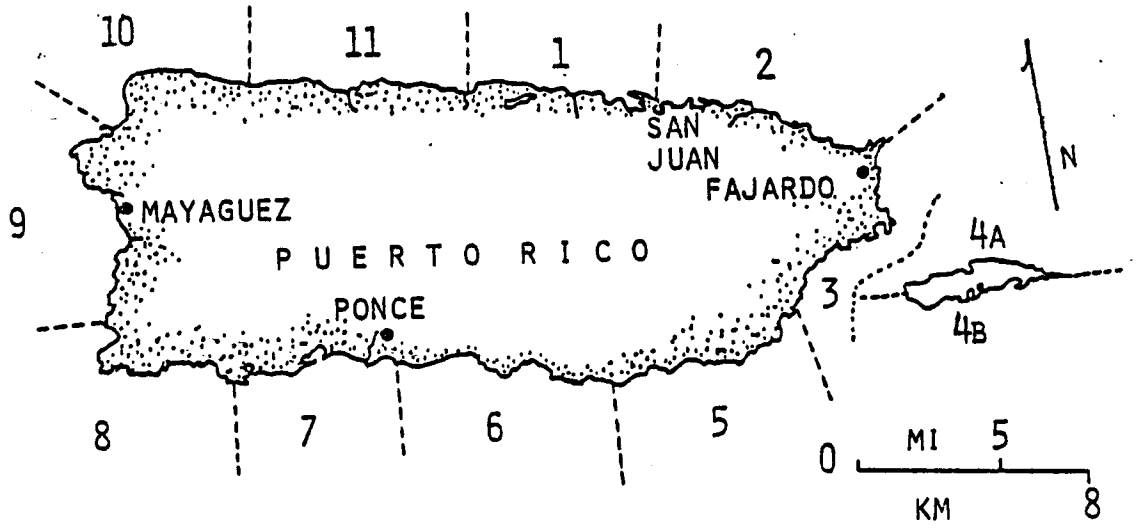
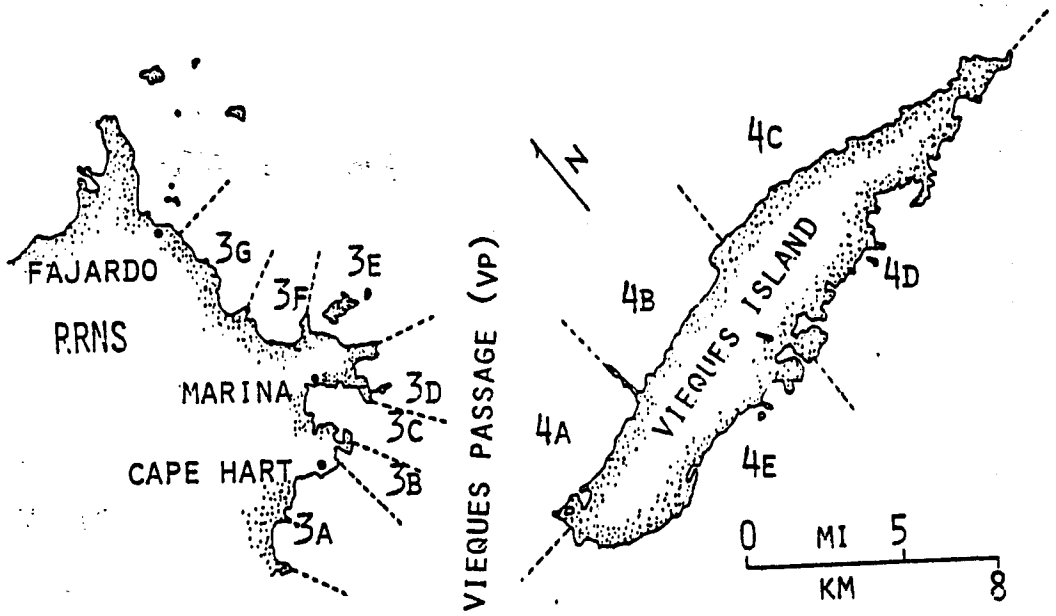


Table 2. Distribution of manatees by coastal segment at Roosevelt Roads Naval Station and Vieques Island, Puerto Rico. Data compiled from 49 weekly aerial surveys from March 1984 through March 1985. VP=Vieques Passage. (From Rathbun, et al., 1986)

	COASTAL SEGMENT												
	3a	3b	3c	3d	3e	3f	3g	VP	4a	4b	4c*	4d*	4e
Total no. of surveys	49	49	49	49	49	48	49	49	49	49	18	18	49
Total manatees sighted (836)	206	158	119	2	32	28	62	0	161	51	0	0	17
Average manatee sightings per survey (standard deviation)	4.2 (2.8)	3.2 (2.1)	2.4 (2.2)	0.04 (0.2)	0.7 (1.0)	0.6 (1.1)	1.3 (2.0)	0 (0)	3.2 (2.4)	1.0 (1.6)	0 (0)	0 (0)	0.3 (0.9)
Percent manatees sighted of grand total (836)	24.6	19.0	14.2	0.2	3.8	3.3	7.4	0	19.3	6.1	0	0	2.0
Percent manatee calves sighted of total calves (66)	27.3	15.2	12.1	0	6.1	3.0	7.6	0	22.7	3.0	0	0	3.0

*Only 18 aerial surveys were completed in these segments due to U.S. Navy restrictions.



estuaries, coves, and bays where the water is calm and aquatic vegetation is available (see brief review in Powell and Rathbun, 1984). In Puerto Rico manatees conform to this pattern (Rathbun, et al., 1986).

Food habits: The feeding ecology of manatees is not well understood. They are known to eat a wide range of emergent, natant, and submergent aquatic and marine plants (Hartman, 1979 and Best, 1981). They have preferences for some species, but these may vary with geographical area (Hartman, 1979 and Bengtson, 1981). In some areas along the eastern coast of Florida they have been observed to excavate the rhizomes and roots of marine angiosperms (Packard, 1984). There is limited evidence that manatees prefer freshwater or estuarine vegetation over marine angiosperms, which may be related to their need for fresh water and maintaining water balance (Powell and Rathbun, 1984). Manatees are reported to eat a wide variety of terrestrial plant parts that fall from vegetation overhanging water (Bengtson, 1981; O'Shea, 1986). Manatees spend about 5 to 8 hours a day feeding and consume from 4 to 11 percent of their body weight per day (Bengtson, 1981; Etheridge, et al., 1985).

They are thought to have a high digestive efficiency and a slow passage rate (Best, 1981; Lomolino and Ewel, 1984). Manatees have not proven to be efficient agents for the natural control of aquatic vegetation, despite initial optimistic claims (Etheridge, et al., 1985). Manatees in Puerto Rico are generally believed to rely heavily

on marine angiosperms for food, mainly because access to other plants is limited (Barrett, 1935). During 1984/1985 aerial surveys (Rathbun, et al., 1986), significantly more manatees were seen feeding in the southwestern corner of Puerto Rico than expected. In the area of RRNS, manatees often were sighted feeding in Pelican Cove and Ensenada Honda. These frequently-used feeding areas were characterized by dense seagrass beds (Rathbun, et al., 1986). Large groups also were seen feeding on the northwestern shore of Vieques Island, where Magor (1979) documented their use of submerged seagrass beds. Manatees frequently use the outfalls at the Cape Hart sewage treatment plant at RRNS as a source of fresh water (Rathbun, et al., 1986).

Social organization: Manatees are non-territorial and do not form stable, close-knit social groups or herds (Hartman, 1979; Bengtson, 1981; Reynolds, 1981; Rathbun and O'Shea, 1984). In Florida and Puerto Rico, they are often seen in groups of two or more individuals; however, lone animals are sighted more frequently than any other group size (Irvine, et al., 1982, Kinnaird, 1983 and Rathbun, unpubl. data). The only known long-term (up to four years) social bond is between a cow and her calf (Hartman, 1979; O'Shea, unpubl. data). In Florida, manatees range over fairly large areas during the summer, perhaps covering up to 200 linear km of river or coastline. Males tend to move over larger areas than females (Bengtson, 1981). Long-distance movements of about 600 km by individuals in Florida have been documented (Rathbun, et al., 1983), and there are numerous cases

of northern extralimital sightings suggesting movements well over 600 km (Rathbun et al., 1982; Powell and Rathbun, 1984). There is no information available on social organization or movement patterns in Puerto Rico. It is very likely that animals are just as mobile as they are in Florida. They have not been seen crossing the Vieques Passage, although they probably do so quite frequently. There is no evidence that they travel between Caribbean islands (Powell, et al., 1981 and Rathbun, et al., 1986).

Activity patterns: Hartman (1979) had no evidence of circadian activity in manatees at Crystal River, Florida. More recent observations, however, indicate that animals move in and out of warm-water sites during the winter on a daily cycle (Bengtson, 1981; Kochman, et al., 1983). Many manatees undertake a seasonal north-south migration on the east coast of Florida in response to seasonal changes in water temperature (Shane, 1983; Rathbun, et al., 1983). There is some indication of a slight peak in breeding activity in northern Florida during the summer months (Sirenia Project, U.S. Fish and Wildlife Service, unpubl. data). There is no evidence of any periodicity in manatee behavior in Puerto Rico, including the use of the freshwater outfall at the Cape Hart seweage treatment plant (Rathbun, et al., 1986).

Reproduction: Female manatees remain in estrus for about two weeks, when they are followed constantly by a dynamic herd of up to 17 males.

Females mate with several males during estrus (Hartman, 1979; Bengston, 1981). Gestation is from 12 to 14 months (Hartman, 1979: Dekker, 1980; Cardeilhac, et al., 1984). Births occur during all months of the year, although in northern Florida there is a slight peak during the summer. Parturition occurs in shallow, calm, and secluded water (Sirenia Project, U.S. Fish and Wildlife Service, unpubl. data). Litter size is normally one, but twins are seen occasionally (Hartman, 1979). Calves are weaned usually between 9 and 24 months of age, although a cow and calf may continue to associate for several more years (Sirenia Project, U.S. Fish and Wildlife Service, unpubl. data). Adoption of orphaned calves and/or nursing of consecutive calves is rare, but has been observed (Hartman, 1979; Sirenia Project, U.S. Fish and Wildlife Service, unpubl. data). There is no information on the lifetime reproductive output of females, although they may live as long as 50 or 60 years.

Adverse influences: The manatee carcass salvage program (Bonde, et al., 1983) has documented in great detail the mortality factors that are important to manatees in Florida (O'Shea, at el., 1985). Although a salvage program began in Puerto Rico in 1974, none were recovered until 1976. Since that time, carcasses from Puerto Rico also have been necropsied, when possible. Unfortunately, few of the specimens have been very fresh, so causes of death were not determined for many of the animals (Table 3) and tissues for contaminant studies have not been collected. Since manatees are primary consumers, they are not expected to concentrate most contaminants, and in Florida this seems

Table 3. Manatee mortality in Puerto Rico. Summary based on deaths examined by participants in the U.S. Fish and Wildlife Service manatee carcass salvage program. (From Rathbun, et al., 1986)

Field No.	Date Reported	Sex	Length	Condition	Location	Cause of Death
M-29	18 Aug 76	M	Ca 210 cm	?	Ceiba, northern coast. 18°20'N. 66°25'W.	Drowned in turtle net
M-203	18 Sep 80	M	313 cm	Badly decomposed	Between Punta Puerto Nuevo and Isletas de Garzas on the northern coast. 18°29'N. 66°23'W.	Undetermined
M-204	15 Sep 80	M	Ca 305 cm	Badly decomposed	El Boquete, E. of Bahia de Tallaboa, near Guayanilla. 17°59'N. 66°43.5'W.	Undetermined
M-281	15 May 81	?	335 cm	Moderately decomposed	La Parguera Bay, southwestern coast. 17°58'N. 67°10'W.	Undetermined
M-282	18 Aug 81	?	293 cm	Badly decomposed	Union Carbide Plant, Guayanilla. 17°57'N. 66°48'W.	Boat strike
M-283	18 Jan 82	F	335 cm	Moderately decomposed	La Perla, Old San Juan. 18°29'N. 66°07.5'W.	Undetermined
M-399	13 Aug 84	F	151 cm	Fresh	Union Carbide Plant, Tallaboa Bay. 17°55'N. 66°44'W.	Undetermined
M-420	4 Feb 85	F	120 cm	Badly decomposed	Playa de Punta Salinas, W. of Jobos Bay 17°58'N. 66°17'W.	Dependent calf
M-421	5 Feb 85	M	Adult	Badly decomposed	Between Punta Picua and Punta Parcha, W. of Luquillo. 18°24'N. 65°46'W.	Gill net/butchered
M-427	11 Feb 85	M	297 cm	Badly decomposed	W. Punta Vacia Talega, E. of San Juan. 18°27'N. 65°55'W.	Net scars - bullet hole in head.
M-443	25 Mar 85	?	CA 360 cm	Badly decomposed	Puerta Chica, Fajardo. 18°18'N. 65°37'W	Undetermined
M-455	21 Mar 85	F	142 cm	Badly decomposed	W. shore Jobos Bay. 17°59'N. 66°14'W.	Dependent calf

to be the case (O'Shea, et al., 1984). There is little reason to believe that the situation would be substantially different in Puerto Rico, although this should be confirmed. The mortality factors that are currently important in Puerto Rico are very different from those in Florida, although both are related to humans. Analyses of manatee carcasses, and observations and interviews with local residents by scientists, indicate that the principal source of human related manatee mortality in Puerto Rico is from entanglement in gill nets, intentionally or unintentionally (Rathbun, et al., 1986), while in Florida it is accidental boat strikes (O'Shea, et al., 1985). There is some indication that industrial development, with its concurrent increase in boat traffic, may be starting to impact manatees on the southern coast of Puerto Rico (Rathbun, et al., 1986). To date, there is no evidence that natural disasters (such as hurricanes), competition, habitat loss, disease, or natural predation cause any significant mortality of manatees in Puerto Rico (Rathbun, et al., 1986).

PART II: RECOVERY

Unfortunately, because of the absence of historical and current data on abundance, it is not clear when the manatee population in Puerto Rico should be considered recovered. This should be determined once the necessary information is obtained. It may not be possible to

establish how many manatees are in Puerto Rico, but by a continuing series of replicated aerial surveys some measure of population trends could be obtained. Concurrent with this, a greater effort should be put into improving the carcass salvage program so that better information is gathered on the causes of death and the number and location of dead animals as well as natural history and taxonomic status of manatees in Puerto Rico. Since mortality in fishing nets appears to be the main adverse problem identified to date, this should receive immediate attention in the form of greater public education and more law enforcement. If fresh specimens are obtained from carcasses, tissues for contaminant studies should be gathered.

Radio tracking studies should be initiated as soon as possible to gather data on manatee habitat use and movement patterns. Without these data it will be difficult to develop and implement meaningful protection plans for manatees and their habitats. A greater effort is needed to coordinate all agencies involved in monitoring and permitting habitat alterations, so that they all are aware of the main habitat features that manatees require. This is especially important with regards to RRNS and the Jobanes National Estuarine Research Reserve, because these are the only areas where manatees currently receive any meaningful protection (due to Navy restrictions and Commonwealth protection, respectively). The amount of habitat loss also should be documented.

The principal agencies involved with the research and recovery efforts will be the Commonwealth of Puerto Rico Department of Natural Resources (PRDNR), the U.S. Fish and Wildlife Service (FWS), the U.S. Navy (USN), and the U.S. Coast Guard (USCG).

A. OBJECTIVES

The ultimate goal of this plan is to recover the population of manatees in Puerto Rico so that the Puerto Rican population of Antillean manatee (*T. m. manatus*) can be delisted. A viable population is one that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes and stochastic and catastrophic events.

The first objective in achieving recovery is to identify, assess, and reduce human-related mortality, especially that related to gill-net entanglement.

The second objective is to identify and minimize alteration, degradation, and destruction of habitats important to the survival and recovery of the Puerto Rico manatee population.

The third objective is to develop the criteria and biological information necessary to determine whether and, if so, when to reclassify (i.e., either delist or change their status to "threatened") the Puerto Rico population of manatees.

B. STEP-DOWN OUTLINE

1. Population Management.

11. Reduce human caused mortality.

111. Expand and improve carcass salvage program

112. Conduct periodic interview surveys to gather mortality data on poaching.

113. Assess the need for boat speed regulatory zones and implement, if necessary.

114. Review coastal developments for impacts to manatees.

115. Develop public interpretation and education (I & E) program.

116. Increase law enforcement efforts.

12. Determine manatee movement patterns and trends in abundance and distribution.

121. Implement replicated aerial surveys to measure trends in abundance and distribution.

122. Radio-tag manatees to determine movements of manatees within Puerto Rico and to determine relationship to manatees outside Puerto Rico.

13. Determine food habits of manatees.

14. Assess contaminant concentrations in manatees.

15. Determine quantitative recovery criteria.

16. Develop manatee protection plans for areas of specific importance.

2. Habitat Protection.

21. Radio-tag manatees to determine habitat utilization.

22. Determine and map distribution of sea grass beds and sources of fresh water.

23. Monitor important habitat components and ensure protection.

C. NARRATIVE OUTLINE

1. Population Management

11. Reduce human caused mortality.

111. Expand and improve carcass salvage program.

Currently, carcass salvage efforts in Puerto Rico are opportunistic and manatee mortality patterns are not well understood. Mortality data are critical in assessing the status of a species with such a low reproductive potential and essential in determining the most important threats to this species. Twelve years of experience with a manatee carcass salvage program in Florida have demonstrated the value of a strong mortality data base in documenting and addressing threats. An efficient carcass salvage network in Puerto Rico will enable managers to determine priorities and direct appropriate recovery actions. The Florida salvage program can serve as a model. In its initial stages, carcass salvage should primarily be a collaborative effort between the Fish and Wildlife Service and Puerto Rico Department of Natural Resources with U.S. Navy and U.S. Coast Guard participation and assistance.

112. Conduct periodic interview surveys to gather mortality data on poaching.

Mortality from poaching may not be easily detected even with a well organized salvage network, since there is an obvious motivation for carcass remains to be disposed of to avoid detection. Alarmingly, one of the five manatee carcasses discovered in 1985 had been butchered and one other shot. There are additional anecdotal accounts suggesting poaching may be a significant factor in manatee mortality in Puerto Rico. Judicious interviews can provide data on this subject to identify law enforcement requirements and to assist in directing their efforts. Information gained from increased law enforcement efforts (task 116) will provide a valuable source of additional information on poaching.

113. Assess the need for boat speed regulatory zones and implement if necessary.

While mortality data are scant, boat-caused mortality has been documented in one of six carcasses with a determined cause of death. Areas of manatee abundance that overlap areas of high density of boat traffic, such as Fajardo and Ponce, should be evaluated to determine the utility of boat speed regulatory zones to minimize the likelihood of manatee injuries or deaths.

114. Review coastal developments for impacts to manatees.

Boat strikes are the largest identifiable cause of manatee mortality in Florida and the chief factor threatening the manatee in Florida. The mortality data base in Puerto Rico is too scant to assess the extent of boat related impacts, but experience in Florida clearly demonstrates the vulnerability of manatees to boat traffic. Marinas, dredging, and other coastal developments therefore must be carefully monitored and reviewed under Section 7 of the Endangered Species Act to ensure adequate protection for the manatee.

115. Develop public I & E program.

A heightened public awareness must be an integral part of any effort to expand the carcass salvage program if it is to be successful and to develop support for manatee conservation in general. Increased public interest in the plight of the manatee is necessary if law enforcement efforts to diminish poaching are to be successful in the long term. Posters, pamphlets and teacher education kits are all excellent mechanisms for increasing public awareness and are being used successfully in Florida.

116. Increase law enforcement efforts.

Based on the limited data available and several anecdotal reports, poaching may be the most serious threat facing the manatee in

Puerto Rico. A concerted law enforcement effort with several well-publicized arrests would diminish poaching mortality. Long-term success, however, must rely on changing public attitudes that tolerate killing manatees for human consumption.

12. Determine manatee movement patterns and trends in abundance and distribution.

121. Develop and implement a standardized aerial survey plan to measure trends in abundance and distribution.

Aerial survey data in conjunction with mortality data provide the only basis for assessing the status of the manatee. A standardized survey plan should be developed and implemented to determine population trends. These data, in conjunction with mortality data, will provide the essential information needed to assess the status of the population.

122. Radio-tag manatees to determine habitat utilization and movements within Puerto Rico and to determine relationship to manatees outside Puerto Rico.

While aerial surveys can detect general localities of manatee abundance, more intensive VHF radio tracking studies are required if specific areas of essential habitat are to be identified. This is extremely critical information if manatees and their essential habitat are to be protected from development threats. Studies should be initiated first at Roosevelt Roads Naval Station, an area of known manatee abundance and greatest potential conflict. Approximately ten manatees should be radio-tagged and monitored each year for a two year period. Additional radio-tagging studies should then occur along the southern coast near Ponce and the western coast near Mayaguez. Several manatees should be tracked with satellite tags to determine long range movements within Puerto Rico and, in particular, determine any movements between Puerto Rico and other Caribbean islands. The

most likely inter-island movements would be with Hispaniola. While there is no evidence that manatees travel to other islands, if regular movements do occur, this could have a significant bearing on assessing the status of the Puerto Rico population.

13. Determine food habits of manatees.

While manatees appear to feed on a wide variety of aquatic and marine plants, there is evidence that some species or parts, such as rhizomes, may be preferred. This information will provide a basis for identifying the most important feeding areas in need of protection.

14. Assess contaminant concentrations in manatees.

There is little likelihood that contaminants pose a problem for manatees since they are primary consumers and are not expected to concentrate most contaminants. Nevertheless, this should be confirmed since some areas, like the central southern coast, do pose a high potential risk to manatees. This can be done in conjunction with an expanded carcass salvage program.

15. Determine quantitative recovery criteria.

Criteria should be based on some measure of mortality and abundance trends since it is unlikely that exact numbers of dead or live manatees can be determined. A minimum population size should be established, based on genetic requirements, to prevent extinction from stochastic perturbations and catastrophic events. Additionally, criteria must also include goals which must be met for long-term habitat protection and adequate mechanisms must be in force to ensure poaching or boating conflicts will remain under control once reclassification occurs. It may be that because of low numbers and high mortality levels, manatees may never be reclassified beyond threatened status in Puerto Rico.

16. Develop manatee protection plans for areas of specific importance.

Areas such as Roosevelt Roads Naval Station should develop plans to ensure that waterborne activities remain compatible with manatee requirements. Plans

should address boat densities, the need for sanctuary areas or boat speed regulatory zones, information and education, data needs, etc.

2. Habitat Protection.

21. Radio-tag manatees to determine habitat utilization (See recovery task 122).

22. Determine and map distribution of sea grass beds and sources of fresh water.

Coastal sea grass beds and freshwater sources should be identified and mapped. This information can be integrated with data from aerial surveys and radio tracking studies and is a prerequisite to subsequent monitoring and protection efforts for manatee habitat.

23. Monitor important habitat components and ensure protection.

Essential manatee habitat identified must be continuously monitored to prevent degradation and loss. Sea grass beds should be periodically surveyed to detect trends in the manatee food base. Also see recovery task 114, which should also apply to manatee habitat.

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PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 4 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the forseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULE

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Part III Implementation Schedule

Antillean Manatee

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS						
					Region	Division	Other	FY 1	FY 2	FY 3	
I-1	Expand carcass salvage program	111	2	10-15 yrs	4	SE/RF	PRDNR, USN, CG	30K	30K	30K	
I-1	Conduct interview surveys	112	2	3-5 yrs	4	SE	PRDNR	5K	5K	5K	
O-3	Assess need for boat regulatory zones	113	3	Continuous	4	SE	PRDNR				
M-7	Review coastal developments	114	2	Continuous	4	SE	PRDNR				
O-1	Develop I & E program	115	2	Continuous	4	SE/RF	PRDNR	20K	2K	2K	
O-2	Increase LE efforts	116	2	3-5 yrs	4	LE	PRDNR	50K	50K	50K	
I-1	Abundance and distribution surveys	121	2	Continuous	4	SE/Res	PRDNR	25K	25K	25K	
I-1,3	Radio tracking study	122/21	2	5-6 yrs	4	Res	PRDNR	100K	100K	100K	
I-14	Determine food habits	13	3	3 yrs	4	Res		20K	20K	20K	
I-12	Assess contaminant concentrations	14	3	5-10 yrs	4	Res					In conjunction with Task 111

Part III Implementation Schedule

Antillian Manatee

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS						
					Region	Division	Other	FY 1	FY 2	FY 3	
M-7	Determine recovery criteria	15	3		4	SE/Res					Contingent on data from Tasks 111, 112 & 121
M-7	Develop manatee protection plans	16	2	3 yrs	4	SE	PRDNR, USN				Contingent on data from Tasks 111, 112, 121, & 122
M-3	Map seagrass beds	22	3	1 yr	4	SE	PRDNR			25K	
M-3	Monitor habitat	23	2	Continuous	4	SE	PRDNR				

LIST OF ABBREVIATIONS

PRDNR = Puerto Rico Department of Natural Resources
USN = U.S. Navy
FWS = U.S. Fish and Wildlife Service
CG = U.S. Coast Guard
SE = Endangered Species
RF = Refuges
Res = Research
LE = Law Enforcement

PART IV: APPENDIX

Appendix A - List of Reviewers for the West Indian Manatee Recovery Plan

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