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West Indian Manatees (*Trichechus manatus*) in the Wider Caribbean Region

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The Antillean or Caribbean subspecies (*Trichechus manatus manatus*) of the West Indian manatee is classified as endangered on the IUCN Red List because the current population is thought to be fewer than 2,500 mature individuals and is predicted to undergo a decline of more than 20% over the next two generations unless effective conservation actions are taken[1]. Yet the West Indian manatee is possibly the best understood species within the family Trichechidae. Since the late 1960s, research on the most northern subspecies, the Florida manatee (*T. m. latirostris)*, has grown exponentially, driven by state and federal agencies, universities, and nongovernmental organizations[2].

In this chapter we address conservation of the remaining West Indian manatees in the Wider Caribbean (WCR), including those populations within the Caribbean Sea, the western Gulf of Mexico and along the Atlantic coasts of the Bahamas, the Greater and Lesser Antilles, and the northern and northeastern coast of South America. The common names Antillean and Caribbean are somewhat misleading. Antillean refers to the Greater and Lesser Antillean Islands; Caribbean refers to the Caribbean Sea, which borders Florida, the Gulf of Mexico, the Antilles, and Central and South America west of the Antilles. But the habitat range of West Indian manatees extends beyond both of these areas and includes the Bahamas, the Gulf coast of Mexico, the Caribbean coast of Central and South America, the Greater Antilles, and the Atlantic coast of South America as far south as Brazil (map 4.1). Moreover, at least one manatee in the Bahamas and one manatee in Cuba are emigrants from the Florida population[3]. Manatees in Guyana, Suriname, French Guiana, and Brazil are classified as a genetically distinct population from both Florida and Caribbean manatees[4]. These recent findings provide considerable evidence that West Indian manatees in the WCR are genetically distinct populations and should be managed as three biogeographic groups: (1) Bahamas, Florida, and the Greater Antilles; (2) Central and South America west of the Lesser Antilles; and (3) northeastern South America east of the Lesser Antilles. In this chapter we refer to all populations from the Bahamas to Brazil, excluding Florida, as WCR manatees. In an effort to highlight advances in each region, we have included text boxes by local scientists where research and conservation efforts have been expanded in recent years.

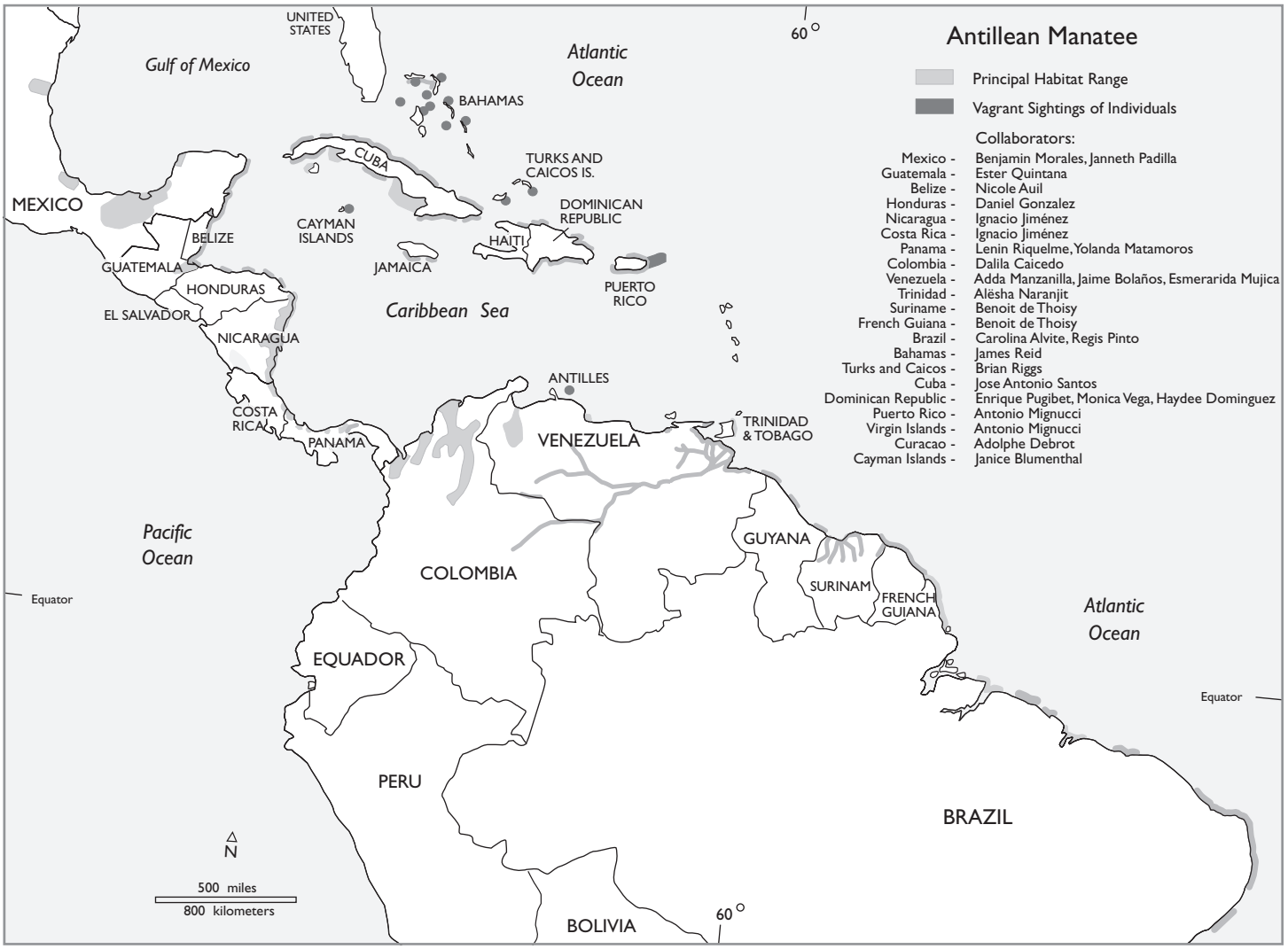
The WCR provides great diversity of habitat owing to geographical, environmental, social, cultural, economic, and political variation. As a result conservation strategies developed specifically for the Florida manatee may not be generally applicable to WCR manatees. Based on diversity within the region and the growing evidence that some individual manatees are wanderers, traveling hundreds of kilometers[5], WCR manatee conservation strategies are most beneficial when they are both locally derived and regionally collaborative.

Background

Had manatee meat not been an important source of food for Indigenous Americans, explorers, immigrants, and slaves, we would know very little about the species' historical range and status within the WCR. Archaeologists have documented the importance of manatee meat to pre-Columbian inhabitants. Early explorers and naturalists often wrote about the distribution, abundance, and use of manatees. Thanks to these writings we have a view into the past that enables us to estimate the historical and prehistoric distribution and abundance of WCR manatees[6].

Historical Distribution

Archaeological evidence indicates that though manatees were used by pre-Columbian inhabitants of the WCR[7], manatee remains are rare in midden deposits, possibly because they were butchered at nearshore shore or offshore sites with only the meat transported inland[8]. Given the rise in sea level since the end of the



Map 4.1. Antillean manatee distribution. (Map by Ellen McElhinny.)

Pleistocene, most of these sites may be underwater or overgrown with mangrove forests[9]. Analysis of one bone midden on Moho Caye, a small island near Belize City, indicates that manatee was a primary food source for the coastal Maya[10]. The midden contained remains of manatee, mollusk, fish, turtle, and deer. Eighty-nine percent of the estimated harvest was manatee, indicating that it was the main source of meat for the Maya hunters and fishers who used Moho Caye during the Middle Classic Period (circa 400–700 AC).

Writings by early explorers and naturalists, along with historical trade documents, have led scientists to hypothesize a significant reduction in the number of WCR manatees over the past 300 years. In 1492 Columbus reported "swarms" of manatees in Cuba and also documented their presence in Hispaniola[11]. In 1520 Oviedo described hunting techniques used by both natives and Spaniards[12]. In 1699 Dampier reported manatee abundance and exploitation throughout the WCR. Whitehead[13] provides an extensive review of the records documenting manatees as far south as 20°S latitude. As recently as 1964 a ton of manatee meat was harvested in Bahia, Brazil[14], an area where manatees are locally extinct today[15]. For a more detailed review of the archaeological and historical records see Durand and see Lefebvre et al.[16].

Historical Research

The earliest scientific investigations of Antillean manatees in the WCR were conducted in the Guianas[17]. After their first expedition there in 1962, Drs. Colin Bertram and Kate Ricardo Bertram, a husband and wife team from the University of Cambridge, U.K., dedicated four decades of their lives to sirenians, publishing more than 20 papers and bringing the dire status of these previously unstudied aquatic mammals to light[18]. Ironically, very little is currently known about the population in the Guianas.

Early scientific expeditions rarely resulted in the direct observation of living manatees. Data were more often limited to interviews with local inhabitants, counts and measurements of harvested animals, and descriptions of manatee habitat. However, interviews with local people have proven to be an essential first step in determining where manatee populations exist within the WCR[19].

During the later twentieth century a contingent of U.S. scientists followed up on interview results by working with local stakeholders to determine distribution and abundance of manatees in the WCR via aerial surveys. By the late 1970s and early 1980s, aerial surveys had become a primary tool for counting manatees in remote areas. Since that time aerial surveys have been conducted in Puerto Rico[20], Jamaica[21], the Dominican Republic[22], Haiti[23], Cuba[24], Mexico[25], Belize[26], Guatemala[27], Honduras[28], Nicaragua[29], Costa Rica[30], Panama[31], and Venezuela[32].

Broad-scale countrywide aerial surveys have become an important tool for predicting manatee presence and habitat use; however, aerial surveys have not proven useful until recently in determining actual population numbers or trends in population size[33]. In the WCR, countries are relatively small and manatees are known to cross political boundaries. Comparison of counts between countries, or even within countries over time, is also difficult owing to variations in survey techniques and the probability of detection, which depends on observer experience, habitat type, and environmental conditions. For example, in the southern Yucatán (Mexico and Belize), where aerial surveys have been conducted frequently in recent years, scientists warn that count variability may result from (a) real changes in population size and distribution, (b) short-term and random movements by manatees, (c) variation in observer reliability, (d) variation in survey methods, or (e) inconsistent detectability biases across spatial and temporal variables such as habitat type and season[34].

Most recently scientists have turned to smaller scale, site-specific studies that include live captures, boat surveys, photo-ID, remote sensing and telemetry, rescue, health assessment, and necropsy programs. For example, since Puerto Rico is a U.S. commonwealth, conservation of the manatee population falls under the jurisdiction of U.S. federal agencies; as a result the manatee population has been studied extensively using the same tools and techniques as in Florida.

In Mexico and Belize, where funding is more likely to come from nongovernmental organizations, advanced techniques have enabled scientists to perform health assessments on populations in Chetumal Bay, Northern and Southern Lagoon, the cayes near Belize City, and Placencia Lagoon[35]. Collaboration among scientists working in the region has improved our ability to estimate population numbers and identify populations at risk and has enabled the detection of seasonal variance in distribution[36].

As with all sirenians, there has been an explosion of new information on WCR manatees over the past 10–15 years, including a better understanding of the importance of habitat and breakthroughs in evolution and genetics[37]. However, if we are to ensure the survival of WCR manatees, we must move beyond traditional approaches of assessment to novel research, interdisciplinary partnerships, and an expansion of policy and conservation efforts[38].

Current Distribution

WCR manatees require habitat that provides specific resources, including fresh water for osmoregulation, warm water for thermoregulation, aquatic vegetation for foraging, quiet secluded areas for resting and reproduction, and safe travel corridors for moving between these activity centers. Many countries within the WCR provide excellent manatee habitat (map 4.1). During the past two decades, manatees have been documented in 27 countries within the WCR[39]; however, year-round populations exist in only 20 (excluding Florida; see table 4.1). Although rare manatee sightings have been reported in small islands of the Greater Antilles (Brit-

BOX 4.1

Manatees in Hispaniola

Haydée Domínguez Tejo

The island of Hispaniola is part of the Greater Antilles and includes two countries: the Dominican Republic (DR) and Haiti. Manatees in the DR are protected by national legislation and by international agreements. Haiti provides no legal protection at this time.

In Haiti the current status of manatees is unknown, but progress is under way. A presidential decree to

establish Haiti's first Marine Protected Area is currently under evaluation. In 2007 manatees were sighted in the Port-au-Prince bay area, along the seagrass beds north of Arcahaie. The proposed protected area includes the location of the latest manatee sightings.

In the Dominican Republic manatees are commonly found in coastal marine and estuarine environments in (1) the northwest coast, from Manzanillo Bay to the Bajabonico River mouth; (2) the northeast coast, along the north coast of the Samana Peninsula, and in the south coast of Samana Bay; (3) the southwest coast, in the Neiba and Ocoa Bays, and east of the Oviedo Lagoon (see map 4.1; Husar 1977; Belitsky and Belitsky 1980; Lefebvre et al. 1989, Ottenwalder 1995; León and Ottenwalder 1997 unpubl.; Pugibet and Vega 2000 unpubl.; Domínguez 2006, 2007 unpubl.). Within these areas manatees appear to favor shallow protected waters in enclosed bays, coastal lagoons, and reef lagoons, where there are mangroves, seagrass beds, and nearby sources of fresh water at river mouths and natural springs. Manatees are occasionally reported outside these three main areas. They have been confirmed by reliable sources along the north coast close to Puerto Plata in 2007 and 2009, and on the southeast coast from Boca de Yuma to Bayahibe in 2006–2008. At the eastern tip of the island, manatee presence was confirmed in Bavaro by SCUBA divers in 2005 and 2006 and by a neonate found in 2008.

Manatee presence has been recently confirmed in at least nine of the coastal marine protected areas in the DR via (1) direct observations during land, boat, and aerial surveys; (2) carcass recoveries; and (3) reliable sighting reports from land, water, and air during commercial flights, all dating from 2004 until the present. These sightings include evidence such as still images or videos of manatees. Some individuals present small scars or markings that may be useful for photo-ID efforts. Furthermore, there are potential locations for manatee photo-ID studies on the north coast of the Samana Peninsula, at Bavaro and in Parque Nacional Jaragua, where manatees have been sighted in clear waters with excellent visibility.

Since 2006 site-specific studies have been conducted by the Marine Biology Research Center of the Autonomous University of Santo Domingo (CIBIMA-UASD) and by local and international NGOs, such as FUNDEMAR and Wildlife Trust. Current research methods include interviews, boat and land-based surveys, and most recently aerial surveys in the Samana Bay area in 2008–2009. All research includes an educational component via workshops for different audiences, and field visits, promoting manatee conservation.

Research on manatee distribution and habitat use by CIBIMA-UASD has revealed an important manatee activity center within the Marine Mammal Sanctuary of Estero Hondo. A coastal lagoon surrounded by mangroves, with calm shallow waters, abundant seagrasses, and freshwater input, has been identified as a feeding, resting, and breeding activity center, where manatees are present year-round, including mother-calf pairs (Domínguez 2007 unpubl.). At least two different sets of triads, consisting of an adult female and two calves of practically the same size, were sighted repeatedly in 2007 and 2008, suggesting the repeated occurrence of twins. Since viable twins are thought to be extremely rare in manatees, these observations invite further studies.

The Nature Conservancy (TNC) analyzed the marine protected areas of the country through a series of participative workshops in 2006–2008(Domínguez et al. 2008). Manatees and sea turtles were established as conservation objects of national priority in terms of coastal marine biodiversity. The national goal was set to protect 65% of their area of distribution within protected areas by 2010. Two proposals, under review at the time of writing, were presented to the government to fulfill this goal. CIBIMA-UASD is currently working with TNC, developing a conservation action plan for the Marine Mammal Sanctuary of Estero Hondo, with manatees as one of the conservation targets.

In spite of these efforts, there are many challenges to overcome: law enforcement is lax; there is still illegal manatee hunting; there is no national conservation and recovery plan for the species, and no ongoing manatee research and conservation efforts exist in most of the marine protected areas due to lack of funds and expertise and limited personnel capacity. To produce the needed information for manatee recovery and conservation, future plans for the Dominican Republic include boat surveys in other possible manatee activity centers along the northwest and southwest coast, nationwide aerial surveys, photo-ID, and telemetry studies.

Acknowledgments

Information regarding the current situation in Haiti was kindly provided by Jean W. Weiner, director of the marine conservation NGO Fondation pour la Protection de la Biodiversité Marine (FoProBim).

ish and U.S. Virgin Islands, Turks and Caicos, Cayman Islands), Lesser Antilles (St. Maarten), and off the coast of South America (Curaçao, Bonaire), these are thought to be wanderers from nearby populations.

All manatee populations within the WCR are locally classified as threatened or endangered, but conservation status varies widely among the 20 countries with year-round sightings[40]. In many locations population sizes and trends are unknown (table 4.1). For the first time, the 2008 IUCN Red List assessment estimated population sizes using orders of magnitude. By country, numbers range on the order of 10 (Bahamas) to 1,000 (Belize, Mexico), with most estimates on the order of 100–500[41]. Using these rough estimates, the total number of manatees in the WCR (excluding Florida) may fall somewhere between 3,000 and 6,000 individuals, including calves and independent juveniles. Extrapolating from Florida data on the proportion of mature manatees, this would put the population of reproductively viable adults at less than 2,500. However, this estimate is at best an educated guess. The revised UNEP/CEP Regional Management Plan is the most recent source of information[42]. Unfortunately, much of the data in this report is based on personal communication and gray literature.

Legal Status

Manatees and their habitats throughout the WCR are protected by both national legislation and international agreements[43]. Legal status and conservation efforts in the region were greatly enhanced when the Caribbean governments reached an agreement during the Convention

Table 4.1. Distribution, status trend, minimum population counts, and population estimates (including adults, calves, and juveniles) for the Wider Caribbean Region.

Country	Trend	Minimum Counts	Population Estimate
Bahamas	I	5	10
Belize	S/D	700	1,000
Brazil	S/D	200	500
Colombia	U/D	100	500
Costa Rica	D	30	100
Cuba	U/D	50	100
Dominican Republic	D	30	100
French Guiana	S	10	100
Guatemala	U	50	150
Guyana	D	25	100
Haiti	U	5	100
Honduras	S	50	100
Jamaica	U/D	25	50
Mexico	U	1,000	1,500
Nicaragua	D	71	500
Panama	U	10	100
Puerto Rico	S	308	618
Suriname	D	10	100
Trinidad & Tobago	D	25	100
Venezuela	D	25	100
Virgin Islands (USA)	E	vagrant	0
Virgin Islands (UK)	E	vagrant	0
Bonaire (Netherlands)	E	vagrant	0
Curaçao (Netherlands)	E	vagrant	0
Turks and Caicos (UK)	E	vagrant	0
Cayman Islands (UK)	E	vagrant	0
Sint Maarten (Netherlands)	E	vagrant	0
Totals		2,730	5,928

Sources: Quintana-Rizzo and Reynolds 2007; Deutsch et al. 2008; Self-Sullivan and Mignucci-Giannoni 2008.
Notes: The last seven locations listed have reported rare sightings of manatees in recent years.
I = possible increase
S = likely stable
D = probable decline
U = unknown (data deficient)
E = locally extinct

for the Protection and Development of the Marine Environment of the Wider Caribbean Region, held in Cartagena on 24 March 1983. The Convention established a regional policy of protection for both endangered species and their habitats. Subsequently, the Specially Protected Areas and Wildlife (SPAW) Protocol to the Convention has become a driving force for the conservation of manatees as a species of priority concern in the WCR[44].

However, legal protection alone has not ensured the survival of manatees and will not. Despite the fact that manatees have been protected by local legislation for over 50 years (table 4.2), illegal hunting and destruction of habitat continue. In additional to local laws, the Convention on International Trade of Endangered Species (CITES)[45] has been ratified by all WCR countries with year-round manatee populations except Haiti. All but three countries have one or more Ramsar sites. The Ramsar Convention on Wetlands, which was signed in Ramsar, Iran, in 1971, is an international agreement that provides a framework for the conservation of wetlands and their resources[46]. Although most countries have signed, ratified, or acceded to these and other international agreements, governmental agencies charged with managing protected species and protected areas in the WCR are generally small and understaffed[47]. Throughout the region, co-management agreements between governmental agencies and NGOs are emerging as one solution to the lack of governmental resources[48].

Threats

Historically, the most significant decline in the number and distribution of WCR manatees came as the result of hunting, which was documented with varying accuracy into the 1960s[49]. When comparing historical writings to the current population estimates, the subspecies may have been reduced by an order of magnitude over the past three centuries. Intrinsic factors, including extremely low fecundity and slow growth, and anthropogenic factors have been cited as reasons for limited recovery of manatees to their historical numbers[50].

The major threats to the survival of WCR manatees today include poaching, incidental or accidental catch, habitat degradation and loss, watercraft collisions, entanglement in fishing gear, chemical contamination and other pollution, natural disasters, and human disturbance[51]. Although threats due to hunting are diminishing in some areas, other listed threats appear to be increasing.

Because the distribution of WCR manatees is linked to

Table 4.2. Partial list of legal protections for manatees and their habitats in the Wider Caribbean Region.

Country	NL	Ramsar	CITES	SPAW
Bahamas	1968	1	1979	NK
Belize	1933	2	1981	2008(R/A)
Brazil	1967	8	1975	NK
Colombia	1969	5	1981	1990(S)/1998(R/A)
Costa Rica	1953	11	1975	NK
Cuba	1936	6	1990	1990(S); 1998(R/A)
Dominican Republic	1938	1	1987	1998(R/A)
French Guiana (FRANCE)	1986	3	1978	1990(S); 2002(R/A)
Guatemala	1959	7	1980	1990(S)
Guyana	1956	NK	1977	NK
Haiti	NK	NK	NK	NK
Honduras	1959	6	1985	NK
Jamaica	1971	3	1997	1990(S)
Mexico	1921	113	1991	1990(S)
Nicaragua	1956	8	1977	NK
Panama	1967	4	1978	1991(S); 1996(R/A)
Puerto Rico	1943	NK	1975	1990(S); 2003(R/A)
Suriname	1954	1	1981	NK
Trinidad & Tobago	1975	3	1984	1990(S); 1999(R/A)
Venezuela	1970	5	1978	1990(S); 1997(R/A)

Sources: Quintana-Rizzo and Reynolds 2010; Self-Sullivan and Mignucci-Giannoni 2008; Ramsar 2009; CITES 2011; UNEP 2009.
NK = none known
NL = earliest known date of species and/or habitat protection by local legislation
Ramsar = number of Ramsar sites
CITES = date of entry into force
SPAW = date signed (S), ratified (R) or acceded (A) to the Specially Protected Areas and Wildlife Protocol of the Cartagena Convention.

the availability of aquatic vegetation, their range, similar to growing human populations, is restricted to the coastal zone: rivers, lakes, estuaries, and seagrass beds along the coastline. The resulting shared habitat naturally results in competition for space with human populations. In areas with high boating, fishing, agricultural activity, or poverty, the competition often ends tragically, especially when humans are using motorized watercraft, gillnets, and agrochemicals.

Hunting and Incidental Catch

Historically, manatees were hunted for meat, oil, and bones. The meat provided a good source of protein, oil was used for cooking, and bones were shaped into weapons, Indigenous religious tools or ground for medicinal purposes. Today, WCR manatees appear to be poached almost exclusively for meat[52]. Depending on the market, manatee meat may sell for anywhere from US$2 to US$100 per pound. Illegal hunting, both for subsistence and profit, is a significant threat in Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, French Guiana, Guatemala, Honduras, Mexico, Suriname, Trinidad, and Venezuela[53]. A favored technique uses a float tied to a harpoon. Hunters harpoon and chase a manatee by following the float until the animal becomes exhausted. Then it is dragged to shore and killed by stabbing or blunt force to the head.

Other hunters are known to place a gillnet across water between rivers and coastal seagrass beds. Incidental entanglement in nets and other fishing gear is often difficult to distinguish from such intentional hunting. Most fishers do not report cases of incidental catch or accidental entanglement[54], possibly harvesting the meat for subsistence or commercial sale.

Watercraft Collisions

With increased tourism in the Caribbean and Central and South America, competition for space between manatees, boats and jet-skis has become a significant threat. Recent studies in Belize and Puerto Rico provide a good example. Although older studies detected no scarring from boats[55], watercraft collision is currently considered one of the leading causes of manatee mortality[56]. With an exponential increase in cruise ship tourism between 2001 and 2004[57], the local perception is that more manatees are being injured or killed by boats each year, especially near Belize City[58]. Boat based studies using photo and video-ID methods indicate that more than 80% of the manatees at Basil Jones and 44% of the manatees in the Drowned Cayes bear scars from non-lethal watercraft collisions[59]. The unique scars are being used to develop a photo-ID catalogue of the manatees in the region[60].

Other Direct Human Disturbance

In addition to collisions, an increase in the number of boats and other human activities also interrupts manatees that are using the areas for feeding, resting, and nursery activities. Little is known about the long-term effects of disturbance on manatee populations; however in the short-term, boats and other watercraft are known to separate mother-calf pairs, often permanently. In Belize tour operators have been observed using small, fast, inflatable boats to bring tourists to known feeding, resting, and nursery areas in the Drowned Cayes and the Belize River, causing manatees to leave. In northeastern Brazil the stranding of live-orphaned calves is considered a primary threat to the subspecies[61]. Researchers concluded that watercraft and other human disturbance

BOX 4.2

Antillean Manatees in Brazil

Carolina Mattosinho de Carvalho Alvite and Regis Pinto De Lima

In Brazil sirenians were observed by the earliest European settlers in the 1500s (Whitehead 1978) ranging from Vila Velha, Espírito Santo (~20°S), to Cape Cabo Orange, Amapá (~4°N). An anonymous author traveling with the Pedro Álvares Cabral Portuguese discovery expedition described a female manatee with "ears the size of arms" in present-day Cabrália, Bahia. We can only assume the author was describing the manatee's forelimbs! Cristóvão de Lisboa, a Franciscan missionary who lived for twelve years in São Luís, Maranhão, reported groups of 300 or more in lagoons, rivers, and coves and along the northeastern coast. Goeldi (1893) reported manatees along the northernmost coastline between Cape Cabo Orange (4°25′N) and Cape Raso do Norte (1°43′N). Ferreira (1903) described manatees near Marajó Island and in rivers in the State of Grão Pará. He reported that they fed on riverside grasses and were harpooned by two or three aborigines in a small canoe. Ferreira also mentions a rare kind of manatee called a butter manatee, "peixe-boi manteiga." From these and other early explorers and writers, we know that historically, manatees were observed in abundance along the north, northeastern, and southeastern coasts of Brazil.

Today the Antillean manatee is listed as critically endangered by IBAMA, the Brazilian Institute for the Environment and Renewable Natural Resources. Population estimates lack calibration and surveys to monitor trends are not being conducted in all areas of historical occurrence. There is no rigorous information about the current population trend, but if we consider the threats and the estimated population size of ~500 individuals (Lima 1997; Luna et al. 2001), the population should be considered decreasing. The estimate of ~500 manatees represents a significant decrease over the past centuries when manatees were one of the most important sources of animal protein in the country. Indiscriminate killing finally motivated the government to prohibit hunting in 1967. However illegal hunting continued until the 1980s. Today hunting is rare, at least along the northeast coast, due to increased conservation efforts. However, manatees in Brazil continue to be threatened by entanglement in fishing nets and indiscriminate coastal development, which has degraded Brazil's aquatic environments. Additionally, increased boating activities have resulted in both lethal collisions with manatees and disruption of manatee behavior, often causing animals to leave their normal habitat.

The stranding of live-orphaned calves has been identified as the main recent threat to the species in northeastern Brazil (Lima et al. 1992; Lima 1997; Parente et al. 2004). Between 1981 and 2002, 74 stranded manatees were reported on the northeastern coast of Brazil; 58% (n = 43) were live manatees. During this period, all the live-stranded manatees were dependent calves, suggesting that that the main reason for manatee strandings along the northeastern coast is the separation of mothers from their calves. This area has become degraded due to shrimp and salt farms and uncontrolled tourism, which has reduced habitat available to manatees for calving and nursing (Lima 1997; Parente et al. 2004).

The coast of Brazil provides three distinct biogeographical habitats for manatees. The north region has a tropical climate, influenced by the South Equatorial Current and the Amazon River, which renders the waters murky and productive. Large, continuous mangrove forests dominate the coastal landscape, fringed by a *Spartina* species of seagrass, which is an important food source for the manatees. Antillean and Amazonian manatees are sympatric near the mouth of the Amazon, and hybrids have been identified using genetic analysis (Vianna et al. 2006; Garcia-Rodriguez et al. 1998). The northeastern region, where most of the research and conservation efforts in Brazil are focused, with its clear, warm waters, has many estuaries, mangrove forests, and coral reefs surrounded by marine algae and seagrass beds including *Halodule*, the preferred manatee food in the region. The southeastern region is more temperate and strongly influenced by both the cooler southern climate and the warm Brazilian Current, which flows from north to south along the coast. In recent years manatees have been reintroduced by scientists in the states of Paraíba and Alagaos. At least one has traveled as far south as the state of Sergipe (see map 4.1).

In 1972 the IUCN Red Data Book classified the species as vulnerable, with a southernmost distribution along the Atlantic coast of the Guianas, excluding Brazilian territory. In 1976 the southernmost distribution was expanded to include northern Brazil. In 1980 Projeto Peixe-Boi (the Brazilian Manatee Project, now run by IBAMA, the national environmental authority), conducted the first surveys in Brazil. They confirmed that manatees had vanished from the states of Espírito Santo and Bahia in the southeast. However, between 1990 and 1993, the Igarakue mobile unit, organized by Projeto Peixe-Boi undertook an extensive survey from Mangue Seco in Bahia to the Oiapoque River, the border between Brazil and French Guyana, conducting interviews with local people, gathering biological material, and reviewing older literature. The survey concluded that the manatee was extirpated in the states of Espírito Santo, Bahia, and Sergipe but still extant from Alagoas to Amapá.

from an increase in shrimp farms, salt farms, and tourism are causing mother-calf separation and a high number of calf strandings.

Cultural and Socioeconomic Significance

Cultural and socioeconomic significance of manatees varies within the WCR. In the Greater Antilles, manatee fat was used by Indigenous people to cook, make candles, and cure diseases. Today in the Dominican Republic, manatee meat, fat, and artisanal products are still used in localized places based on these traditions[62]. Bones have special value as medicines. The ancient Tainos of Hispaniola and Puerto Rico crafted rib bones into ceremonial instruments such as spatulas to induce vomiting[63]. In Cuba poaching does not seem to be a major threat. More than 80% of people interviewed were aware of the laws protecting manatees[64].

In Central America the ancient Maya hunted manatees for spiritual requirements as well as for the meat.

The ear bone was considered an amulet that protected its owner from evil powers. A special process was used to dry manatee meat, called *bucan*, which was thought to increase a man's strength and virility[65]. Today in Belize the living manatee is culturally and socioeconomically significant primarily as a tourist attraction. However, along the Miskito Coast of Nicaragua, Indigenous people continue to hunt manatees and may take up to 40 animals per year[66].

In South America Indigenous peoples were hunting manatees prior to European colonization, using both harpoons and nets. Specialized knowledge of manatee behavior, required to become a successful hunter, was passed down from one generation to the next[67]. In Brazil some cultures believe that manatee genitalia, skin, and ribs have magical significance. In French Guiana some cultures believe the manatee to be a water spirit; others consider the ear bones to be charms with therapeu-

BOX 4.3

Manatees in Nicaragua and Costa Rica, Central America

Ignacio Jiménez Pérez

Historical distribution of manatees in Nicaragua and Costa Rica was probably determined by water depth and accessibility of watercourses and wetlands connected to the Caribbean Sea. There is some evidence that manatees once inhabited Lake Nicaragua (O'Donnell 1981), the largest body of fresh water in Central America. It still contains other marine species, including sawfish, tarpon, and bull sharks. Despite its proximity to the Pacific, the lake drains into the San Juan River, which currently has manatees in its lower regions near the Caribbean (Jiménez Pérez 1999, 2003). However, upper regions of the river contain rapids that should prevent manatee movement to and from Lake Nicaragua, despite the fact the bull sharks, jumping like salmon, navigate the rapids. Manatees have not been observed in the Sarapiquí and San Carlos, two large rivers that drain into the San Juan from Costa Rica, since the late 1800s. Massive deforestation has been blamed for the species' absence in these two rivers, as in the Parismina, Reventazón, and Matina (O'Donnell 1981, Jiménez Pérez 2005a, 2005b). Manatees were also formerly present in the small Estrella River and Mahogany Creek in southern Costa Rica, and in the Walpasiksa River bar in Nicaragua, and may have used the lower Coco River, on the border between Nicaragua and Honduras (Jiménez Pérez 1999, 2002; see map 4.1).

However, manatees are still present in most areas of their historical range in Nicaragua and Costa Rica, though there are no good estimates of manatee abundance. They have recently been observed along the Caribbean coast, in the main rivers and lagoons near the sea, and up to 60 km upstream in the San Juan, Wawa, and Kurinwás rivers (Jiménez Pérez 1999, 2002). Aerial counts have either underestimated the population substantially, as was the case in Costa Rica (Reynolds et al. 1995), or were limited to a small fraction of the national range, as happened in surveys carried out by Carr (1994) in the Miskito lagoons of northern Nicaragua. In fact, Nicaragua may have one of the highest densities in the Caribbean, with some groups surpassing 20 individuals. Informed guesses estimate that 30–60 manatees inhabit Costa Rica, found mostly in the northeastern half of the country (Jiménez Pérez 1999), and that several hundred individuals were present in Nicaragua (Jiménez Pérez 2002). Aerial surveys and interviews indicate much larger manatee groups in northern Nicaragua than in southern Nicaragua and Costa Rica (see Carr 1994; Reynolds et al. 1995; Jiménez Pérez 1999, 2002, 2005b). Northeastern Costa Rica is the only area in both countries where there has been some systematic research on population trends of manatees. Jiménez Pérez (2005b) used standardized interviews to assess population changes in this region between 1996 and 2005, concluding that manatee abundance and group size had probably increased during the last ten years.

To understand differences in conservation status between the two countries, we should look at the history of manatee hunting. Hunting was common practice in Costa Rica during the 1960s and 1970s, becoming rare in 1980s, and was practically extinguished by the late 1990s due to scarcity of manatees and the initiation of conservation (Jiménez Pérez 1999). A similar pattern, 5–10 years later, occurred in southeastern Nicaragua (Jiménez Pérez 2003). Manatee numbers have rebounded from a minimum during the last two decades in the frontier region between Nicaragua and Costa Rica.

On the other hand, manatee hunting decreased sharply in central and northern Nicaragua during its civil war in the 1980s, only to be revived in Indigenous communities (e.g., Halouver, Krukira, Bismuna, and Rama Cay) after peace returned in the 1990s (Jiménez Pérez 2002). Between 1999 and 2001, an estimated 41 to 49 manatees were killed in Nicaragua. Present poaching rates in northern Nicaragua vary from year to

year, depending on such economic and social factors as commercial fishing, logging contracts, and cocaine smuggling (Espinoza Marin 2004). Thus it is extremely difficult to provide a realistic assessment of the population status of manatees in the northern half of Nicaragua.

Both Nicaragua and Costa Rica harbor abundant, pristine manatee habitat. Northeastern Nicaragua has extensive floodplains of up to 100 km in width along its Caribbean coast, which include many slow-moving rivers, creeks, lagoons, and bays. Vegetation is abundant and ranges from tropical forest species along the river banks to large mangrove-enclosed lagoons of seagrass beds. Shallow water with extensive seagrass beds extends far offshore (Jiménez Pérez 2002).

In southeastern Nicaragua and northeastern Costa Rica the large brackish lagoons have been replaced by freshwater rivers, creeks, and small lagoons surrounded by rainforest and grass-swamps. The largest rivers in this area carry abundant sediments from the volcanic interior to the sea, creating a highly turbid coastline with few seagrass beds. As a result, manatees in this region are more abundant inland in wide, slow-moving rivers and lagoons with abundant emergent and floating vegetation, similar to habitats used by the Amazonian manatee (Jiménez Pérez 2005). Among these habitats, the Tortuguero waterways have the greatest disturbance due to an increasing ecotourism industry and pesticide runoff from neighboring banana plantations.

South of the Tortuguero floodplain there is a 45 km stretch without good manatee habitat, until seagrass beds reappear in the coastal zone close to the Panama border, and emergent vegetation becomes abundant in the Sixaola River (Jiménez Pérez 1999). This small area in southeastern Costa Rica is connected to known manatee habitat in San Changuinola, and Bocas del Toro, Panama (Mou Sue and Chen 1990).

A vast network of protected areas covers over 60% and 85% of manatee habitat in Nicaragua and Costa Rica, respectively. However, differences in enforcement of conservation policies vary widely. Protected areas in central and northern Nicaragua are little more than "paper parks" where native people tend to be unaware of the existence of reserves, and manatee poaching is common in some Miskito and Rama indigenous communities (Chacón 2000; Jiménez Pérez 2002; Espinoza Marin 2004). On the other hand, the UNESCO Rió San Juan Biosphere Reserve has significant enforcement due to governmental presence. This large reserve is adjacent to the Tortuguero Conservation Area in Costa Rica, with a longstanding tradition of protected area management. This binational network of protected areas along the Nicaragua-Costa Rica border provides one of the best conservation strategies for manatees in Central America.

tic properties[68]. In Venezuela manatee meat, oil, skin, and bones are thought to have medicinal value, and the manatee played a significant mythological role in some tribes[69]. In Colombia the Sikuani tribe of the Orinoco values the living manatee and believes that rivers will dry up if people eat manatee meat[70].

Research Needs

Given the paucity of data within the WCR, conservation research should focus on (1) assessment of manatee distribution and relative abundance, and (2) assessment and control of threats to manatees and their habitat. Additionally, there are reports of interesting phenomena at specific sites that warrant further behavioral research; for example, the possibility of twinning in the Dominican Republic and the seasonal use of barrier reef sites in Belize.

It is difficult to develop the standardized protocols and techniques needed for population estimates on a regional level. Optimally, assessments of status should include population estimates and trends, demographics, and identification of threats to WCR manatees. However, if data cannot be statistically analyzed or compared across spatial and temporal scales, then the time and resources invested may be wasted. Most advanced techniques are costly and labor intensive, making the probability of implementation throughout the WCR unlikely. Details of relevant research techniques are presented throughout this volume.

Regional Database

In most WCR countries, watercraft collision has been reported as a growing threat to the local manatee population. Given the high proportion of manatees bearing unique scars in Belize, the development of a photo-ID database to serve the WCR would increase our ability to evaluate the subspecies and track movements of individual manatees between political jurisdictions. A photo-ID database with fields similar to the MIPS database for Florida manatees could be modeled after the online EC-OCEAN database for whale sharks, which enables collaboration among scientists[71].

Summary

West Indian manatees are an endangered species of priority concern within the WCR. Their numbers have declined exponentially since European colonization and will continue to do so without significant changes in human behavior. Despite an explosion of new data over the past decade, we have failed to develop the interdisciplinary partnerships necessary to coordinate conservation efforts. Owing to their endangered status, time is of the essence and priority should be given to providing protection for manatees and their habitat. Improved public awareness, increased protected areas, better enforcement of laws, reduced anthropogenic mortality, and cooperation among local, national, and regional entities are essential to the success of existing conservation strategies. National recovery plans should outline and prioritize activities with a specific time-line for completion. Regional networks should be strengthened to ensure coordination of activities across political boundaries. Several organizations are dedicated to supporting such networks, including Mote Marine Laboratory, the Marine Mammal Commission, the USGS Sirenia Project, Save the Manatee Club, Sea to Shore Alliance, Sirenian International, and the Puerto Rico Manatee Conservation Center. The updated WCR management plan recommends additional conservation strategies and specific research needs[72].

From an ecological perspective, manatees are the largest primary consumer within the WCR. Their decline is an indicator of significant changes is the coastal marine ecosystem, which is essential to the health and well-being of all species, including humans. Although the legal framework for protection of manatees and manatee habitat is in place, the success of conservation efforts relies on conformance by stakeholders who share the manatee's environment. The charismatic nature of the West Indian manatee provides a unique opportunity for educational outreach with the goal of improved conformance with existing laws and conservation programs.