

**THE WEST INDIAN MANATEE  
IN THE CARIBBEAN  
AND NORTHERN SOUTH ATLANTIC**

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## PREFACE

**T**he Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals (MMAP) was developed between 1978 and 1983 as a joint effort by the United Nations Environment Programme (UNEP), the Food Agriculture Organization of the United Nations (FAO) and other governmental and non-governmental agencies concerned with marine mammal issues, such as the International Whaling Commission (IWC) and the World Conservation Union (known as IUCN).

The principles of MMAP were approved by the FAO Fisheries Committee in October 1983, and adopted by UNEP's Governing Council in May 1984. During its annual meeting in June 1984, the IWC lent support to the portion of the MMAP relevant to cetaceans. In November of that year, the General Assembly of IUCN approved the promotion of the MMAP as an item of high priority. With this official support, the implementation of the MMAP was initiated.

The primary objective of the MMAP is to generate a consensus among the world's nations on which to base a worldwide policy for the conservation of marine mammals. "Conservation" here means the rational exploitation of the species and the management of human activities that may affect it. The concept involves "the preservation, maintenance, sustainable use, recovery and enhancement of the natural environment".

The MMAP consists of five target areas: policy formulation, regulatory and protective measures, improvement of scientific knowledge, improvement of law and its application, and enhancement of public understanding. The MMAP aims to enlist public support for measures of conservation in general and the Action Plan in particular, and the consolidation of the interests of all parties with similar objectives in the sphere of marine mammal conservation.

Organizations willing to play important roles in the implementation of the MMAP include governmental and non-governmental organizations such as UNEP, FAO, the Intergovernmental Oceanographic Commission (IOC/UNESCO), the Inter-American Tropical Tuna Commission

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(IATTC), IUCN, World Wide Fund for Nature(WWF), Greenpeace International, and the International Fund for Animal Welfare (IFAW) which are all signatories to a Memorandum of Understanding on cooperation in the framework of the Action Plan.

Scientific investigation and conservation of aquatic mammals in South America has expanded notably since 1984. The communication and exchange of ideas among researchers was reinforced with the organization of the biannual Workshop of Experts on South American Aquatic Mammals. The first workshop took place in 1984 in Buenos Aires, Argentina; the second in Rio de Janeiro, Brazil in 1986; the third in Montevideo, Uruguay in 1988; the fourth in Valdivia, Chile in 1990; the fifth in Buenos Aires in 1992, and the sixth in Florianópolis, Brazil in 1994. Experts throughout South America have participated in the meetings, and the quantity and quality of presentation at those meetings attest to the increasing interest shown in aquatic mammals in the region.

The Caribbean manatee (*Trichechus manatus manatus*) is a large yet gentle mammal that lives in warm waters. Unlike other marine mammals (seals, dolphins, porpoises and whales), manatees do not feed on fish but subsist almost entirely on vegetable matter. Manatees share waterways and coastal areas with man and this makes them vulnerable to human activities. Because of their gentle habits, slow movements, and preference for habitats favoured by man, they are in danger of becoming extinct in all areas where they live. Commercial and subsistence hunting, associated with a low rate of reproduction, and present rates of loss of habitat have caused their decline. Despite legal protection in most countries, some manatee populations are still decreasing because they are being killed by local people for food.

This booklet is an attempt to bring together information on the biology, ecology and behavior of manatees along the coasts of Central and South America and to raise awareness of the delicate situation in which they survive. In areas where specific knowledge on the Caribbean manatee is not readily available, information is provided on the Florida subspecies (*Trichechus manatus latirostris*), which has been studied more intensively.

### Description

Adult Caribbean manatees have massive, cylindrical bodies, which average about 300 cm in length and 500 kg in weight. The record weight belongs to a 1,200 kg animal entangled in a net in northeastern Brazil in 1982. A 366 cm animal was recovered in Puerto Rico in 1985. Manatees have peculiar diaphragms (which are in a horizontal position) and lungs (which are very elongated and dorsally located). These characteristics, associated with very dense and massive bones of the skull and ribs, and

the large body size, allow good stability in the water and prevent manatees from expending excessive energy when moving about feeding.

Manatee skin is not smooth like that of dolphins, but rough and covered with sparse short, fine hairs. The colour may vary with age, from almost black to grey or brown, but algae growth may lend it different shades. One cannot determine the sex of a manatee, unless it is accompanied by a calf or rolls over onto its ventral surface. The only sexual dimorphism is in the position of the genital apertures. In females it is more caudal, closer to the anus; in males the genital opening is located

toward the middle of the body, in close proximity to the umbilicus. The single mammary glands are found behind each flipper, in the axilla.

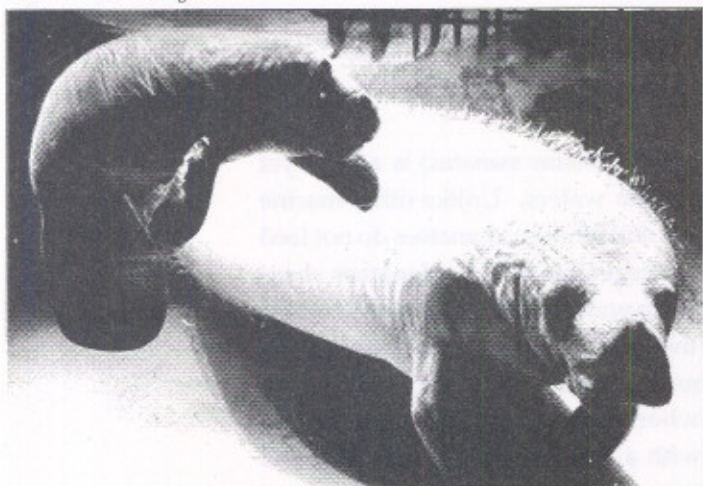
The head is relatively small, not distinctly visible from the body, and is often surrounded by heavy folds. The snout is squarish and downturned, adjusted to the feeding habits of the species. The fleshy, movable lips have stiff bristles and food is grasped in the mouth between tough pads in the front of the upper and lower jaws. The tail

is a large spatulate paddle shape. Pectoral flippers are well developed and flexible, and have three to four small nails. Manatees lack a dorsal fin and hind limbs, but the pelvic bones remain as vestigial reminders of a land ancestor.

The eyes are small, although well-developed; they are positioned laterally on both sides of the head. Of limited use in murky water, they allow object detection within several metres in clear waters. The sense of smell seems to be deficient or at least unused in the underwater environment. There is no external ear, and the opening is reduced to a minute hole located behind the eye. Ear bones are large even in small animals, and hearing is very acute. Good auditory capabilities have helped manatees detect and avoid hunters. Unlike other marine mammals, manatees do not seem to use echolocation.

Manatees normally keep their nostrils closed, whether above or below the surface. They open them only for a few seconds, when taking

Photo: Natura Artis Magistra



*Fig 1: Fine hairs scattered over the body may perform a sensory function as the animals maintain close contact*

a breath. Breathing intervals may be greater than 10 minutes<sup>22,37</sup>, but usually range between 1.5 and 5 minutes, depending on the manatee's activity. Young calves remain submerged for very short periods of time compared with adults<sup>37</sup>.

A unique manatee characteristic is its dentition. The entire tooth row migrates forward (at approximately 1 mm/month), and the worn teeth eventually fall out halfway through to the front, their roots having been reabsorbed. There are only 6-8 erupted functional molars at any one time in each half jaw. New teeth emerging from the rear replace the ones lost, as is the case with elephants. However, the manatee, unlike the elephant, has an unlimited number of teeth. The migration starts when the calf begins to chew on solid food. This mechanism is adaptive to increased tooth wear due to the abrasive effects of silica in the diet. This kind of dentition renders the widely used age determination through teeth inapplicable in the case of manatees. Manatee ear bones, on the other hand, contain growth rings similar to those found in the teeth of other mammals and may be used to estimate age<sup>58</sup>. A male manatee (297 cm) from Puerto Rico was estimated to be 26 years old when it died. The oldest manatee examined in Florida so far, contained at least 50 layers on its ear bone at time of death. Unfortunately this manatee was hit and killed by a boat so there is no telling how long it might have lived if it hadn't had the accident.

Although manatees have been portrayed as quite unintelligent creatures due to their slow mode of life, recent research has demonstrated that their brains are well developed<sup>93</sup>.

### Related Species

*Trichechus manatus* is a member of the family Trichechidae in the order Sirenia. This family is composed of only three species of manatees, all of which are found in tropical and subtropical latitudes along the coasts of the Atlantic Ocean and in adjacent rivers. Two subspecies of the West Indian manatee have been described: *Trichechus manatus latirostris* (Florida manatee) inhabiting coastal Florida and the Gulf of Mexico, and *Trichechus manatus manatus* (Antillean manatee), occurring in the Caribbean and along the coasts and rivers of northern South America<sup>29,42</sup>. The deep water and strong currents of the Straits of Florida on the one hand and the cool winters along the northern coast of the Gulf of Mexico on the other, may constitute barriers to gene flow between the two subspecies<sup>29</sup>. *Trichechus senegalensis* (West African manatee) occurs in the rivers and estuaries of West Africa. *Trichechus inunguis* (Amazonian manatee) lives exclusively in freshwater, and inhabits rivers of the Amazon basin.

Manatees are closely related to the dugong (*Dugong dugon*), a totally marine species of the Indo-Pacific region. The most conspicuous difference between manatees and dugongs is the fluked tail in the latter. *Hydrodamalis gigas* (Steller's sea cow) inhabited the Bering Sea and was the only sirenian to have lived in cold waters. It attained sizes almost three times as large as recent manatees and was over-exploited by meat hunters and exterminated within 25 years of its discovery in the early 18th century.

### Evolution

The group Sirenia includes the manatees and dugongs, which derive from an ancestral group of early plant-eating land mammals that existed some 50 million years ago<sup>94</sup>. Hyraxes (small mammals from Africa and Asia) and elephants are the closest living relatives to manatees and dugongs<sup>48</sup>.

Sirenians used to be much more diverse in the New World waters. During the Eocene, dugongids thrived in the marine waters whereas early manatees appeared in the Miocene and lived in the fluvioestuarine areas. Conditions changed with the uplift of the Andean chain. Erosion processes added silt and nutrients to the waters, stimulating plant growth, especially seagrasses. Manatees adapted to the changes by developing their specialized dentition, but dugongs were unable to evolve rapidly

enough to compete with manatees, and disappeared from the Western Atlantic.

During the mountain-chain forming, some manatees were trapped in inland waters long enough to allow the evolution of the Amazonian manatee<sup>27</sup>.

### Habitat

The sirenians are restricted to relatively shallow waters where plants are abundant. The Antillean manatee is commonly found in estuaries, rivers and streams, and coastal lagoons and lakes. They may move upstream tens of kilometres their progress blocked only by river rapids. Manatees may also spend considerable time in coastal salt water, particularly protected areas

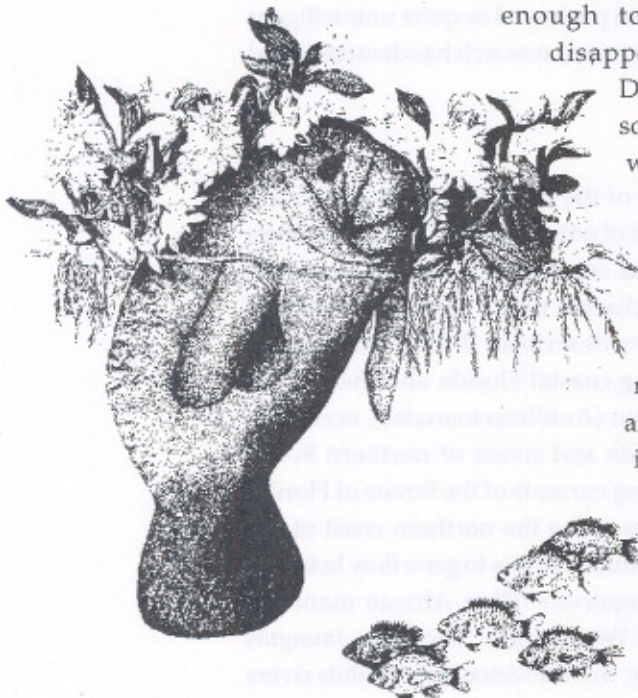


Fig 2: Manatees depend on shallow coastal habitats in tropical latitudes where aquatic plants are abundant.



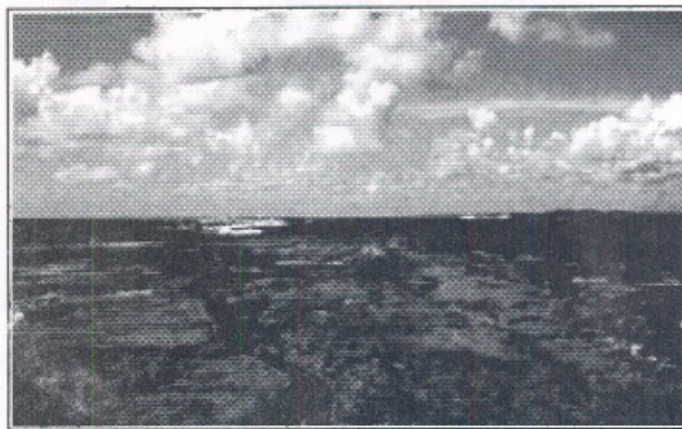
around reefs, which promote a diversity of food stuffs, and act as natural barriers to the mechanical dynamics of the marine environment. Manatee habitat in the Dominican Republic is coastal marine, probably due to the numerous sand bars at river mouths as a result of land clearing<sup>7</sup>.

Manatees frequently occur in freshwater 2-3 metres deep and only look for deeper waters as an escape route or refuge. Turbidity probably does not effect manatees, as they are found both in clear and murky waters. Water temperature is uniform year-round and does not limit manatee movements in the Caribbean as it does in the southeastern United States<sup>27, 27</sup>. Tides, Salinity and currents do not notably affect behaviour and biology. In Quintana Roo (Mexico) costal freshwater lagoons with a connection to the ocean ("cenotes") are important and unique areas where manatees can drink freshwater, rest, and find shelter and shade<sup>20, 36</sup>.

Vegetation is a determining factor of manatee distribution. Manatees in highly seasonal areas exhibit migratory behavior in response to changes in water levels and greater availability of food due to the rains. During the rainy season, manatees move up into the lakes and stream where they find abundant aquatic vegetation on which to feed. As the water levels drop in these inland areas during the dry months, food becomes limited and manatees move back down towards the lower parts of the main rivers and along the coast<sup>18, 20, 43, 54</sup>. It is during the dry season, as they concentrate in river channels or deep holes, that manatees become most vulnerable to hunters.



Fig. 3a, b Mangrove swamps and waters protected by reefs are typical



Photos: M. Borobia

## Distribution

Manatee distribution is fragmented and numbers are locally reduced along the Atlantic coasts of northern South America, the Caribbean coasts of South and Central America, and the Antilles<sup>51</sup>.

### Northern South America

Manatee distribution used to be considerably larger in Brazil, where they were believed to be abundant as far south as northern Espirito Santo (20°S)<sup>101</sup>. Nowadays there are only reduced groups along the northern and northeastern coasts, from Oiapoque (Amapá) to southern Bahia (~17°S)<sup>2,5,13,25,53</sup>.



Fig 3: Manatee distribution in the Caribbean and northern South America

The groups may be more representative in the states of Amazonas, Pará and Amapá, but the occurrence of tidal waves at the mouth of the Amazon and other large rivers may restrict the occurrence of manatees in areas of the state of Pará<sup>2</sup>. The mouth of the Amazon river is the only area where Amazonian and Antillean manatees might share the habitat<sup>25</sup> and there was an unconfirmed report of that in 1983<sup>5</sup>. In Maranhão they occur in the Mearim river, in an environment similar to that used by Amazonian manatees<sup>25</sup>. In the northeastern coast they occur in all states from Ceará (~3°S) to Bahia, but recent surveys suggest that manatees may have disappeared from Sergipe<sup>53</sup>. Much of the hiatus in distribution seems to be due to hunting activities. Populations under study include groups in the estuarine settings of the estuary of Mamanguape river (Paraíba) and Santa Cruz Canal (Pernambuco). Brazilian hunters in the vicinity of Oiapoque river, on the Brazilian border

with French Guiana, reported manatees in the eastern portion of that country<sup>13</sup>, but the absence of a coastal plain limits the amount of suitable habitats in that area<sup>10</sup>. In Surinam and Guyana manatees live in the larger rivers and creeks and at the mouths of rivers<sup>11,43</sup> with the greatest concentrations on both sides of the border between the two countries<sup>42</sup>. In Trinidad they are only found in the large freshwater Nariva swamp<sup>40</sup>. Venezuela represents a major break in the manatee range and gene flow. They are apparently absent from the whole 1,500 km of Caribbean coastline and nearshore islands, probably due to habitat unsuitability. Manatees have been known to live, although in reduced numbers, in parts of Lake Maracaibo, and in greater abundance in the Orinoco river system and in drainage basins in eastern Venezuela along the Gulf of Paria<sup>69,70,78</sup>. In Colombia they persist in isolated pockets of major river systems or estuaries distant from human settlements<sup>51,85</sup>.

### Central America

Discontinuous habitat and possible depletion along Panama the longest Caribbean coastline of Central America, has resulted in fragmented distribution in that country. Manatees still occur in areas of optimal habitat<sup>51</sup>

such as in the rivers of Bocas del Toro province<sup>72</sup>. They are also present in Gatun Lake and adjacent rivers. Some of these manatees could be descendents of nine Caribbean manatees introduced into the Panama Canal for weed control in 1964<sup>57,71</sup>. Manatees have recently reached the Pacific Ocean

through the Panama Canal<sup>29</sup>. Even though there is good habitat, particularly in the northeast, manatees are very rare in *Costa Rica*, probably

Photo: B. Morales V.



Fig 4: Aerial view of a manatee in Bahia de Chetumal, Mexico among seagrass beds

due to hunting and habitat degradation<sup>96</sup>. *Nicaragua* contains excellent and extensive habitats for manatees<sup>51</sup>. They have been reported in Lake Nicaragua and may occur in low numbers along the Costa Rican border<sup>74</sup>. Distribution is uneven in Honduras, with greatest concentrations in the coastal lagoons of Mosquitia<sup>47,88</sup>. Guatemala, with the smallest Caribbean coastline in Central America, has good habitat in all areas<sup>1</sup>, but harbours only a small number of manatees, most of which appear to occupy Lake Izabal and the Dulce river<sup>46</sup>. Although Belize has a comparatively short coastline, the manatee population is probably the largest in Central America<sup>77</sup>.

### North America

Manatees historically occurred all along the coast of the Gulf of Mexico and in the Caribbean Sea<sup>15</sup>. Nowadays they occupy much of the southeastern coast of Mexico from Nautla, Veracruz to the Belize border. However, they are only reasonably abundant in the wetlands of Tabasco, the bays and coastal springs of Quintana Roo, and in rivers near Alvarado in Veracruz<sup>17,20</sup>. The ribs of an adult manatee found 40 km inland in Tamaulipas along with reports of its presence, represent the northern and westernmost record of the species distribution in Mexico<sup>50</sup>. The rare sightings of manatees in the Bahamas<sup>73</sup> may represent strays from Florida or the Greater Antilles, or alternatively possible lack of detection<sup>51</sup>. The United States represents the northern limit of manatee distribution. They are normally present in Florida year round, all along the east coast and most of the west<sup>51</sup>.

### Greater Antilles

Manatees occur along both the north and south coasts of Cuba<sup>32,51</sup>. In *Jamaica* they are found primarily along the more extensive shallows of the southern coast<sup>33</sup>. In Hispaniola manatees are restricted to a small portion of the west coast of Haiti<sup>90</sup> and north and southwest areas in the Dominican Republic<sup>7</sup>. In Puerto Rico they are unevenly distributed, with greatest concentrations on the south-central and eastern shores<sup>84,89</sup>. Manatees are reportedly extinct in the Virgin Islands<sup>31</sup>. A recent sighting may represent a stray from Puerto Rico<sup>65</sup>.

### Lesser Antilles

Bones have been excavated from Indian sites (middens) in St. Croix<sup>68</sup>, but there are no recent records of manatees in the Antilles, and the species is thought to be extinct there<sup>91</sup>.

### Population Estimates

Although it is impossible to estimate past manatee numbers, it is

clear from historical accounts and recent interviews that their relative abundance in many areas was greater than it is today<sup>77</sup>. Notable declines are thought to have occurred in Brazil, Costa Rica, Guatemala, Honduras, Mexico, Panama, and Venezuela<sup>11,15,25,44,46,47,69,74,78,88</sup>. Aerial censuses are the most important method of determining relative concentrations of manatees, but they are of limited use owing to factors such as manatee movement, visibility, and turbidity of the water<sup>80,82</sup>. Numbers presented below are only minimum counts or expert guesses. Only a few hundred are estimated to remain along the northeastern coast of Brazil; northern populations are assumed to fare somewhat better<sup>53</sup>. The only early indication of numbers is from the colonization period, when

Fray Cristóvan observed groups of up to 300 manatees in São Luís (Maranhão), probably in rivers and lagoons and not the sea<sup>101</sup>. Both Surinam and Guyana were known as areas where manatees were particularly numerous<sup>9,30</sup>. Guyana's was considered the largest residual stock in South America, with expert guesses of a few thousand animals approximately two decades ago<sup>9</sup>, but no recent surveys have been conducted. Manatees today are thought to be the most endangered mammal of Surinam, with an estimate of 500-600 animals in the late 1970s<sup>30</sup>. Aerial surveys suggested low population densities in Venezuela<sup>78</sup>. The Gulf of Paria may contain 100-150 animals<sup>70</sup>. No estimates are available for Colombia, or Costa Rica<sup>52</sup>.

An estimated 42-72 animals inhabit the Bocas del Toro area in Panama<sup>72</sup>. Recent findings indicate the presence of a considerable concentration of manatees in Nicaragua<sup>102</sup>. The total population in Honduras may not exceed 100 animals<sup>21</sup>, and is subject to an annual mortality of 10% due to illegal capture mainly by the use of gill nets.

Photo: Grupo de Mamíferos Acuáticos-NE



Fig 5: Interviews with local populations and old manatee hunters help us to understand patterns of distribution and abundance.

Around 50-100 probably remain in Guatemalan waters<sup>103</sup>, but the population remains low because of between 2-4 deaths per year<sup>1</sup>. Belize seems to contain the largest population of the Caribbean nations. A total of 102 were counted during an incomplete aerial survey during 1989. The proportion of calves compares well with the healthy population in Crystal River, Florida<sup>77</sup>.

An estimate of 5,000 manatees in Mexico in the late 1970s is now considered extremely high. Aerial surveys in 1987-1988 provided estimates of 100 manatees in the Chetumal and Hondo river area, and 110-120 for the entire state of Quintana Roo. The proportion of calves was determined as 3.6<sup>19</sup>. The Florida Department of Natural Resources synoptic census revealed a minimum count of 1,856 manatees in peninsular Florida (United States) in 1992<sup>104</sup>. The number of manatees in Puerto Rico has not declined since 1978<sup>51</sup>.

Manatees were probably never very abundant in the Greater Antilles, with the exception of Cuba<sup>51</sup>. Studies conducted in late 1970s and 1984 suggest that only 100-200 manatees exist today off the Caribbean islands<sup>66</sup>. Partial aerial surveys conducted in 1985-87 in Cuba produced a maximum count on any one flight of 11 and 14 manatees in the south coast of Sancti Spiritus Province and in Ensenada de la Broa, respectively, but local people feel that manatee numbers have increased in the last 10 years<sup>28</sup>. Less than 50-100 animals are thought to remain today in Jamaica<sup>67</sup>. In Haiti there has been a decline in numbers over the past 50 years, with one entire coastal aerial survey in 1982 suggesting a maximum population of 32<sup>90</sup>. In the Dominican Republic the maximum count from aerial surveys in 1977 was only 41<sup>7</sup>. The total population size of the manatee stock in Latin American countries is presently unknown, but may be similar or even smaller than the Florida population.

## Economic Importance

### Past

Sirenians have been hunted by native peoples, and exploited by Europeans for food, hide, oil and medicine<sup>11</sup>. It is believed that exploitation by the native people started before the arrival of the Europeans, as soon as man colonized Caribbean coasts<sup>74</sup>. Manatee meat contributed to the diet of prehistoric settlers in the Maya area and in other parts of mainland Central America and the Caribbean West Indies<sup>14,49,62</sup>. Manatee bones were also used to carve artifacts (both utilitarian and ceremonial burial or cache type items) at several coastal and inland Maya sites<sup>7,62</sup>.

Besides traditional hunting by indigenous peoples for subsistence,

West Indian manatees were commercially exploited on a large scale in the Guyanas and Brazil for export during the seventeenth century<sup>11,26,42</sup>. Amerindians hunted the animals and the Dutch salted the meat chartered ships to transport it to workers on sugar-cane growing islands in the West Indies<sup>11</sup>.

### Present

Manatee meat evidently contributes very little to the diet of present-day native coastal Caribbean groups. Despite tales of previous manatee abundance, both Miskito and Rama Indians of Caribbean Nicaragua find manatees difficult to capture<sup>62</sup>.

Manatees can be used as biological agents to reduce aquatic vegetation or as a source of meat for human consumption<sup>4,55</sup>. The overgrowth of aquatic plants in tropical countries results in obstruction of waterways, precludes hydroelectric generation and navigation, and stimulates growth of pathogenic organisms. Early studies in Guyana and Florida seemed encouraging but manatees have not proved efficient controllers of aquatic weeds<sup>33</sup>. It may be that they choose to eat a variety of plants rather than concentrate on the worst pest species<sup>98</sup>. The use of manatees for weed control programmes requires more extensive research. Semi-captive ranching of wild populations for protein is equally unfeasible due to the depleted condition of the stock.

Probably the most important ecological contribution by this large herbivore is in the recycling of nutrients. An adult manatee may eat 30-40 kg plants/day and return roughly 40% of it as nutrients to the ecosystem, stimulating primary production<sup>55</sup>. Additionally, the manatee has value in the aesthetic arena because of its the inherent beauty. Areas where manatees occur in clear water may become important as educational sites and for non-consumptive use.

### Physiology

Manatee body temperatures average 36.4°C. A reduced ability to produce heat, matched against the heat-stealing medium of water, suggests that manatees are poorly adapted in terms of energy to winter water temperatures in Florida<sup>45</sup>. When ambient water temperatures drop below about 20°C in autumn or winter, manatees in Florida migrate to natural or man-made warm waters sources<sup>45,97</sup>. This does not constitute a problem in the Caribbean where water temperatures are less variable throughout the year.

Manatees are non-ruminant animals with an enlarged hind gut. They enlist the help of microorganisms (anaerobic bacteria) in the cecum and large intestine to digest the cellulose contained in their plant foods.



Photo: Natura Artis Magistra

*Fig 7: Manatee calves suckle in a horizontal position from mammae located behind the mother's flipper*

Manatees are capable of assimilating a great volume of relatively low quality, high water-content forage<sup>12</sup>, and must process 8-15% of their body weight in plants daily to obtain enough energy and nutrients for their maintenance. Manatees have a high digestive efficiency and one of the slowest gut

passage rates<sup>56</sup>, (in the order of a week). Unlike other marine mammals, they expend little energy, as their slow nature and tropical habitats do not require much energy to regulate and maintain constant body temperature. Their metabolic rate is one of the lowest among mammals, corresponding to 15-22% of predicted weight-specific values<sup>45</sup>.

Access to freshwater attracts and may be essential for manatees, and they frequently drink from freshwater sources such as backyard hoses in Florida. It is yet unclear how long manatees could live in saltwater but they are uncommonly seen around Caribbean islands devoid of natural freshwater sources, such as the Bahamas, Cuba and Puerto Rico, and in the Dominican Republic they frequent three upwellings located in coastal waters<sup>7</sup>. Kidney anatomy suggests that manatees can produce very concentrated urine<sup>39</sup>.

## Reproduction

Although calves have been seen throughout the year<sup>7,43,44</sup>, in some areas mating and birthing may occur at about the same time of year, which in some places coincides with the rainy season<sup>18</sup>. Manatee reproductive activity in markedly seasonal habitats is closely linked to the increase in water levels in main rivers and consequently the greater availability of food. The rise in river levels or some associated factor must trigger the synchronization of the reproductive cycle of manatees, thus allowing excellent nutritional conditions during gestation. Fat stores must play an important role in meeting the greater daily energy demand during lactation.



Females give birth to a single calf, after a gestation period of approximately 13 months. Newborn manatees are approximately 100 cm long and weigh 18-27 kg<sup>22,43,44</sup>. Twins are not common<sup>16,35</sup>.

The mother's behaviour is very helpful and solicitous, pushing the calf to the surface after birth for the first breath. The young suckles underwater in a horizontal position<sup>63</sup> once or twice an hour<sup>76</sup>, with bouts of 1-2 minutes duration<sup>23</sup>. Calves tend to remain close to their mothers, often travelling parallel to the female's body, and the female positions itself between approaching manatees or humans and her offspring. Nuzzling, mouthing and synchronous breathing may add to the cow-calf bond<sup>95</sup>. Groups of calves observed in secluded waters of Florida and Cuba suggest that in certain areas females may leave their calves in safe places, while they go out to forage<sup>28,95</sup>. Calves remain with the females for one or sometimes two years, and some females have been observed with young of different ages<sup>43</sup>. The prolonged nursing period allows the calves to grow more rapidly during early life through a diet of plants supplemented by rich milk, and to learn about migratory routes, food and feeding areas in the company of the female. Calving intervals vary between two and five years.

Histological studies have suggested reduced reproductive activities in male Florida manatees during the winter<sup>38</sup>. It is possible that stresses associated with the dry season (such as lack of food) in areas of Latin America and the Caribbean affect spermatogenesis as well<sup>60</sup>.

The study of growth-layer groups in ear bones suggests that Florida male and female manatees may mature as early as three and four years of age, respectively<sup>59,60</sup>.

## Behaviour

### Activity cycles

In some areas manatees are more active in feeding in the evening and early morning hours<sup>1,20,22,88,96</sup> (and possibly at night). This is probably a defence mechanism to avoid hunters. This behaviour may also prevent



Fig 8: Manatees feed on aquatic plants which they grasp with their flippers and then place in their mouths

them from being active during the hottest part of the day<sup>96</sup>. At these times they become quiescent and often lie at the surface apparently basking in the sun, with the back strongly arched and the head below the water. When disturbed they submerge, quietly and with minimum movement<sup>10</sup>. Wherever manatees feel relatively unthreatened, such as in refuges in Florida, they may feed, rest, socialize, or engage in other activities throughout the day<sup>37</sup>.

### Locomotion

Manatees barely make ripples on the water's surface as submerged and with flippers close to the chest they cruise at a speed of 4-10 km/h<sup>10</sup>. Nevertheless, manatees are excellent swimmers and may attain 25 km/h for short periods<sup>37</sup>. When speeding they keep their noses above the surface. The tail is very important for propulsion but may also be used to steer. Flippers are responsible for all the manoeuvring at slow speed<sup>37</sup>. They are also known to "walk" on the river, lake or sea beds<sup>36,37</sup> and to push themselves halfway out of the water, which they do to reach and graze on river bank plants<sup>10</sup>. Long-distance travel of 200-300 kilometres at rates of up to 49km per day have been documented in Florida<sup>92</sup>.

### Feeding

Manatees feed on submersed, floating or emergent vegetation of freshwater, marine and estuarine environments. They prefer to feed as low in the water column as possible and to pull the food below the

surface<sup>24</sup>. Flippers are used to sweep the food towards the mouth, but the animals may also rest on their finger tips and grope among the weeds with their snouts<sup>10</sup>. Young manatees start nibbling solid food when only a few weeks old.<sup>42</sup>. Occasionally manatees eat fruit from riverbank

Photo: B. Morales V

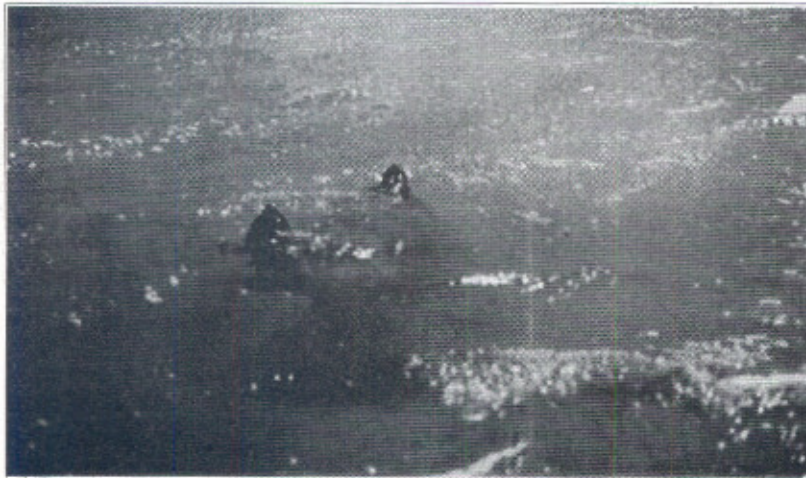


Fig 9: Cow-calf pair in the Bay of Chetumal, Mexico.

trees in flooded areas, or leaves and roots of mangroves<sup>12,22,30,36,72</sup>. Invertebrates and associated algae are incidentally ingested<sup>18,20,70</sup> but some

freshwater algae may be actively sought<sup>12</sup>. Powell<sup>83</sup> reported manatees consuming dead fish from fishermen's nets in Jamaica. Manatees are also coprophagous (dung-eaters)<sup>12</sup>. Feeding activity may leave trails, a kind of sediment which floats to the water surface<sup>7,20</sup>. Caribbean manatees feed for 6-8 hours a day, in bouts of between 30 to 90 minutes, with a maximum of 2-2.5 hours<sup>12</sup>.

In some areas, seasonal availability of food plants is dependent on the annual 10-15m rise and fall of river levels due to seasonal rains. Manatees do not remain in the same place all the time, but move as soon as the density of preferred food has decreased. In this way they cover extensive grazing areas<sup>18</sup>. They prefer areas which contain a variety of grasses or aquatic macrophytes and shallow waters (2-4 m). The seasonal variation in food availability may be a direct cause of local and regional movements, and an indirect cause of seasonal reproduction. During the dry season, when manatees congregate in deep water lakes and channels, they must either fast or consume dead organic matter<sup>70</sup>, as living vegetation may become scarce or absent. Under these circumstances, the animal's low metabolic rate and fat stores help it through the fasting period.

### Resting and Maintenance Behaviour

Manatees are shy and skittish creatures

Photo: E.M. Oliveira



Fig 10: A group of Caribbean manatees in the estuary of the Mamanguape river, Paraiba, Brazil

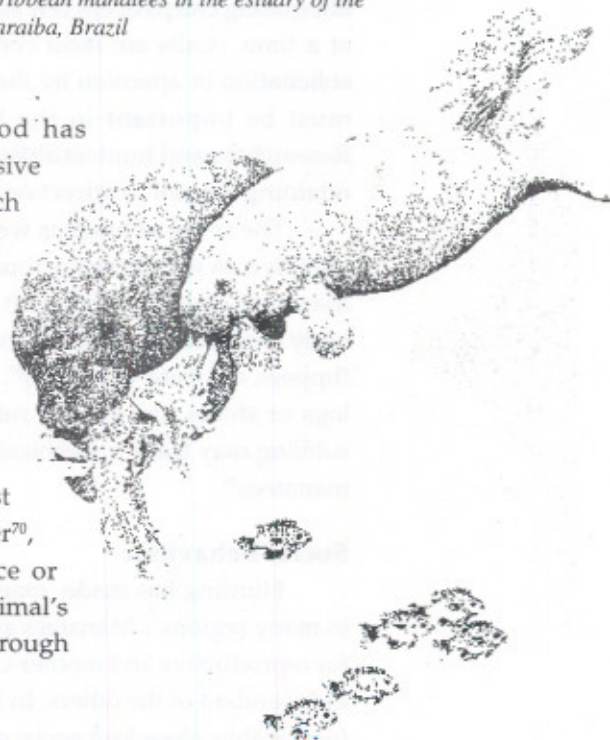


Fig 11: Single or small groups of manatees are the most frequent sights

when they feel threatened, and they soon learn to use protected areas and refuges with low human activity. When disturbed, manatees quietly let themselves sink below the water surface, and swim away to deeper parts of the river<sup>43</sup>. If frightened by the approach of a boat, they flee at high speed, head and shoulders above the water for a moment, followed by a dive with a forceful sweep of the tail<sup>22</sup>.

Manatees rest from 2-12 hours daily, usually in two to four hour sessions<sup>37</sup>. While resting, the animals are totally relaxed, their eyes are closed and they are either suspended near the surface of the water or are lying prostrate on the substrate<sup>42</sup>. Hartman<sup>37</sup> described manatees in a variety of maintenance functions such as scratching, stretching, mouth cleaning, and rubbing.

### Communication

Manatees are normally silent, except during times of fear, protest, sexual arousal and play<sup>37</sup>. When produced, the sounds are short, not very loud, and best described as single-note squeals, whines, or grunts<sup>37,86</sup>. Changes in pitch, loudness, duration and harshness probably communicate mood or intentions to nearby manatees. Calling is most frequent between cows and calves. Cow-calf pairs perform duets by alternating chirps every few seconds for periods of up to several minutes at a time. Calls are most conspicuous under situations of distress or solicitation of attention by the calf<sup>86</sup>. Calf vocalization soon after birth must be important in the bonding between mother and young. Researchers and hunters alike have used female and calf interactions by retaining the calf to attract or bait the mother.

The sense of touch is well developed and the epidermis is highly sensitive; as with hearing, touch is very important for social interaction. Manatees engage in frequent social contact in small groups. Muzzle-body and muzzle-muzzle contact, and grasping one another with flippers, are some examples<sup>37</sup>. It has been hypothesized that prominent logs or stones are used as rubbing posts. It has been speculated that rubbing may leave a chemical message that can be recognized by other manatees<sup>86</sup>.

### Social Behaviour

Hunting has made manatees extremely wary and fearful of man in many regions<sup>9</sup>. Manatees are only moderately social animals. Except for reproductive and mother-calf interaction, each individual is basically independent of the others. In Florida they are non-territorial and do not form stable, close-knit social groups or herds<sup>37</sup>.

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<sup>97</sup>. Solitary animals are also the most common group size in Cuba<sup>32</sup>. Groups may vary from three to 15, with a maximum of over 20, but the norm seems to be three in northeastern Brazil<sup>2,53</sup>. In the Yucatan Peninsula groups are more frequent and contain greater numbers (15-30) in freshwater habitats, while estuarine and marine habitats in coastal zones contain only 5-15 individuals<sup>20</sup>. The only known long-term (up to 4 years) social bond occurs between a cow and her calf<sup>37</sup>.

### Sexual behaviour

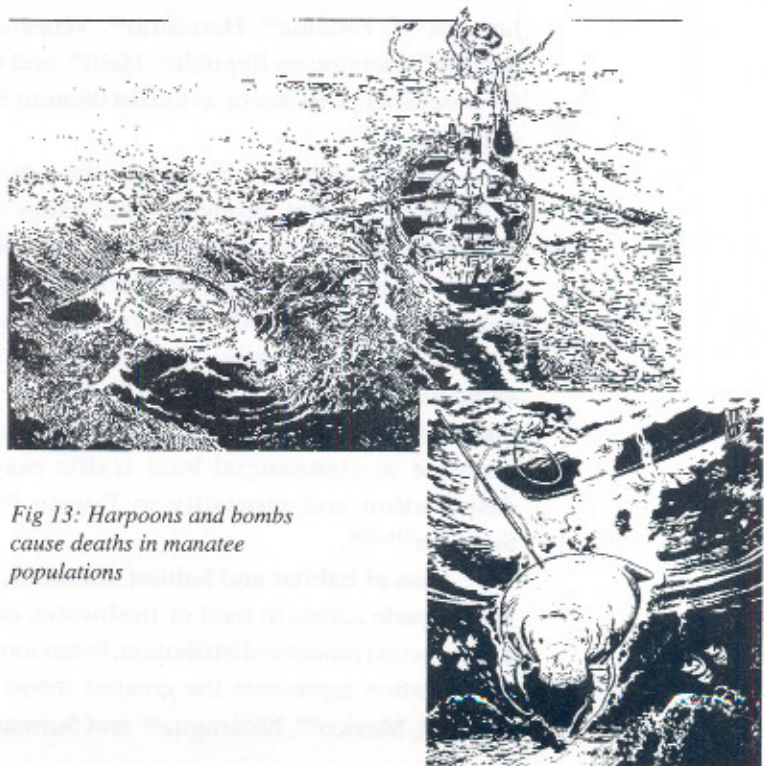
A female on heat attracts a variable number of males, the number may exceed a dozen animals<sup>10,16,63</sup>. Oestrus may last for a few weeks, during which time the males follow the female over long distances<sup>8,37</sup>. The prolonged courtship period may allow time for more potential mates to gather<sup>86</sup>. The bulls attempt to "kiss" and "caress" the female, but for the most part she avoids them by fleeing or turning her back on them. When the cow becomes receptive she may copulate with several males.

Mating occurs in shallow areas with a great deal of commotion and disturbance in the water. The pairs embrace with their abdomens touching and with the male underneath, or they may lie on their sides<sup>10,16</sup>. The entire courtship and mating lasts for about 10-15 minutes<sup>16</sup>.

### Mortality

#### Man-related causes

**Fishing gear:** Commercial fisheries are currently developing and expanding in many tropical areas. Cotton fibres have been replaced by nylon and polyester nets that are harder to detect and avoid, representing a serious hazard to manatees, as well as to the smaller cetaceans and sea turtles. Nets may in fact be set specifically to catch manatees for human consumption in the Caribbean region<sup>66</sup>.



*Fig 13: Harpoons and bombs cause deaths in manatee populations*

Manatees have been reported entangled in fishing nets (gill nets or beach seines) in nearly all countries where they occur<sup>1,2,7,21,30,44,47,51,53,64,70,71,75,88,90,98</sup>. Fishing gear is one of the main sources of human-related mortality in Cuba<sup>28</sup>, Guatemala, Haiti<sup>90</sup>, Honduras<sup>51</sup>, Jamaica<sup>41</sup> and Venezuela<sup>88</sup>. Fishermen in Colombia and Belize slaughter manatees for food following incidental entanglement in nets<sup>77,78</sup>. Although some animals may escape while still wrapped in small nets, their subsequent fates are unknown<sup>78</sup>. In northeastern Brazil, nets set up across the river beds may cause manatees to become entangled or stranded during the receding tides<sup>3</sup>.

**Poaching and vandalism:** Even though no substantial manatee fishery exists today, manatees are opportunistically killed by local inhabitants of the depressed economies of Latin American countries. Hunting accounts for the most immediate threat to the survival of manatee populations in Colombia and Panama<sup>51,72</sup> and Puerto Rico<sup>44</sup>.

Manatees are occasionally killed for food in the Yucatan Peninsula<sup>36</sup>, Brazil<sup>53,75</sup>, and possibly in Costa Rica<sup>96</sup>. Movement along rivers, and spotting and pursuit of manatees has been greatly facilitated by the increased use of canoes with outboard motors.

Commercial marketing has been greatly reduced, but meat is still occasionally available in a clandestine way and in remote areas where law enforcement is more difficult. Meat sales have been reported in Jamaica<sup>41,98</sup>, Panama<sup>72</sup>, Honduras<sup>21</sup>, Venezuela<sup>78</sup>, Guatemala<sup>1</sup>, Belize<sup>77</sup>, Mexico<sup>20</sup>, Dominican Republic<sup>7</sup>, Haiti<sup>89</sup>, and Colombia<sup>51</sup>. Bones are sold for medicinal purposes or as tourist items in Belize, Dominican Republic, and Mexico<sup>66,77</sup>.

**Boats:** Collision with boats is the major known cause of mortality in Florida<sup>51</sup>. Hulls, propellers and skegs often inflict fatal blows to manatees, and those that survive bear permanent scars. In Latin American countries and the Caribbean pleasure power boating is expensive and restricted. However many dugouts and small boats with outboard motors (usually 25hp) have been seen in small creeks where avoidance would be difficult<sup>30</sup>. There have been a few reports of boat hits in Colombia<sup>44</sup>, Mexico<sup>36</sup>, Guatemala<sup>1</sup>, Panama<sup>71</sup>, and Venezuela<sup>78</sup>. An increase in commercial boat traffic may have affected manatee distribution and mortality in Puerto Rico, Brazil, Guyana, and Surinam<sup>2,19,66,89</sup>.

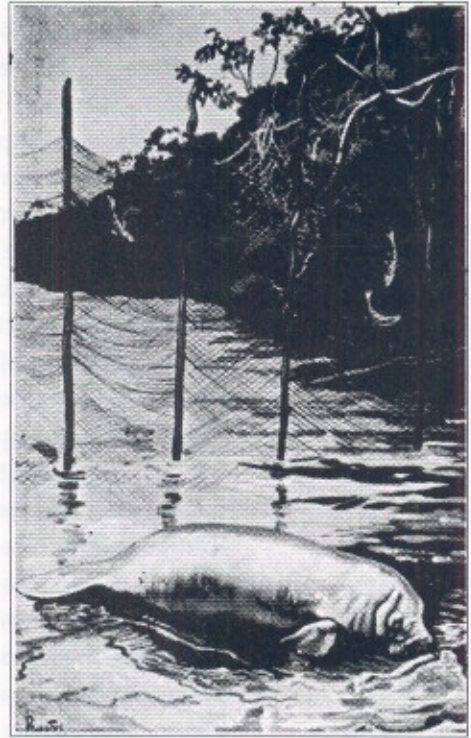
**Loss of habitat and habitat alteration:** Any habitat modifications that impede access to food or freshwater, or affect mobility could have an impact on manatee distribution, behaviour, and reproduction. Habitat modification represents the greatest threat to manatee populations in Belize<sup>101</sup>, Mexico<sup>106</sup>, Nicaragua<sup>107</sup> and Surinam<sup>43</sup>.

Extensive land reclamation in the Orinoco delta to control the seasonal flooding and drain soils for crops and pastures may reduce manatee foraging grounds<sup>69</sup>. Habitat alteration in Venezuela is a particularly serious problem in the central plains tributaries<sup>51</sup>. River damming, logging and destruction of mangrove forests, dredging projects, draining of wetlands for agriculture, and general disturbance<sup>78</sup> have changed habitats significantly. Modification of the wetlands for proposed agricultural and maricultural schemes comprises the primary threat in Trinidad<sup>51</sup>. Mangrove clearing and land filling have contributed to increased sediment loads in rivers and estuaries in northeastern Brazil<sup>3</sup>. Habitat changes are likely to occur with the construction of roads associated with a new oil pipeline in Panama<sup>72</sup>. The construction of a large port facility south of Recife, Brazil, may have driven manatees away<sup>2</sup>. Manatees have been killed by blasting activities in the Panama Canal<sup>71</sup> and Albuquerque and Marcovaldi<sup>2</sup> reported that whole populations were decimated by explosions of TNT in Brazil.

Hydroelectric projects, such as the Miguel Aleman dam in Veracruz (Mexico), or the setting up of nets across rivers that are important routes for manatees in the Mexican state of Tabasco may reduce or prevent local or seasonal movement. Additionally, fishing activities may affect reproductive and feeding activities in certain areas<sup>20</sup>.

**Pollution:** Pollutants may have direct toxic effects or may accumulate in manatee body tissue and weaken the animal in the long term. They may also indirectly affect manatees by damaging their food base.

A great part of Brazil's northeast region is committed to the sugar cane plantation industry to fulfil the demands of alcohol fuel for the automobile industry. The residue from the transformation process is extensively discharged into rivers. Textile, rubber, cement and paper industries, and mining operations also dump their residues in that area<sup>53</sup>. Manatee populations in the Coatzacoalcos river and surrounding areas in Mexico have disappeared because of the contamination by lead, mercury and poisons from chemical industries<sup>20</sup>. Industrial development may also be implicated in the observed decline in manatee numbers in



*Fig 12: Stranded manatee, victim of a fishing net stretched across a river*

Puerto Rico<sup>89</sup> and the silting of many rivers has also reduced food supply. Chemical residues associated with pesticides used in banana plantations in Costa Rica and Panama<sup>72,96</sup> and organochlorines in Surinam<sup>30</sup> must clearly have an impact on manatee habitats. Plastic bags are a potential threat in Costa Rica<sup>96</sup>. Debris ingestion may reduce food assimilation or lead to intoxication<sup>6</sup>.

Although the direct effects to exposure to oil in manatees is not known, it is clear that a spill in water systems used by the animals would detrimentally affect the population. Lake Maracaibo in Venezuela is a site of significant oil exploitation and associated activities such as barge traffic and pollution. Coastal oil exploration is likely to increase offshore drilling and oil shipping in the Gulf of Mexico.

**Harassment:** Some factors may not cause direct mortality, but alter distribution and behaviour. Factors which disrupt manatees' normal routines may cause stress and affect their health.

In Mexico, catching manatees often involves harassment of the animals. Fishermen sometimes use explosives to make the animals flee in the direction of a group of men waiting with harpoons and lances, or powered boats chase manatees until they tire and then men throw nets to catch and drown the animals<sup>20</sup>. In northeastern Brazil, explosives used in illegal fishing activities are frightening manatees away from estuarine areas<sup>3,99</sup>.

### Natural factors

**Cold weather and red tide:** Meteorological factors may significantly affect manatee habitat, behaviour, and possibly survival. The following cases illustrate manatee vulnerability to sudden changes in their environments, particularly in areas with small populations. Manatees in Florida are especially susceptible to unpredictable extremely low winter temperatures as occurred in 1989. Starvation was reported to be an important factor in the deaths of

Photo: Group of Aquatic Mammals of the Northeast



Fig 14: Bottle-feeding a stranded orphan manatee, Paulista, Pernambuco, Brazil



landlocked animals during the dry season following a hurricane in Honduras<sup>88</sup>. Over 30 manatee deaths were indirectly linked to an episode of red tide in Florida, possibly through ingestion of filter-feeding ascidians<sup>79</sup>.

**Natural predators:** To date, there is no documentation concerning predation upon manatees, although sharks<sup>19,20,36,44,54,72</sup>, piranhas<sup>11</sup>, crocodiles, and caimans have been suggested as potential predators, especially for newborn, young, or injured manatees.

### Legal Protection and Conservation Efforts

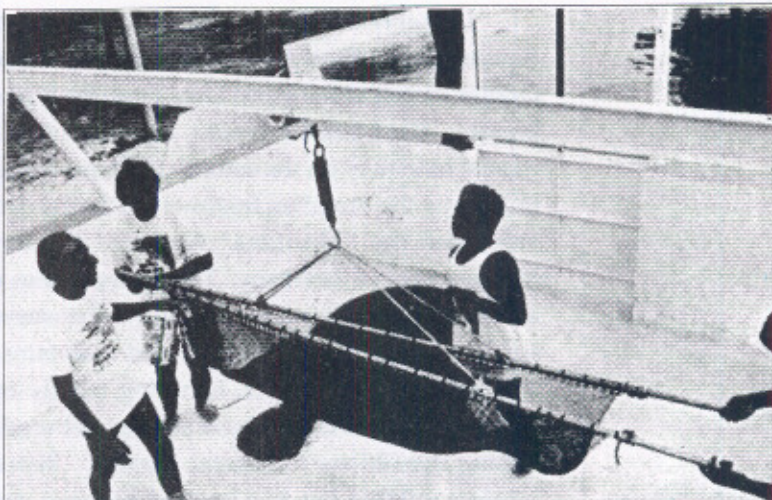
All recent sirenians are considered as vulnerable to extinction by the World Conservation Union, and manatees are protected in almost all countries where they occur. They are also protected under the Convention for International Trade of Endangered Species (CITES), and therefore their parts or products may not be freely exported or imported. However, lack of interest by authorities or awareness by local people, coupled with the large and often remote areas manatees inhabit as well as the general poverty levels in developing

countries often mean that protective legislation is not enforced.

A specialist Manatee Workshop sponsored by the National Research Council of Guyana, the National Academy of Sciences of the United States, and the International Development Research Centre of Canada was organized in Guyana in February 1974. During that meeting the establishment of an International Manatee Centre in Georgetown was recommended, with the objectives of research and preservation<sup>9</sup>. Unfortunately the idea never became a reality.

National parks or reserves play an important role in manatee conservation in the Caribbean and northern South America. The Biotope for the Conservation of Manatees Chocon-Machacas (Guatemala) was

Photo: R. Soavinski



*Fig 15: Routine weighing of rescued orphan manatees kept in captivity for rehabilitation and reintroduction. Manatee Center/IBAMA, Itamaraca, Pernambuco, Brazil.*

the first manatee reserve anywhere in Central or South America<sup>51</sup>. Manatees are also present in Salamanca Island National Park (Colombia), Tortuguero National Park (Costa Rica), Platano River Biosphere Reserve and Cuero y Salado Wildlife Refuge (Honduras), Juan Manuel Marsh (Venezuela), Coppename River Nature Reserve (Surinam), and Everglades National Park and Blue Spring State Park (United States). Twenty-two manatee sanctuaries with restrictions on boat speed have been established in the United States.

Outstanding manatee conservation programmes have been established in Belize and Brazil. The Belize Audubon Society, Belize Center for Environmental Studies, and Belize Zoo have succeeded in promoting a high level of local awareness. The Belize Zoo Outreach project has a travelling manatee conservation education programme that aims at reducing illegal hunting of manatees<sup>51</sup>.

Protected areas in Brazil include the first two Areas of Environmental Protection for manatees in northeastern Brazil<sup>53</sup>, and Cape Orange National Park and Lake Piratuba Biological Reserve in northern Brazil<sup>13</sup>. The Manatee Project, a preservation and research nucleus for coastal manatees on the estuary of Mamanguape river (Paraíba) created in 1986 by the Brazilian Institute for the Environment, was expanded in 1990 into the "Manatee" National Center for Conservation and Management of Sirenians. The center carries out education campaigns aimed at coastal communities in northeastern Brazil. It also conducts surveys and research projects, and maintains a Rescue, Rehabilitation and Reintroduction Unit, handling mostly orphaned calves. Studies developed by the Center have prompted the adoption of a law regulating fishing operations in coastal Paraíba. Because interpretation of the original wildlife law has been ambiguous, and manatees may or may not be considered "fish", or even "wildlife", a new proposal has been presented to Congress to outlaw all fishing/hunting of manatees and commercialization of their products<sup>53</sup>.

### Outlook for the Future

Manatees are vulnerable not only to direct human-related deaths but also to the cumulative effects of various stresses. A reduced reproductive capability makes recovery and replenishment of manatee populations an extremely slow process. Demographic studies suggest that fecundity is low and sirenian population growth rates are in the order of 5-10%<sup>61,81</sup>, which is counteracted by similar rates of mortality in some stocks. Continued human population growth in coastal environments is likely to enhance habitat depredation and destruction, and the development of commercial fisheries contributes to the

widespread use of tough man-made material in fishing nets. These factors nowadays are perhaps even more important than illegal hunting in terms of threats to manatee populations.

Not everything is bleak in the manatee future. Despite considerable shrinkage of both the abundance and range of manatee populations from the original, there are enough manatees today to justify conservation efforts and for those concerned to feel optimistic about the outcome. The gentle nature of the manatee, its quiet habits, its shying away from disturbance and subtle submergence tactics as well as its strong awareness of the environment are factors in its favour. Manatees can respond to a changing environment. They are catholic in their diet and adapt easily to salinity gradients. Manatees learn to use protected or otherwise undisturbed areas, such as the sanctuaries in Florida. Present legislation has substantially changed attitudes, reduced hunting activities, and the sale of meat. Manatee hunting is a dying art in most countries. Traditional hunting knowledge is not being passed on to the younger generation, instead they are turning to easier, more abundant catches in more accessible habitats. Some will not hunt for fear of being caught, whereas a few comprehend and appreciate the animal's importance in its setting. However, a significant number of people remain unaware of protective measures and need to be educated.

Manatee conservation in developing countries with large human populations who live at subsistence level can only be attained if people accept to share the habitat and the resources. The best approach to reduce human-related mortality seems to be a combination of educational campaigns and law enforcement efforts. Law enforcement should include not only the monitoring of hunting activities, but specific measures such as restricting fishing areas and the type of fishing gear during certain times

Photo: G.A. Sategna



Fig 16: Caribbean manatee in captivity at Jardín Zoológico de Barranquilla, Colombia

of the year. Educational programmes must inform fishermen about the importance of releasing entangled manatees from nets. Programmes must be geared to local inhabitants as well as law enforcement agents, policy makers, legislators and public officials. Manatee conservation strategies must include cooperative programmes between countries, as it is of little use protecting manatees in one country when the neighbouring country continues to allow the netting or harpooning of manatees.

The establishment of reserves and sanctuaries will set aside suitable habitats and hopefully provide safe havens from hunters until local populations are educated enough to preserve manatees. Finally, an ecosystem management plan preventing pollution, siltation, and dredging activities will benefit not only manatees but other coastal populations as well. Waters of eastern Venezuela and the Orinoco system provide some of the largest continuous manatee habitat anywhere within the species' range. If hunting pressure and development are controlled, Venezuela may represent a major stronghold for manatees in the future<sup>51</sup>. Present low human densities and excellent manatee habitat<sup>51</sup> make Belize one of the last strongholds for manatees in the Caribbean<sup>77</sup>.

Manatees are valuable in ecological, economic, aesthetic and scientific ways. Man has largely been responsible for the demise of manatee populations. The time has come and it is our duty to help preserve this species. By combining protective legislation, educational campaigns and the establishment of reserves man can ensure manatee survival. A first step has been taken in Kingston, Jamaica, 1-4 March 1994. A multinational group of manatee experts met with professionals from related areas under the auspices of NRCA and RCU to discuss manatee conservation in the wider Caribbean. As a result, a regional management plan and implementation plan were drafted identifying steps that need to be taken in the areas of conservation, education, law enforcement, and research. Public education and awareness was identified as one of the most important routes to explore, and individual countries were urged to develop a regional effort for the conservation of this endangered species.

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