

## Manatee Rescue, Rehabilitation, and Release Efforts as a Tool for Species Conservation

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Wildlife rehabilitation programs have been used on numerous species to augment conservation and management efforts. The rescue, rehabilitation, and release of injured or sick animals have become a widespread practice among wildlife management programs<sup>1</sup>. These programs can make a significant contribution, especially to threatened and endangered species or when specific populations are at risk of extinction. Sirenians are no exception (figure 23.1). Several countries, including the United States, Puerto Rico, Mexico, Belize, and Brazil, have established extensive manatee rehabilitation programs, consisting of four basic components: rescue, rehabilitation, release, and post-release monitoring. Rescue and rehabilitation of dugongs have also been conducted by Sea World–Gold Coast in Australia, Toba Aquarium in Japan, and Underwater World in Singapore. In this chapter we outline the basic components of manatee rehabilitation programs and detail those existing in North, Central, and South America.

### Goals of Rehabilitation Programs

Rehabilitation programs may be established for a variety of reasons, including conserving species, increasing public awareness, supporting local economies, and satisfying governmental regulations or political concerns. Some programs focus on the humane, seeking to provide care for those animals affected by natural or anthropogenic impacts. Although these programs have merit, rehabilitation has greater worth when it contributes to species conservation and population growth.

Historically, rehabilitation programs have offered opportunities to educate the public about threats to wildlife and the environment while promoting conservation<sup>2</sup>. Rehabilitation and release programs can also provide platforms to develop and test the release of captive-bred threatened and endangered species to the wild<sup>3</sup>, and to

increase our knowledge and ability to treat wildlife diseases<sup>4</sup>.

Rehabilitation programs are often initiated to protect animal populations at risk of extinction. Such programs intervene with injured or distressed wildlife, providing animals with a second chance to survive in the wild and contribute to the population's gene pool.

### Program Structure

Rehabilitation programs may be developed in different ways, depending on available resources, infrastructure of the lead organization or agency, and the purpose of the program. A successful program depends on rapid response, proximity of adequate facilities, available resources, including funding and personnel, and an experienced rescue team<sup>5</sup>. A rehabilitation program typically has the following components: verifiers, rescuers, transporters, rehabilitation facilities, and biologists who conduct post-release monitoring.

Verifiers are used to determine if an animal is in distress. Their role typically does not involve hands-on work but rather a site visit and verification of reported sightings. Verifiers need to know the signs of distress that determine if assistance is necessary; these may include buoyancy problems including listing or inability to submerge, irregular breathing, lethargy, disorientation, and in cooler climates, the suite of symptoms termed “cold stress.” Abandoned calves and severe injuries, such as those caused by people (e.g., boat strike, entanglement), are easier to verify. Once an animal is confirmed as being in need of assistance, verifiers monitor the animal until the rescue team arrives.

Rescuers and transporters require special training in particular species handling techniques. Protocols should be strictly followed to ensure that the health and welfare of the animal are not compromised. Typically, the



Figure 23.1. West Indian manatee in rehabilitation at Centro Mamíferos Aquáticos in Itamaracá, Brazil. (Courtesy of Luciano Candisani.)

individuals who rescue sirenians are also authorized to conduct transport.

Rehabilitation facilities require the most extensive understanding of sirenian biology and medicine, and caregivers should be experienced in current husbandry techniques. The attending veterinarian should possess training in wildlife medicine, especially marine mammal health and disease processes.

Once the attending veterinarian has given medical clearance, rehabilitated animals can be released, some through an acclimation process (e.g., naive orphaned animals) and others directly (e.g., animals brought in as injured adults). Prior to release, a final health assessment should be conducted on all animals. Distinguishing marks should be documented, and all individuals should be tagged using a passive integrated transponder (PIT) tag<sup>6</sup>; animals without distinguishing marks may be freeze branded for future identification<sup>7</sup>. Blood serum and tissue samples for genetics assessment should be collected and archived<sup>8</sup>.

Monitoring is conducted on all manatees that have been released in Puerto Rico, Belize, and Brazil and for

selected animals in the United States. The intensity of monitoring efforts depends on available resources, the release candidate, monitoring goals, and the risk associated with the release of the individual. Monitoring typically includes radio-tracking to obtain location data, visual sightings, and planned capture for full health assessments<sup>9</sup>. Researchers conducting the post-release monitoring must possess specific training in the various capture, tagging, and tracking techniques<sup>10</sup>.

Those responsible for the development and implementation of a rehabilitation program should clearly delineate its structure and goals, define protocols, and identify partners with designated roles. Program success relies on effective communication among participants and on timely reporting. Periodic review of rehabilitation protocols is also recommended to determine if modifications are necessary.

### Partnerships

A successful program requires extensive resources, and expertise and partnerships are essential. Partners can le-

verage limited resources and bring stability and longevity to a program. They can be drawn from national, state, local, and tribal governments, nongovernmental organizations (NGOs), aquariums and zoos, academia, or the private sector. Partners will have various reasons for participating, and common goals or objectives should be defined initially and agreed upon by all.

Partners play a variety of roles depending on the needs of the program and personal interests. Some individuals or organizations may serve on an executive committee that makes decisions for the program, while others may serve in an advisory capacity when needed. Partners may be asked to provide expertise on issues regarding medical treatment, husbandry care, rescue and release logistics, or field monitoring. Others may contribute monetary resources, in-kind services, or other donations, such as field equipment. Rehabilitation programs may also offer local communities an opportunity to be involved in wildlife management, promote the ecological value of rehabilitating wildlife, and increase environmental awareness<sup>11</sup>.

### Management and Science

A critical component of any rehabilitation program is the cooperation among scientists, the rehabilitators, and the managers who rely on the supply of biological data acquired through research. Similarly, scientists need managers and rehabilitators for support and guidance to identify species needs, support protection measures, and drive conservation efforts.

Efficient rehabilitation programs possess a close working relationship among all the players. Scientists answer the biological questions, while managers make conservation decisions, and rehabilitators implement appropriate actions to save individual sirenians. A lack of cooperation among management and scientists can result in managers making biological decisions without supporting scientific evidence. Conversely, scientists may not conduct the critical research necessary to manage a species if they are not conversant with the conservation issues.

### Assessing Rehabilitation Program Success

One of the more challenging tasks of animal rehabilitation is assessing success. Success may be difficult to determine, and assessment can vary greatly. It can be defined in many ways: increases in the numbers of animals released, births, thriving generations, improvements in population survival rates, overall population numbers,

or successful medical treatments. Other programs may base initial success on increased funding contributions, improved cost-effectiveness, benefits to the local community, or advancement in science. In some instances the evaluation of success and the effectiveness of a rescue and rehabilitation program may require knowledge of population structure<sup>12</sup>.

Educational benefits may also define program success, especially in local communities where hunting exists. Although difficult to measure, educational benefits can contribute significantly to rehabilitation programs. The persistence of a viable population does not depend solely on financial contributions and conservation-minded expertise; it also depends on the attitudes and actions of people who share the animals' habitat.

The measure of success for any rehabilitation program can be arduous, especially when resources are limited, baseline data are lacking, sample sizes are small, or program longevity is not yet established<sup>13</sup>. Although rehabilitation is acknowledged as a means for conserving and managing species, it remains controversial because the expense and labor may not match the overall success of the program's contribution to the population<sup>14</sup>.

### Manatee Rehabilitation and Captive Programs

West Indian manatee (*Trichechus manatus*) and Amazonian manatee (*T. inunguis*) rehabilitation programs exist in the United States, Mexico, Belize, Puerto Rico, Peru, and Brazil (table 23.1). In addition, manatees are sporadically kept at captive at facilities for rehabilitation in Brazil, Colombia, the Dominican Republic, Guyana, Jamaica, and Venezuela (table 23.1).

#### West Indian Manatee

##### United States

The United States has a long-standing rescue, rehabilitation, and release program assisting injured or distressed manatees and, when necessary, providing supplemental captive care. The program's goal is to release manatees to the wild and ensure their greatest chance of survival.

The U.S. Fish and Wildlife Service (USFWS) provides management oversight and is ultimately responsible for the animals under the authority of the U.S. Endangered Species Act and Marine Mammal Protection Act.

The program was formalized in 1973, and in 1991 the Interagency/Oceanaria (I/O) Working Group was created to support and assist in its implementation. Partners represent national, state, and local agencies, oceanaria, academia, and NGOs.

**Table 23.1. Summary of facilities holding West Indian manatees (*Trichechus manatus*) or Amazonian manatees (*T. inunguis*) for rehabilitation or display in the Americas as of August 2009.**

Facility	Location	Year established*	Manatees		Volume	Water	Tank system	Staff	
			Rehab	Captivity				Vets	Caretakers
<b>West Indian manatee (<i>Trichechus manatus</i>)</b>									
Acuario de Veracruz	Veracruz, MEX	1998	0	6	40,250	Salt	Closed	2	3
Acuario Nacional	Santo Domingo, DOM	1995	0	0	108,300	Salt	Open	2	2
Belize Manatee Rehabilitation Centre	Sarteneja, BLZ	1999	1	0	10,640	Brackish	Open	2	2
Caleta de Xel-Há	Quintana Roo, MEX	1999	0	3	-	Fresh	Open	1	2
Centro de Convivencia Infantil	Tabasco, MEX	1981	0	3	-	Fresh	Enclosed lake	-	-
Centro Mamíferos Acuáticos	Pernambuco, BRA	1991	17	10	1,079,750	Salt	Open	1	13
Cincinnati Zoo and Botanical Garden	Ohio, USA	1999	2	0	456,000	Fresh	Closed	2	3
Colombus Zoo and Aquarium	Ohio, USA	1999	2	0	950,000	Brackish	Closed	1	3
CVS/Fundación Omacha	Córdoba, COL	1990	1	3	-	Fresh	Enclosed lake	1	1
Dallas World Aquarium	Texas, USA	2000	2	0	839,000	Fresh	Closed	2	1
Disney's Living Seas	Florida, USA	1988	2	0	608,000	Salt	Closed	2	6
Dolphin Discovery's Cozumel	Quintana Roo, MEX	2007	0	3	-	Salt	Open	4	4
Dolphin Discovery's Isla Mujeres	Quintana Roo, MEX	2007	0	3	-	Salt	Open	4	4
Dolphin Discovery's Puerto Aventuras	Quintana Roo, MEX	2001	0	4	1,145,000	Salt	Open	4	4
El Colegio de la Frontera Sur	Quintana Roo, MEX	2003	0	1	690,000	Brackish	Open	1	2
Fundación Ecológica Amigos del Manatí	Bolivar, COL	1986	0	33	-	Fresh	Enclosed lake	0	1
Fundacion Zoológico Metropolitano del Zulia	Maracaibo, VEN	1998	0	1	80,000	Fresh	Closed	3	2
Guyana Zoological Park	Georgetown, GUY	1895	0	13	-	Fresh	Closed	1	9
Homassasa Springs Wildlife State Park	Florida, USA	1980	5	1	456,000	Fresh	Enclosed river	3	9
Tampa's Lowry Park Zoo	Florida, USA	1990	11	0	962,000	Fresh	Closed	1	7
Miami Seaquarium	Florida, USA	1954	7	2	950,000	Salt	Closed	3	8
Mote Marine Laboratory	Florida, USA	1996	2	0	266,000	Salt	Closed	1	3
Natural Resources Conservation Authority	Clarendon, JAM	1981	0	3	-	Fresh	Open	0	1
Parker Manatee Aquarium	Florida, USA	1949	2	1	245,000	Fresh	Closed	1	4
Parque Zoológico y Botánico Bararida	Barquisimeto, VEN	1994	0	3	-	Fresh	Closed	2	1
Puerto Rico Manatee Conservation Center	Bayamón, PRI	1990	2	0	160,000	Fresh	Closed	2	10
Puerto Rico Zoo	Mayagüez, PRI	2005	0	0	-	Fresh	Closed	1	2

*continued*

Table 23.1—continued

Facility	Location	Year established*	Manatees		Volume	Water	Tank system	Staff	
			Rehab	Captivity				Vets	Caretakers
Sea World of Florida	Florida, USA	1985	13	0	1,712,000	Fresh	Closed	4	4
Xcaret	Quintana Roo, MEX	1999	0	2	413,000	Fresh	Open	1	2
Yumká	Tabasco, MEX	1993	0	4	2,460,194	Fresh	Open	1	2
Zoológico de Barranquilla	Atlántico, COL	1988	0	2	-	Fresh	Closed	1	-
Total			69	101					
<tsh>Amazonian manatee ( <i>Trichechus inunguis</i> )									
Centro de Proteção e Pesquisa de Mamíferos Aquáticos	Amazonas, BRA	1992	9	35	850,000	Fresh	Open	2	8
Centro de Rescate Amazónico	Iquitos, PER	2007	9	0	409,000	Fresh	Open/closed	2	4
INPA Laboratório de Mamíferos Aquáticos	Amazonas, BRA	1974	8	30	650,000	Fresh	Open	1	6
Museu Paraense Emílio Goeldi	Para, BRA	1955	0	1	160,000	Fresh	Open	1	1
Total			26	66					

\* Year that the manatee program was established, Rehab = at present in rehabilitation, Captivity = at present in permanent captivity or semi-captivity, Volume in liters of water, Vets = veterinarians, BLZ = Belize, BRA = Brazil, COL = Colombia, DOM = Dominican Republic, GUY = Guyana, JAM = Jamaica, MEX = Mexico, PER = Peru, PRI = Puerto Rico, USA = United States of America, VEN = Venezuela.

The core of the rehabilitation program consists of eleven facilities: seven in Florida, two in Ohio, and two in Puerto Rico (table 23.1). Five of these—Sea World of Florida, Tampa's Lowry Park Zoo, Miami Seaquarium, Puerto Rico Zoo, and the Puerto Rico Manatee Conservation Center—are authorized for critical care. Additional facilities and organizations are authorized to verify, rescue, and transport injured or distressed manatees.

Causes of distress include watercraft injuries, entanglement, exposure to cold or red tide, entrapment or crushing in water control structures, orphaned calves, and other natural causes such as disease or reproductive complications. As of 2008, the program has rescued over 1,051 manatees and has released 351<sup>15</sup>. The longevity of the program has enabled significant global contributions to the advancement of manatee biology and medicine (figure 23.2).

In 1992 the USFWS and the I/O Working Group developed release criteria for the program, based on medical history, the circumstances of birth (e.g., wild-born adult, wild-born orphan, captive-born, inbred, foster-reared, human-reared) and length of time in captivity.

Five release categories were defined: <1 year, 1 to 5 years, 5 to 10 years, 10 to 15 years, and >15 years. Initially, animals rescued as adults, or those in captivity for the shortest period of time, were given highest priority for release. Over the years, the program has progressed to releasing younger animals and individuals that have been in captivity for longer periods of time.

The most challenging release candidates are those captive-born orphans with minimal wild experience or animals with over 15 years in captivity. These high-risk animals are monitored after release via radio transmitters. Although expensive and time-consuming, these efforts have allowed managers and biologists to develop a better understanding of habitat use, distribution patterns, behavior, health, and the capacity for adaptation to the wild. With over 107 manatees tagged, the program has further refined protocols and criteria that have enhanced survival rates.

#### Puerto Rico

Rescue and rehabilitation efforts began in Puerto Rico in 1990<sup>16</sup> and are at present conducted by two rescue and rehabilitation facilities. The Puerto Rico Manatee Con-



Figure 23.2. Rescue and transport of a West Indian manatee in Crystal River, Florida. (Courtesy of Antonio A. Mignucci-Giannoni.)

ervation Center (PRMCC) is operated by the NGO Red Caribeña de Varamientos (Caribbean Stranding Network) and the Inter American University of Puerto Rico under special permits from the U.S. and Puerto Rican governments (table 23.1). PRMCC staff consists of caretakers, a curator, an attending veterinarian, and an alternate veterinarian. Volunteers assist in daily duties and an extensive educational outreach program. The PRMCC has also provided expertise and assistance to other Latin American countries, Africa and China.

Since 1990, the program has cared for 27 manatees. The majority of animals rescued (85%) were calves that had been orphaned or separated from their mothers. Adults and juveniles brought in for rehabilitation generally suffer from pneumonia or long-term malnutrition, including severe cachexia (extreme loss of weight and muscle mass). Calves typically are prematurely born and malnourished, with colic, enteritis, colitis, and pneumatosis intestinalis as medical complications (figure 23.3).

The rehabilitation approach involves intensive 24-hour supervision during the first week, hydration through a calculated and balanced formula of electrolytes and elemental peptide-based milk formula (Nestlé's Peptamen Junior<sup>®</sup> or Enfamil's Nutramigen<sup>®</sup>), and antibiotics based on bacteriology and sensitivity. If necessary, animals are hydrated intravenously or tube-fed to secure nutrition and electrolyte balance. Feeding is then transitioned to a soy or milk-based diet (Similac's Isomil Advance<sup>®</sup>, Nestlé's Nutren Junior<sup>®</sup>, Enfamil's Kindercal<sup>®</sup>) and a bitch-replacement milk (PetAg's Zoologic<sup>®</sup> Milk Matrix 33/40) with vitamins (multivitamin, taurine, and vitamins E and C), and canola oil as a source of fat (figure 23.4). Animals are started on vegetables and fruits after six months of age until they are progressively weaned at 1.5 years. After weaning, diets become completely solid, consisting of romaine and iceberg lettuce, spinach, broccoli, cabbage and a variety of fruits and tuberous roots, including cantaloupe and honeydew melons, bananas, papayas, carrots, pumpkin, cucumbers, apples, pears,



Figure 23.3. Routine medical examination of a West Indian manatee calf in Puerto Rico. (Courtesy of Antonio A. Mignucci-Giannoni.)

yams, and sweet potatoes. Diets are often supplemented with “manatee” biscuits consisting of alfalfa, soybean meal and hulls, kelp, wheat, and a vitamin and mineral mixture, with a nutrient composition similar to that of romaine lettuce.

Successful rehabilitation protocols used at PRMCC include periodic health assessments, first at weekly intervals and then monthly. Morphometric measurements are taken to document developmental progress, and health parameters are documented on an extensive assessment form. Hematology and blood chemistry history of all patients allows the staff to detect and treat medical problems early, comparing values with those for a clinically healthy Antillean manatee. The program has also pioneered the use of a subdermal PIT tag system that incorporates temperature-sensing capabilities (Destron Fearing’s LifeChip® with Bio-Thermo® technology), allowing caretakers to take multiple temperature readings using a hand-held reader (Destron Fearing’s DTR<sup>4</sup>) without having to capture or restrain the manatee.

Puerto Rico’s approach to rehabilitated manatee release includes weaning animals from milk to a herbivorous diet through the use of bottom PVC feeders, presentation of seagrasses (*Thalassia testudinum* and *Syringodium fili-*



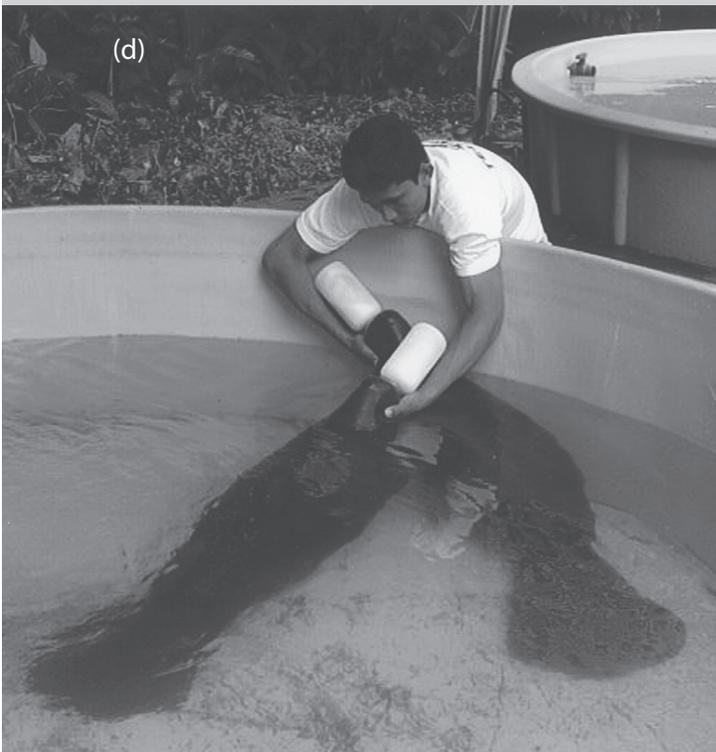
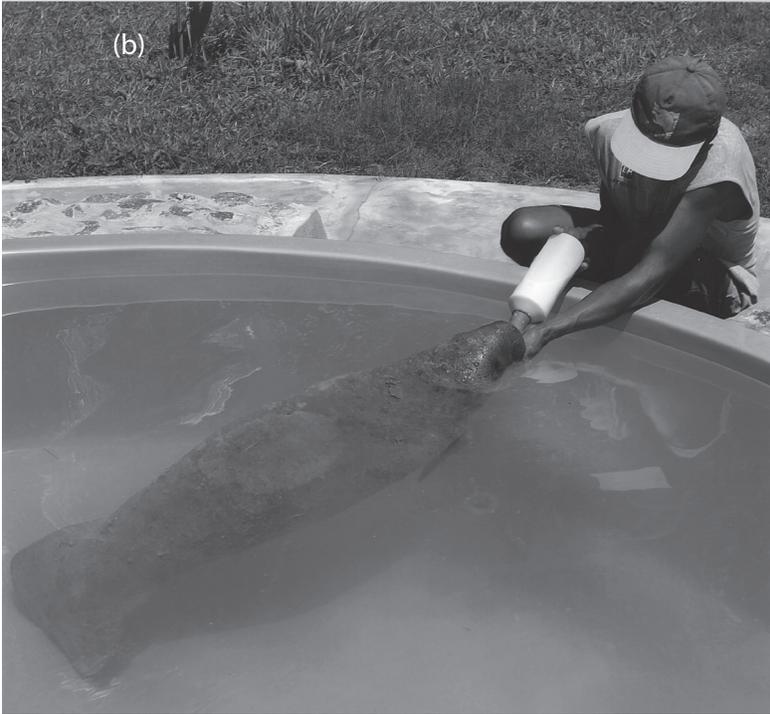


Figure 23.4a–e (*facing and above*). Bottle-feeding of orphaned West Indian and Amazonian manatees at different rehabilitation facilities in Puerto Rico, Brazil, Mexico, and Peru. (Courtesy of Antonio A. Mignucci-Giannoni, Geraldo Falcão, and Benjamín Morales-Vela, INPA.)

*forme*) and water hyacinths (*Eichhoria crassipes*) one year prior to release, progressive saltwater acclimation in captivity three months prior to release, and a three- to six-month soft release using a shore-based 15 km<sup>2</sup> sea-pen with seagrasses to allow for acclimation. In the sea-pen, manatees are weaned from lettuce onto seagrass and offered fresh water from a hose at different intervals during the day. Following release from the sea-pen, manatees are monitored for one year via radio-tracking (figure 23.5) with periodic health assessments, mostly through trained medical behaviors (e.g., blood and urine sampling, physical exams)<sup>17</sup>.



Figure 23.5. Recently released West Indian manatee with satellite transmitter in Puerto Rico, part of the post-release monitoring program. (Courtesy of Marlene Colón.)

A release is considered successful when the manatee is observed feeding on wild vegetation and drinking fresh water from a natural source, such as a river; interacting with other manatees; avoiding watercraft and other human-related hazards; and traveling out of the sea-pen and into adjacent areas; and when it is repeatedly found medically stable and healthy and survives for a year after release. A release is considered unsuccessful if the manatee exhibits excessive weight loss (30–40%), does not meet the preceding criteria, or shows signs of stress or illness.

Three animals have been released under this program and others are scheduled. Moisés, the first successful rehabilitated manatee of the program and considered a symbol for manatee conservation in Puerto Rico, was rescued in 1991 and released in 1994<sup>18</sup>. After 17 years, he is still thriving in the wild. Rafael, released in 2003, survived for just over a year; unfortunately, when found, his body was too decomposed to determine the cause of death. Tuque, released in 2010 is still being monitored through radio-telemetry.

#### Dominican Republic

A rehabilitation program has been run by the Acuario Nacional in Santo Domingo since 1995, using protocols from Puerto Rico. The Acuario Nacional has rescued two orphaned calves and two ill adults<sup>19</sup>. One of the calves was kept captive for over 12 years and was featured in a long-standing education campaign in the Dominican Republic. A major limitation to this program is the lack of funding to expand facilities and train volunteers, veterinarians, and biologists in current methods of manatee care and husbandry. Future plans include the enhancement of community outreach, partnerships with local and municipal NGOs in rescue efforts, and development of conservation-oriented research projects that should aid in manatee conservation throughout Hispaniola.

#### Jamaica

Manatees are highly endangered in Jamaica owing to severe poaching and habitat destruction, with a population of fewer than 30 animals<sup>20</sup>. Around 1980 the Natural Resources Conservation Authority initiated a project to manage manatees and hold a small captive population for display, education, and breeding<sup>21</sup>. Four female manatees were introduced into the fenced-off Alligator Hole River in Clarendon; however, by 1984 funding ceased. Repeated unsuccessful attempts were made to manage or release the animals with radio-transmitters. One of the animals died, and three are still trapped in the river<sup>22</sup>.

## Mexico

A rescue and rehabilitation program was initiated in 1995 with the relocation of 17 manatees isolated in a drying lake in Chiapas to a nearby lake with a small manatee population. Under the supervision of the National Subcommittee for Manatee Conservation, partnerships were established between the federal and state governments, oceanaria, zoos, and university programs.

The Acuario de Veracruz was the first to provide care for two orphaned calves in 1998, and since then has rehabilitated another five. These manatees, along with an additional two born in captivity, are on permanent exhibit. In 2001, Xcaret and Dolphin Discovery, two wildlife recreational parks in Quintana Roo, assisted in the rescue of six manatees isolated in a small lagoon at the Centro de Convivencia Infantil in Jonuta, Tabasco. Two of the animals were placed in semi-captivity in the same lagoon and are now cared for by the Centro under the auspices of the municipal government. The remaining manatees were split among the two facilities in Quintana Roo, initially for rehabilitation, and later for exhibition, research breeding, and a “swim with manatee program.” In 2001 another young manatee was received in the Centro in Jonuta. In 2002 Dolphin Discovery received a manatee stranded in a lagoon in Tabasco, and Xcaret received in 2005 an additional calf from Jonuta. Four manatees rescued from fishers’ nets are exhibited in a lake at Yumká, a park in Villahermosa, Tabasco.

In 2003 El Colegio de la Frontera Sur (ECOSUR) and Africam Safari rescued an orphaned calf in Quintana Roo and transferred it to improvised facilities in Chetumal. The calf was bottle-fed a milk-based formula (PetAg’s Multi-Milk) with canola oil and a taurine supplement. After failed attempts to release the calf into the wild it was kept in semi-captivity to increase public education and species conservation.

A total of 26 manatees reside in captivity or semi-captivity, exhausting the current capacity of Mexican rescue and rehabilitation facilities. A new facility dedicated for rescue, rehabilitation, and release is needed.

## Belize

Manatee rescue and rehabilitation in Belize is conducted as part of the Belize Marine Mammal Stranding Network, established under the government’s Coastal Zone Management Institute (CZMAI) and in partnership with the NGOs Wildtracks and Wildlife Trust. Rehabilitation activities began in 1999 with the rescue of an orphaned calf. The rescue of a second calf led to the formal beginning of Belize’s Manatee Rehabilitation Program in 1999.

The majority of the animals rescued are orphaned calves; however, two injured adults have also been rehabilitated. The husbandry protocol includes continual observation until animals are roughly two years old and routine medical checkups. The feeding protocol begins with a milk replacement formula and later introduction of and feeding with local aquatic vegetation (i.e., purslane [*Portulaca* spp.]), water hyacinths, water spinach (*Ipomoea aquatica*), and shoal grass (*Halodule beaudettei*). Once rehabilitated, manatees are transferred to a national protected area, where they are tagged, released, and monitored for an additional two years. Success is achieved when the animals are observed interacting with conspecifics, grazing, gaining weight, and avoiding watercraft and human interactions. If a released animal does not adapt, it is brought back to the rehabilitation facility or kept in a protected sea-pen.

The first rehabilitated manatee was released in 2001 at Gales Point (Manatee) Wildlife Sanctuary, chosen because it is a semi-enclosed coastal lagoon used by manatees year-round<sup>23</sup> and a site for an ongoing tagging project. Two additional calves have been successfully rehabilitated and released.

The program relies on the public to report abandoned or stranded animals to the stranding network and a centralized coordinator. Additionally, the program incorporates a public awareness component targeted at schools in key manatee areas. One limitation has been the lack of specialized veterinarians and limited training for caretakers. Partnerships and liaisons between CZMAI, Wildtracks, Wildlife Trust, the Forest Department, and the Belize Agriculture Health Authority are an invaluable asset. Operating funds are scarce, but the program survives with support from local private sector entities and a dedicated group of volunteers.

The existence of the program has led to increased interest and awareness among the public, a rise in manatee reporting, and an observed decrease in manatee hunting. These factors, together with increased experience, have enhanced the efficacy and success of manatee rehabilitation in Belize.

## Colombia

Manatees, threatened by poachers, have been rescued informally in Colombia since the late 1980s. Montoya et al.<sup>24</sup> documented a total of 33 manatees in captivity or semi-captivity, including four captive-born. Manatees are also kept in artificial lakes (currently 40 individuals) along the Magdalena, Cauca, Meta, Sinú, and San Jorge river beds. These animals have access to natural forage

with limited human contact. In Magangué, manatees are cared for by the NGO Fundación Ecológica Amigos del Manatí, which also provides educational programs to reduce poaching. Captive animals are also held by the Fundación Yamato, the Zoológico de Baranquilla, and Corporación Autónoma Regional de los Valles del Sinú y San Jorge (CVS), under the guidance of the NGO Fundación Omacha.

Many manatees, illegally captured for meat, have been confiscated by the government, including several orphans, and some injured or sick (e.g., cachexia, septicemia) individuals. These cases have provided valuable baseline manatee biology in Colombia, including disease processes<sup>25</sup>, hematology<sup>26</sup> and population genetics<sup>27</sup>.

At present all rehabilitation efforts are coordinated by the Colombian Environmental Ministry and the environmental public corporations in each region, in partnership with NGOs, and under guidelines set by the National Program for the Conservation and Management of Manatees in Colombia<sup>28</sup>. Regular monitoring programs for captive and semi-captive manatees have been established, and a release program with post-release radio-telemetry monitoring has been implemented in the Sinu River by the CVS and Fundación Omacha since 2008.

#### Venezuela

Manatee rescue and rehabilitation has been conducted since 1985, when a calf was rescued where the Portuguesa and Apure rivers meet<sup>29</sup>. Since then, a few animals have been rescued from poachers, and in collaboration with the Dallas World Aquarium, two females were transported to the United States until a formal rescue and rehabilitation program can be established in Venezuela. In 2005 a calf was rescued at Lake Maracaibo and it is exhibited at the Parque Zoológico Sur. The calf was bottle-fed using a goat milk and Multi-Milk formula and weaned onto iceberg lettuce, chard (*Beta vulgaris*), papaya, and bananas. In 2007 a calf was born to the manatee pair at the Parque Zoológico y Botánico Bararida. The two facilities now holding manatees in Venezuela are both remodeling and expanding their manatee exhibits.

#### Guyana

Manatees have been kept captive at the Guyana Zoological Park and Botanical Gardens in Georgetown since 1895<sup>30</sup>. They were originally kept to help maintain the irrigation canals, keeping them clear of aquatic vegetation, but rescued animals have been introduced into the wild

population. Their reproduction has been very successful; manatees have been exported to zoos and aquariums in Denmark, France, Germany, Japan, Netherlands, Portugal, and Singapore.

#### Brazil

Field research by the Projeto Peixe-Boi and Fundação Mamíferos Aquáticos to study West Indian manatees on the northeastern Brazilian coast discovered that many of the dead animals were orphaned calves. In response, the Manatee Rescue and Rehabilitation Facility at the Centro Mamíferos Aquáticos, a unit of Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), was created in 1991 on Itamaracá Island, Pernambuco (figure 23.6). Partnerships with members of the Rede de Encalhe de Mamíferos Aquáticos do Nordeste (Northeastern Stranding Network) have allowed for rapid and efficient responses to live strandings, resulting in increased survival rates.

Several adults and 48 orphaned calves have been transported to this facility. Ten resident manatees are housed in three large interconnected pools; the remaining captives will eventually be released. Orphaned calves, housed in eleven pools in a separate area isolated from public viewing, are cared for over approximately 30 months with a soymilk formula and shoal grass. After two years they are fed only seagrass and algae from bottom feeders used for encouraging bottom feeding for animals in captivity.

The established release protocol includes general guidelines and criteria for candidates, release sites, the translocation process, public education campaigns, acclimation, and post-release monitoring. The reintroduction of youngsters along the coast of Alagoas, the southernmost known extent of the West Indian manatee's range, began in 1994 with two manatees (Astro and Lua). Animals at this location are of critical concern due to their geographic isolation from the remaining Brazilian manatee population. The desire is for future releases to restock this area to historical numbers. Since 2006 there have been eight reintroductions, totaling 15 animals. All animals are radio-tagged and their health is regularly monitored.

Results from the reintroduction and post-release monitoring have been used to modify and improve captivity care. The conservation strategy developed by the Centro Mamíferos Aquáticos has been successful in minimizing mortality through rescue, rehabilitation, and release. The goal is to increase manatee numbers throughout their historical range along the northeastern coast of Brazil.



Figure 23.6. West Indian manatee rehabilitation facility at Centro Mamíferos Aquáticos in Itamaracá, Brazil. (Courtesy of Geraldo Falcão.)

### Amazonian Manatees

Amazonian manatees are traditionally hunted with harpoons. However, they are also hunted by using calves as bait to attract their mothers. Many orphaned calves are kept alive in small tanks, backyard ponds, or bound with rope in shallow water and inadequately fed.

#### Brazil

There are currently two Amazonian manatee rehabilitation centers in Brazil: the Robin C. Best Aquatic Center at the Laboratório de Mamíferos Aquáticos of the Instituto Nacional de Pesquisas da Amazônia (INPA) in Manaus (Amazonas), and the Eletronorte's Centro de Preservação e Pesquisa de Mamíferos Aquáticos (CPPMA) in the city of Presidente Figueiredo (Amazonas).

INPA pioneered rehabilitation of and scientific research on Amazonian manatees in captivity. Since 1974 INPA, and more recently CPPMA, have rescued more than 250 Amazonian manatees. Most of these were

orphans, their mothers having been victims of illegal hunting, the early orphans arriving emaciated and with severe cachexia, dying within days. However, an increase in trained technicians and financial support has substantially improved the survival success of rescued manatees<sup>31</sup>.

Young orphaned Amazonian manatees are typically easy to raise if they are not seriously dehydrated, malnourished, stressed, or suffering acute harpoon wounds. Upon rescue, orphans are fed an artificial formula consisting of whole-fat powdered cow milk, water, canola oil, and the supplement Aminomix<sup>32</sup>. This formula is offered every two hours during the daytime, giving a total volume of 2–4 liters/day, depending on the age of the animal. Newborn calves and those in poor health are fed with lactose-free milk, to avoid complications with diarrhea, flatulence, and colic, until at least two months of age (figure 23.7). Calves are also exposed to aquatic plants and vegetables to initiate familiarity with different types of food items and are weaned when they reach 60

kg of body weight. Captive Amazonian manatees are fed over 23 different species of cultivated vegetables, such as cabbage, kale, lettuce, pumpkin, cucumber, tomatoes, carrots, and several other fruits and roots. Floating pellets specially developed for manatees are being tested at INPA/Manaus for acceptance, palatability, and nutritional requirements to reduce the costs of maintenance of Amazonian manatees in captivity and improve their diet quality. Routine health examinations are conducted to monitor captive animals, including biometry and blood (hematology, biochemistry, and serology) and urine analysis<sup>33</sup>. The success of the rehabilitation program of INPA can be measured by the first birth of an Amazonian manatee in captivity in 1998. The mother of the first calf conceived and born in captivity arrived in INPA in 1974, when she was about six months old. She

was raised with an artificial milk formula and since 1998 she has been reproducing at a rate of about one calf every three years. Today captive manatees reproduce regularly at INPA and CPPMA.

Although releasing rehabilitated animals is also among the main goals of INPA's Amazonian manatee conservation program, it has been avoided for many years for various reasons. First, manatee slaughter is a common practice, and as manatees raised in captivity are habituated to human contact, released manatees may approach coastal communities and boats and be harpooned. Second, Amazonian manatees travel long distances, at times over 250 km from flooded areas during the high-water period to lakes or to main river channels during receding and low-water periods. These movement patterns require learning that naive captive-raised

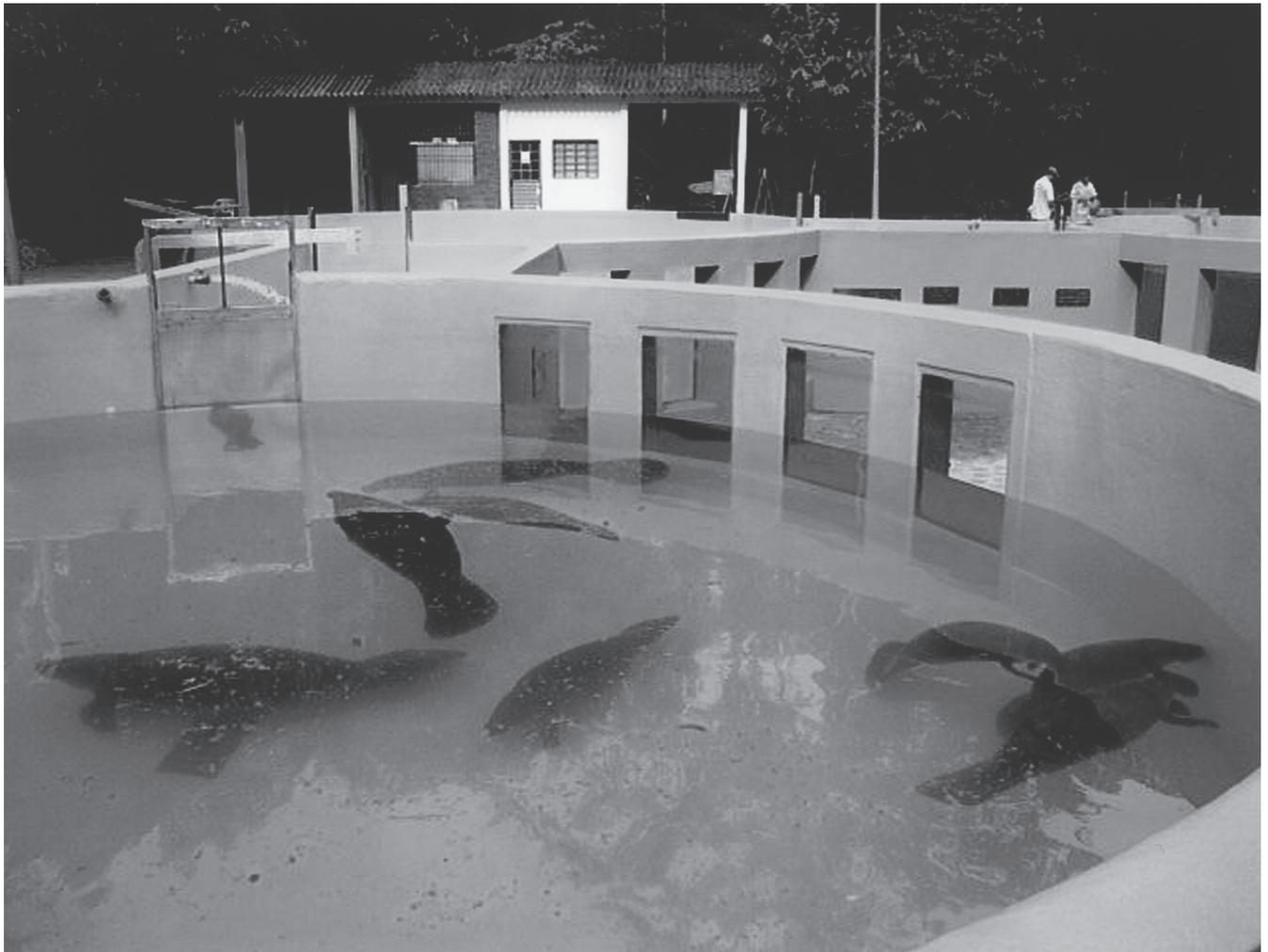


Figure 23.7. Amazonian manatee rehabilitation facility at INPA's Laboratório de Mamíferos Aquáticos in Manaus, Brazil. (Courtesy of INPA.)

manatees do not possess, making them susceptible to stranding and hunting. Third, financial limitations have precluded implementation of releases.

However, in March 2008 INPA, together with the Instituto de Pesquisas Ecológicas (IPÊ), started the first phase of a project to release Amazonian manatees raised in captivity. Genetic flow of this species in the Amazon is high, and consequently the populations are genetically well mixed<sup>34</sup>, so releasing animals in areas different from their original locality is not a major concern. The first phase of the project aimed to explore potential areas where manatees could be safely released by characterizing habitats used by resident manatees, determining food availability, and identifying local human perception regarding manatees. The second phase of the project focused on an intensive environmental education program within riverine communities, along with the completion of health assessments of possible release candidates. The criteria adopted to choose the animals to be released were being male, subadult, and presenting good health conditions and higher haplotypic similarity with wild manatees of the area. Animals have been released in small groups at different intervals and tracked by radio-telemetry. This is an expensive project, as both trackers and educators must be in the field full-time. Nevertheless, thanks to financial support from Petrobras S.A., to date four captive-raised Amazonian manatees have been released back in the wild, two in March 2008 and two in April 2009.

#### Colombia

Amazonian manatee calves have been rescued in Colombia after their mothers were butchered. One calf was kept at the Jardín Zoológico de Leticia from 1992 until its death in 2006. In 1998 Fundación Omacha rescued a calf in Puerto Nariño, which was successfully rehabilitated and released with a transmitter in 2002. The Indigenous Ticuna community rescued a calf in 2004; however, it died while receiving medical treatment.

#### Peru

In the Loreto region of Peru, poaching activities have resulted in orphaned calves, which have been housed in private ponds as pets or in aquaculture stations to control aquatic plants. In 2007 the Ministerio de la Producción (PRODUCE) found a calf and a subadult in the Marañón River and turned them over to local NGOs for rehabilitation. These rescues prompted the creation of the Centro de Rescate Amazónico in conjunction with the Dallas World Aquarium, where nine manatee calves

are now in rehabilitation and five have been released. Through this initiative, the Centro Peruano and the regional government jointly manage orphaned or confiscated Amazonian manatees at the same time that an aggressive outreach community effort is made to educate people about the need for conserving this species in this part of the Amazon region.

#### Conclusions

As the primary threats to sirenians are increasingly human-related, many countries are supporting local populations through various recovery schemes. The rescue and rehabilitation of orphans and injured or ill individuals is a significant tool that supports conservation of sirenians, both locally and regionally. Partnerships between management and science and the incorporation of education and public awareness are critical. Rehabilitation programs around the world continue to evolve and to collaborate with one another, advancing general biological knowledge, improving medical treatments, enhancing protocols for release and adaptation to the wild, and assisting in promoting protection measures to ensure population viability and species conservation.

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