

Sirenews

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- World's northernmost dugong population is likely to be at serious and imminent risk of extinction! (see page 28)
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IN MEMORY OF DR. MARK T. LOWE



Dr. Mark Lowe feeds two manatees in this August 2000 file photo taken at the Homosassa Springs Wildlife State Park. Dr. Lowe, who worked tirelessly with the gentle marine mammals, died March 4 at age 69.

UNION INTERNATIONALE POUR LA CONSERVATION DE LA NATURE ET DE SES RESSOURCES

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James A. Powell and Robert K. Bonde

CMA Research Institute, 249 Windward Passage, Clearwater, FL 33767 USA

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Dr. Mark Lowe, a veterinarian with warmth, wit and wisdom

By Nancy Kennedy – Previously published in the Citrus County Chronicle – 11 March 2019

As a veterinarian, Mark Lowe had a way with animals -- and with people. "Medicine is both science and art, and he had the touch," said Susan Lowe, Mark's wife of 42 years. "He'd say, 'You have to look at the animal and touch them.' That was really important to him." When he was treating or examining an animal, he would talk directly to them and not to the animal's owner. "He knew that way, the owners would listen in and pay attention," she said. "And he shed tears with them when their animals died."

For Mark Lowe, longtime senior veterinarian at Midway Animal Hospital in Homosassa and contract veterinarian at the Ellie Schiller Homosassa Springs Wildlife State Park, being a veterinarian was more than a career. "It wasn't just that he loved animals -- for my dad, it was his true calling," said his daughter, Shannon Lowe. Dr. Mark T. Lowe retired from veterinary medicine in 2009 after being diagnosed with early onset dementia. He died March 4 at age 69.

Dr. Mark Lowe worked at Midway Animal Hospital in Homosassa from 1984 to 2009. "He had a real passion for the profession, that's why he was so good at what he did -- he was excellent," said retired veterinarian Dr. KC Nayfield, who hired Mark in 1984 at Midway Animal Hospital. "In my career, I've worked with close to 100 veterinarians over the past 39 years, and I would put Mark up near the top of the list." Nayfield added, "He was a mentor to well over a dozen new graduates that I hired at Midway...and he helped shape the careers of many of them."

Dr. Jason DeLaPaz, veterinarian at Lecanto Veterinary Clinic, was one of them. "After high school I went to work at Midway (as a veterinary technician), and it was cool, the type of veterinary medicine that he practiced," DeLaPaz said. "Such a great character, cracking jokes all the time. That, and the way he handled animals, that solidified what I wanted to do...I am a veterinarian because of him." A graduate of the Ohio State University -- as a die-hard Buckeye, Mark insisted you always use "the" in the school's name -- he and Susan moved to Florida from Dayton, Ohio, in the early 1980s, first to Ocala and then to Citrus County.

"As a dad, he was awesome," Shannon Lowe said. "He was always teaching us about things and bringing us into where he worked...we learned a lot of veterinary tech skills and he taught us about animals and animal surgeries."

It was a treat when Shannon and her brothers, Jason and Ian, would go on emergency calls with their dad. "Friends and family would bring their dogs in who had to have a C-section, and we'd each have a towel and help bring the puppies into the world," Shannon said. "We got to get dressed up in scrubs -- he would 'gown us up' and show us how to 'scrub in' -- such good memories."

At home, the Lowes always had a menagerie of pets, farm animals and exotic animals -- birds, horses, English setters, chickens and even giant tortoises. Exotic birds were Mark's special interest, but manatees became his passion. "He was captivated by them," Susan Lowe said. "He said when you look into their eyes, you could feel their gentleness and peacefulness." Art Yerian, the wildlife park manager from 1994 to 2013, said he and Mark had some "great adventures" together.

Among the many animals Dr. Mark Lowe took care of over the years as a veterinarian, he had a special affinity for the bear cubs he and Art Yerian, former park manager at the Ellie Schiller Homosassa Springs Wildlife State Park, rescued from the Ocala National Forest.

“We went to Hialeah and caught the flock of flamingos that’s currently at the park. We also traveled to the Ocala National Forest to pick up orphaned baby bears that we brought back to the park and shared time hand-raising those bears,” he said. “They’d go to his house for a couple of nights and then my house a couple nights.

“We flew manatees up to the Columbus and Cincinnati zoos and drove down to Key Biscayne several times to pick up baby manatees at the Miami Seaquarium,” Yerian said. “Mark was just an excellent veterinarian and person. His wife, Susan, actually worked for me. They lived at the park, so Mark was always on hand, and he volunteered quite a bit, did the manatees every morning.”

Mark Lowe had a keen sense of humor. He was a jokester and a master at telling stories. He loved the outdoors, fishing, camping, hunting, being on the water in a boat or on skis and in the water, snorkeling or diving.

Mark was a charter member of Kings Bay Rotary, started the Friends of the Ellie Schiller Homosassa Springs Wildlife State Park and the Friends of Chassahowitzka National Wildlife Refuge Complex. He was also a member of the U.S. Fish and Wildlife Service Manatee Rescue Team.

“When it was time for him to retire -- we had started to see signs of his disease -- I had sold the practice, so I'm glad I never had to make that difficult decision,” KC Nayfield said. “But we had a lot of good times at Midway. We fixed and helped a lot of animals in those days, and Mark made the world a better place.”

Editor’s Note: Dr. Mark Lowe worked with many sirenian managers, researchers, and veterinarians over the years. Among his duties as a veterinary practitioner in Homosassa, Florida, he was also in charge of the care of many animals at the Homosassa Springs Wildlife State Park. He made trips to Belize, Jamaica, and Trinidad and Tobago to assist with manatee care and provide veterinary treatment. Mark was an active member of the Florida Manatee Rescue, Rehabilitation, and Recovery Program over the years and along with his expert experience he always had a way to interject humor into any discussion. Our community is saddened by his death and will miss him and his smile.

LOCAL NEWS

BRAZIL

Northeast Brazil extends capacity and qualification in the rehabilitation of Antillean manatee (*Trichechus manatus manatus*)

The Projeto Cetáceos da Costa Branca (PCCB) of the Universidade do Estado do Rio Grande do Norte (UERN) and the Centro de Estudos e Monitoramento Ambiental (CEMAM), both institutions that work in the favor of conservation of habitat of marine fauna in Brazil, has been acting in important actions for the West Indian manatees (*Trichechus manatus manatus*) in the country since its creation, 1998 and 2014, respectively. Since 2012, with the Brazilian government's demand on amplification of rehabilitation centers for the species, PCCB/UERN and CEMAM has been accomplishing efforts for this necessity and, thereby, building a better structure for this attendance and also investing on the staff training. Currently, mainly masters' and Ph.D.s in biology and veterinary, aimed at study of the species, form the professional boards of both institutions. Besides, in March of 2019, the new calf rehabilitation base is being renovated and inaugurated (Fig. 1), where all structure is being built with a view to the health and well-being of the animals. For a faster and efficient attending, four other bases are being maintained on the coast of Rio Grande do Norte (RN), for stabilization of the animals until the transport to the rehabilitation base. Thereby, the state of Rio Grande do Norte has a reception capacity up to 11 (eleven) animals up to 3 (three) years old, highlighting that the animals can be also from other areas of occurrence in Brazil, when it is pertinent.

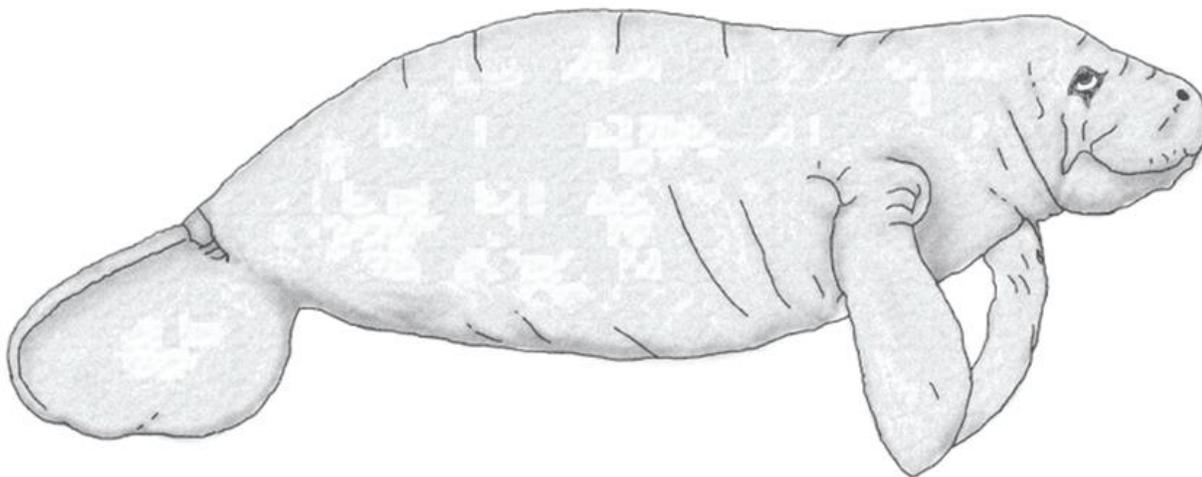


Figure 1. Rehabilitation base recently inaugurated on the northern coast of Rio Grande do Norte.

The new rehabilitation center receives captured saltwater from the area that the animals possibly will use when they are released to their natural habitat. Thereby, they are able to adapt to the microbiology present in this environment since their arrival, to help with their future adaptation. We highlight that the rehabilitation base region, is an area with the major occurrences of stranding of West Indian manatee calves in Brazil and, this new place will allow the release of the animals in the same place where they have been rescued, avoiding the removal of these individuals from their environment. The next steps will be the preparation and implementation of projects for the release of these animals in the regions, aiming to contribute to an improvement of the status of conservation of the species. In addition, Rio Grande do Norte is an important area for connecting populations between the extreme south and the north. Therefore, a population growth in this area will provide animals in reproductive phase for the other adjacent areas, providing, thereby, a better possibility of distribution of the West Indian manatee in Brazil.

-Flavio José de Lima Silva¹, Radan Elvis Matias de Oliveira², Amy Borges Moreira³, Augusto Carlos da Bôaviagem Freire⁴, Aline da Costa Bomfim⁵, Simone Almeida Gavilan⁶, Daniel Solon Dias de Farias⁷, Heloisa Cristina de Moraes e Sá Leitão⁸, Fernanda Loffler Niemeyer Attademo⁹ (¹CEMAM – PCCB/UERN; ²CEMAM – PCCB/UERN; ³PCCB/UERN; ⁴CEMAM – PCCB/UERN; ⁵CEMAM – PCCB/UERN; ⁶CEMAM – PCCB/UERN e UFRN; ⁷CEMAM – PCCB/UERN; ⁸CEMAM – PCCB/UERN; ⁹CEMAM – PCCB/UERN; Email⁹: niemeyerattademo@yahoo.com.br).

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Sirenews - West Indian manatee
(Free Web clipart)

Rio Grande do Norte, Brazil: An important area of conservation of the Antillean manatee (*Trichechus manatus manatus*)

The state of Rio Grande do Norte (RN) State is localized on the northeast of Brazil, being this area a zone of occurrence of Antillean manatees (*Trichechus manatus manatus*) (Alves et al, 2015). Currently, the species is listed as endangered (Luna et al, 2018). Luna et al, 2012 verified that the population in the state is genetically similar to the other population in the northeast, nevertheless with little differences from the population from the northern region of the country. The coast of RN has been one of the main regions of stranding of calves in the country, standing only behind the Ceará State (Balensiefer, et al, 2017) and with it providing great part of the animals of the manatee reintroduction program of Brazil (Normande et al, 2014). At this moment, 30% (14/47) of the animals released to their natural habitat in Brazil were from this region.

Exploration of hydrocarbons, salt extraction, fishing and shrimp cultivation are the regional economy of the state of Rio Grande do Norte; activities with the potential to interfere in the survival of the Antillean manatee.

The genetic diversity of this population is small and, until 2012 all rescued animals were transported and released to other regions, resulting in a reduction in the number of individuals in the RN State (Luna, 2013). For this reason, since then, the individuals rescued on the coast of the state have been maintained in nearby institutions, in order for the release of these individuals to also occur in the same regions.

The state of RN has important feeding areas for manatees, being already verified the presence of *Halodule wrightii*, *Ruppia* spp., *Gracilaria* sp., *Rhizophora mangle*, *Avicenia schaueriana*, *Sargassum* sp. among others, besides fresh water fountains, whether in estuaries or in the ocean itself. This allows a propitious environment for a greater survival of the species. Therefore, the Projeto Cetáceos da Costa Branca (PCCB) and the Centro de Estudos de Monitoramento Ambiental (CEMAM) has been providing these foods for the animals in rehabilitation, allowing, since their arrival, a feeding adaptation with these natural items supplied.

The number of individuals in the state has not been defined yet, however the animals in this area have a big importance for the other regions, because in the northern region of the state, the animals move into the state of Ceará and in the southern region, the animals move into the state of Paraíba. Hence, RN is characterized as a connection between these populations providing genetic input and population increase for the adjacent states. Notwithstanding, the animals reintroduced to Paraíba have been moving to RN (Normande, 2014) and thereby affording an environment for the distribution of these animals.

Conservation activities have been occurring in the state since the 90's. However, more studies are required to gather additional information that favors Brazilian public politics in the management of the species, in order to diminish the risk for the West Indian manatee.

-Flavio José de Lima Silva¹, Radan Elvis Matias de Oliveira², Amy Borges Moreira³, Augusto Carlos da Bôaviagem Freire⁴, Aline da Costa Bomfim⁵, Simone Almeida Gavilan⁶, Daniel Solon Dias de Farias⁷, Heloisa Cristina de Moraes e Sá Leitão⁸, Fernanda Loffler Niemeyer Attademo⁹ (¹CEMAM – PCCB/UERN; ²CEMAM – PCCB/UERN; ³PCCB/UERN; ⁴CEMAM – PCCB/UERN; ⁵CEMAM – PCCB/UERN; ⁶CEMAM – PCCB/UERN e UFRN; ⁷CEMAM – PCCB/UERN; ⁸CEMAM – PCCB/UERN; ⁹CEMAM – PCCB/UERN; Email⁹: niemeyerattademo@yahoo.com.br).

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Maranhão, Brazil, revisited. Part I: On a live-stranded Antillean manatee in Pericumã River

A live manatee was observed early in the morning on 30 November 2013 near the gates of the Pericumã River dam (02°27'20"S, 45°00'20"W), Pinheiro municipality, Maranhão, Brazil (Fig. 1). The large specimen, approx. 3,0m long, became stranded in the low tide on the muddy bottom of the Pericumã River. In fact, most of its body was out the water during the low tide (Fig. 1). Fortunately, it was rescued and released in deeper waters by the Pinheiro Prefecture staff. For some reason, the manatee displaced himself at least 40 km from the mouth of the Pericumã River, in Baía do Cumã, and then became stranded at low tide, in a narrow strip of water, preventing maneuverability of its heavy body. This record is significant, as quite limited information on manatee's occurrence is available for Baía do Cumã and the Pericumã River, west coast of Maranhão. This area is included in the Baixada Maranhense Environmental Protection Area, established in 1991, and a Ramsar site since 2000. Previous data on manatee records in Maranhão are based on historical accounts (Whitehead, 1978), short surveys conducted in the early 80's (Albuquerque and Marcovaldi, s.d.; 1982) and relatively recent interview records (Luna, 2001; Luna et al. 2008a,b,c and Luna 2010). Sighting records during regular Antillean manatee monitoring were reported from 2003 to 2005 by Alvite et al. (2006) in three localities along the coast of Maranhão: Guarapiranga (São José de Ribamar), Barra do Gato (Humberto de Campos) and Ponta de Pedras (Alcântara). Indeed, Albuquerque and Marcovaldi (1982) were the only ones to clearly indicate manatee concentration at two localities at Baía do Cumã: Igarapé da Siribeira and Recife do Marinaldo (or Ponta do Murici). The latter is cited as an important congregation zone for manatees. The Pericumã River dam was inaugurated in 1982 to control the influx of saline waters to the marshes upstream and thus prevent floods and regulate the water influx during dry season. As the present observation was recorded during the peak of the dry season (November), low water levels could have trapped the manatee in the narrow course of the river. Movements of Antillean manatees in search of freshwater have been widely reported (e.g. Alvarez-Alemán et al. 2016) and could have motivated this upstream movement of an adult manatee at Pericumã River.

-**Salvatore Siciliano** (Laboratório de Enterobactérias, IOC/Fiocruz, Rio de Janeiro, RJ Brazil; Grupo de Estudos de Mamíferos Marinhos da Região dos Lagos (GEMM-Lagos) and Grupo de Estudos de Mamíferos Aquáticos da Amazônia (GEMAM), Museu Paraense Emílio Goeldi, Belém, PA, Brazil; Email: gemmlagos@gmail.com).

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Figure 1. Stranded Antillean manatee on the muddy bottom of the Pericumã River, 30 November 2013, near the gates of the Pericumã River dam (on the back of the photo), Pinheiro, Maranhão, Brazil. Source: Pinheiro Municipality.

Maranhão, Brazil, revisited. Part II: Alcântara, where Antillean manatees and other endangered marine species deserve attention

Alcântara (2°24'32"S, 44°24'54"W), is a place of historical importance for Antillean manatees, as they have coexisted with people for centuries. Native people, French and Portuguese colonizers have occupied these lands and seas as far back to 1648. Manatee hunting events in Alcântara have been reported as recently as 1991 (Siciliano, 1991) and contributed to decrease their numbers. Subsequently, Antilleans manatees were confirmed as residents in this area (Luna, 2001). More recently, sighting records have been regularly reported from 2003 to 2005 (Alvite et al. 2006) off the locality of Ponta de Pedras, or Ponta do Rasgado, in Alcântara. A recent visit to the area from 14–17 February 2019 provided new insights of the status of Antillean manatees and other endangered marine fauna in these waters. During this period, Alcântara fishermen reported regular manatee sightings in the Rasgado area, although mentioning that they are more difficult to be seen during the rainy season (December – May), as waters are murky. A fisherman has reported the entanglement of a large manatee in the 'tapagem' nets set at Igarapé São José, in November 2017. These nets are set from one river bank to another, and usually catch croakers, catfish and four-eyed fish. The manatee survived the event as it successfully tore up the 50m wide net. Additionally, short boat cruises off Alcântara during this period resulted in sightings of three groups of Guiana dolphins (*Sotalia guianensis*) and a young green turtle (*Chelonia mydas*), both listed as endangered in Brazil (Fig. 1). The small size of sighted Guiana groups and their relative low numbers in the area were attributed to frequent gillnet entanglement. The same was mentioned for marine turtles. Alcântara may soon face a rapid and deep

transformation. It is home to the Alcântara Launch Center, a Brazilian Space Agency satellite launching facility, operated by the Brazilian Air Force. Traditional fishing and living practices and rapid urban and rural development will necessarily share the same environment with large marine endangered fauna.

-**Salvatore Siciliano** (Laboratório de Enterobactérias, IOC/Fiocruz, Rio de Janeiro, RJ Brazil; Grupo de Estudos de Mamíferos Marinhos da Região dos Lagos (GEMM-Lagos); and Grupo de Estudos de Mamíferos Aquáticos da Amazônia (GEMAM), Museu Paraense Emílio Goeldi, Belém, PA, Brazil; Email: gemmlagos@gmail.com).

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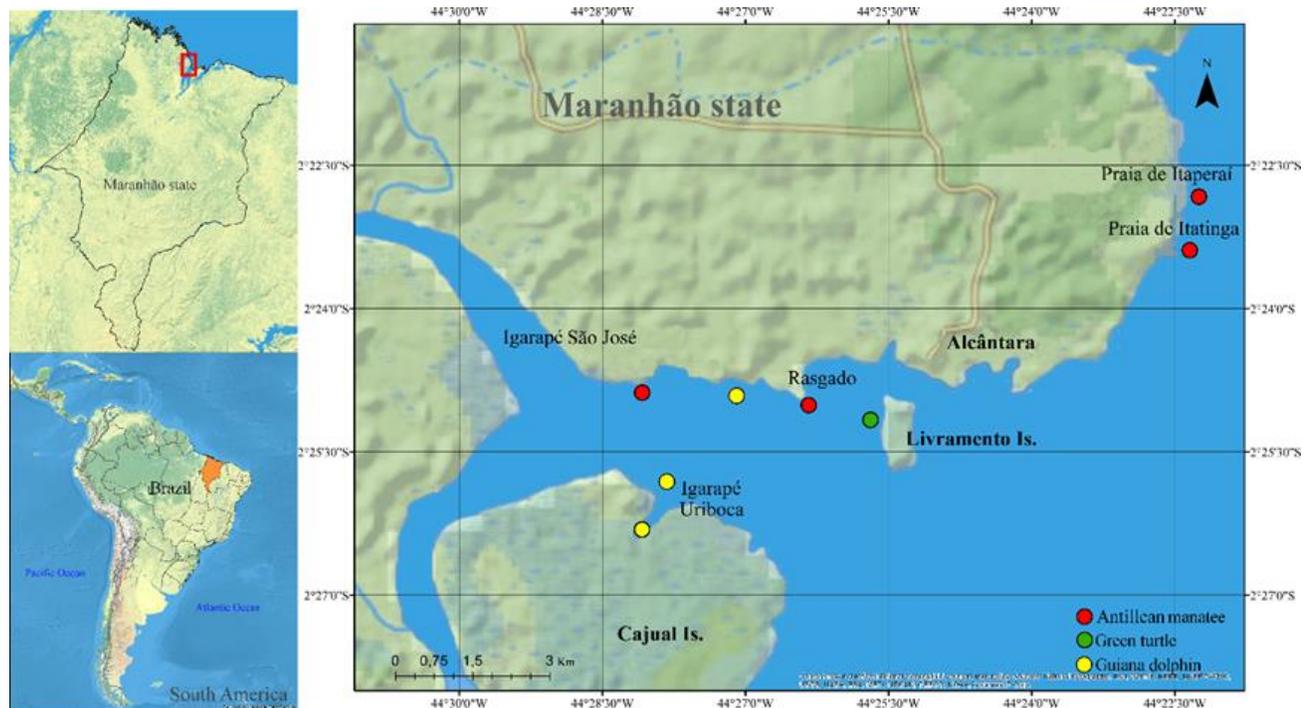


Figure 1. Location of Alcântara, west coast of Maranhão, Brazil, indicating the localities of manatee sightings and entanglement (in red), green turtle sighting (in green) and Guiana dolphin sightings (in yellow). Map prepared by Francisco Nascimento.

AMPA and INPA launch a campaign to teach environmental agents, fishermen and *ribeirinhos*, how to release accidentally caught healthy Amazonian manatee calves

Amazonian manatees are protected in all countries of its distributional area. They are classified by the IUCN and in Brazil, as Vulnerable (IUCN, 2016; ICMBio, 2018). From year 2000 to present day, a total of 162 orphan Amazonian manatee calves have arrived at the Robin C. Best Aquatic Center- INPA, Manaus, Brazil, averaging eight calves per year. These calves were in their majority newborns, with body size and weight averaging 97 cm long and 18kg of body mass. Of these, 32% calves were found alone/stranded, 28% were accidentally caught in fishing gear, and 40% arrived without information. The high percentage of animals without information is probably related to the fear of the fisherman/*ribeirinhos* stating that they were either keeping these animals in illegal captivity or hiding the slaughter of the mother. Therefore, when giving up the baby manatee, usually denounced by a third party or by their incapacity to supply the daily needs of the baby manatee, they fail to provide complete information to avoid producing self-incrimination evidence.

When we evaluate all manatees rescued with information (60%), we found that 46% of the calves were accidentally caught in fishing nets, and were, in majority, in very good physical conditions. This information suggests that until trapped in the net, these calves were probably still with their mothers and therefore, if quickly released in the same location, the chances to reunite with the mother are possibly very high. Female Amazonian manatees are very protective mothers, keeping constant vocal and physical contact with their offspring, swimming side by side in very close proximity during the first year of life (Sousa-Lima et al., 2002; authors personal obs.).

In an attempt to reduce the number of unnecessary rescues, the Friends of the Amazonian Manatee Association- AMPA, in collaboration with INPA, and sponsored by the Petrobra Socioambiental – Projeto Mamíferos Aquáticos da Amazonia (PMMA), launched a campaign to teach the *ribeirinhos* and fishermen from different communities and from areas of high rescue incidence, on how to recognize and release healthily baby manatees. This campaign produced a poster and a brochure (Fig. 1), with self-explanatory illustrations and simple texts on how to differentiate baby manatees in good condition and apt to be immediately released from the net into the wild, from an emaciated and weak calf – usually separated from its mother several days or weeks before capture (Fig. 2).

A workshop was held at INPA, Manaus, in March 20th (Fig. 3), to present and distribute these materials among State and Federal environmental agencies, so that these environmental agents can multiply this methodology in each of the communities they visit, distributing the material produced and explaining its contents. Our goal is to reduce the number of unnecessary rescued manatee calves, releasing them immediately after capture without the need to remove them from the water and avoid their transportation to INPA unless absolutely necessary. These proceedings will reduce the rehabilitation costs and the total number of manatees in captivity, enabling AMPA/INPA to concentrate their efforts in animals with health problems and higher needs.

-Vera M. F. da Silva^{1,2}, Diogo A. de Sousa^{2,3}, Louise Lauschner² and José Anselmo d’Affonseca^{1,2} (¹National Institute of Amazon Research (INPA), Aquatic Mammals Laboratory, Av. André Araújo, 2936, Manaus, Am, Brasil. 690 067-375; ²Friends of Amazonian Manatee Association (AMPA), R. Jaú, 17.

Waimiri-Balbina, Am, 69736-000; ³Japanese International Cooperation Agency (JICA), Projeto Museu na Floresta, c/o INPA; Email¹: vmfdasilva@gmail.com).

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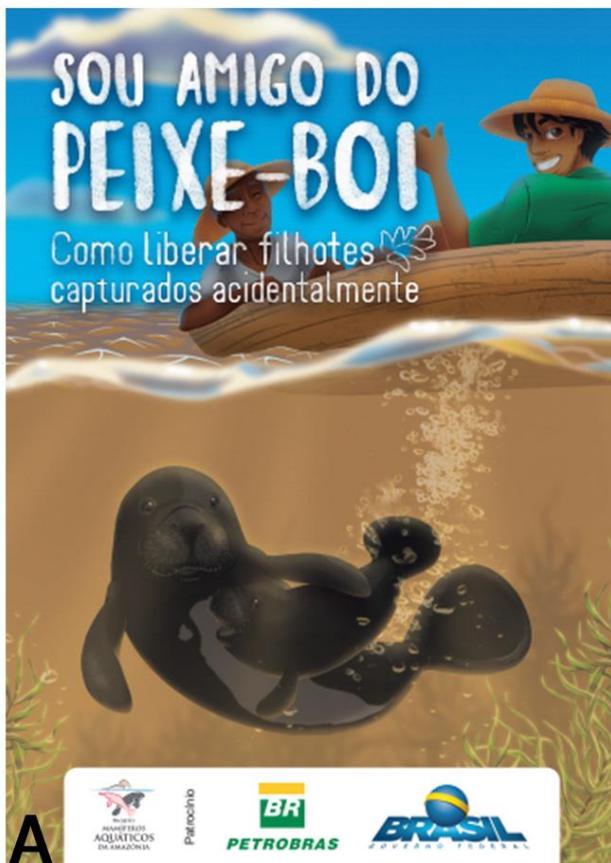


Figure 1. Material produced for the Release of Amazonian manatee calf: campaign (A) Brochure and (B) poster.



Figure 2. Flyer illustrating baby Amazonian manatees (A) in good physical condition and (B) debilitated/emaciated, with explanation on how to define these conditions.



Figure 3. Photo of the group participants during the Workshop held in Manaus to launch the information on the Release of Amazonian manatee calf Campaign.

CAMEROON

African manatee conservation effort in Cameroon

The African Marine Mammal Conservation Organization (AMMCO) is a local NGO based in Dizangue (Littoral Region, Cameroon) and founded in 2014. AMMCO's mission is to contribute to the protection of the African manatee and other aquatic megafauna and their habitat in Central Africa by upgrading the scientific knowledge and involving fishers and other stakeholders in alternative livelihoods, awareness, and responsible watershed use. AMMCO's conservation activities are currently focused in Cameroon and the organization envisions expanding their activities in other countries in Central Africa in the mid-term.

The African manatee is threatened by accidental bycatch and poaching throughout its distribution range, including Cameroon. But in this country, very little is known about manatees and their conservation status. Because of this, AMMCO has been monitoring monthly, for the past five years, manatee occurrence and habitat quality in Lake Ossa (Dizangue, Littoral Region of Cameroon) as this lake is known as a sanctuary for manatees, especially during the dry (low water level) season. The organization also established since 2012 a stranding network along the Cameroon's coasts. This network is made of local fishermen (initially trained by AMMCO's staff) who are equipped with smartphones with the SIREN application installed. SIREN is a free mobile App developed by AMMCO to facilitate the reporting of opportunistic sighting of aquatic megafauna by fishermen and other water users. Through this network, AMMCO has been documenting manatee strandings but also other aquatic megafauna species. Observations reported are available for public view on the AMMCO [webmap \(http://siren.ammco.org/web/en/\)](http://siren.ammco.org/web/en/).

AMMCO has been leading environmental education in three high schools (two in the Lake Ossa Wildlife Reserve and one in the Douala-Edea National Park), so as to improve the perception of young pupils towards threatened species in general, and the African manatee in particular. In general, an average of 1500 students are reached yearly. Also, AMMCO often organizes educational chats with local communities, especially with fishermen, in order to raise awareness about the importance of manatees in an ecosystem.

AMMCO has been promoting alternative livelihoods in the Lake Ossa Wildlife Reserve through building capacity of local communities. In 2018, 51 fishermen have been trained on bee-farming practices, 14 youths on ecotourism and 60 women on homemade soap and vinegar. The goal of this training is to reduce the increasing anthropogenic pressure on the manatees' sanctuary (Lake Ossa), since an important part of local populations depends mainly on fisheries.

AMMCO acknowledges the support of the Save The Manatee Club, African Aquatic Conservation Fund (AACF), Global Environmental Fund (GEF-SGP Cameroon), the Wildlife Conservation Network (WCN), Wildlife Conservation Society (WCS), and the International Union for Nature Protection (IUCN).

-**Aristide Kamla Takoukam** (African Marine Mammal Conservation Organization and University of Florida, Department of Large Animal Clinical Sciences, College of Veterinary Medicine, Gainesville, Florida, 32610, USA; Email: akamla@ammco.org).

Photo credits: AMMCO



African manatee sighting in Lake Ossa.



AMMCO team during a manatee survey in Sanaga River and Lake Ossa.



Students of the Bilingual High School of Dizangue (near Lake Ossa) during an environmental education course provided by AMMCO.



Family photo with women of Dizangue (near Lake Ossa) after they successfully participated in the training to make homemade soap.

COLOMBIA

Occurrence of the “El Niño Effect” on free ranging manatee populations in the Colombian Caribbean: a challenge for its conservation

In Colombia, there is few information about the effect of “El Niño phenomenon” on the wild populations of the Caribbean manatee (*Trichechus manatus manatus*); this phenomenon is characterized by both precipitations decline and temperature increase. Between 2015 and 2016, the strongest El Niño event was ever recorded, causing serious environmental damage and altering the manatee distribution. It reduced habitat and food availability but also changed physicochemical water properties.

During this period, the “Fundación Omacha” together with environmental authorities, found that because of the “El Niño phenomenon”, manatees were concentrated in the deepest places (1-2m) of water bodies, making them an easy prey for hunters. Furthermore, physiological stress due to extreme environmental conditions were also notice in the manatees. This situation took place in the Zarzal-El Tupe (Bolívar), Jaraba (Magdalena), Sucre (Sucre), Tadó (Antioquia) and El Totumo (Antioquia).

In the Zarzal-El Tupe, a swamp complex in the Colombian Caribbean region, more than 38 cases of dead animals were recorded (Fig. 1). Deaths were attributed to opportunistic hunting and unknown causes. As a result, manatees in critical conditions were monitored on field and 10 individuals were rescued with the help of the local community. Manatees were identified as follow: Carolina, Esperanza, Isabel, Gleimer, Jey-Jey, Hugo, Batata, Tico, Sebastián and Lila. The Veterinary assessment determined that all manatees presented mild to severe dehydration and malnourishment. Feces contained a high amount of fiber and mud. Blood cells count and blood chemistry results showed physiological alterations of renal function.

The manatees were moved to a lake, located in a military base, in semi-captivity conditions. In this lake manatees were fed and medically treated until physiological parameters were normal again. Currently, the rescued manatees are still in rehabilitation and monitored regularly.

Manatees are expected to be released soon with the support of local communities, generating a positive impact for the species conservation and its habitat. In order to involve local communities, workshops were also performed with fishermen and students from schools in the region, to encourage the manatees’ conservation and protection.

After all, alterations in the habitat of the Caribbean manatee due to climate change or human impact is still a concern. For example, in the Bolívar state, an increase in the average temperature of 0.9°C is expected and a precipitation decrease of 15.09% from 2011 to 2040. With this view, it is very important to identify the different factors that may affect the manatee’s conservation status, and to continue carrying out studies that can establish specific effects of climate change on species in Colombia.

-Isabel Gómez-Camelo¹, Laura Jaramillo², Dalila Caicedo Herrera³, Paula Torres Forero⁴ (¹PhD Ecology and Natural Resources Management, Research associate at the Fundación Omacha, Email: isabel@omacha.org; ²Veterinarian at the La Salle University, Research associate at the Fundación Omacha, Email: laurisjaramillo90@gmail.com; ³Marine biologist at the Jorge Tadeo Lozano University, Executive Director at the Fundación Omacha, Colombia, dalila@omacha.org; ⁴Biologist at the Universidad de los Andes, Research associate at the Fundación Omacha, Email: paulatorres01@hotmail.com).

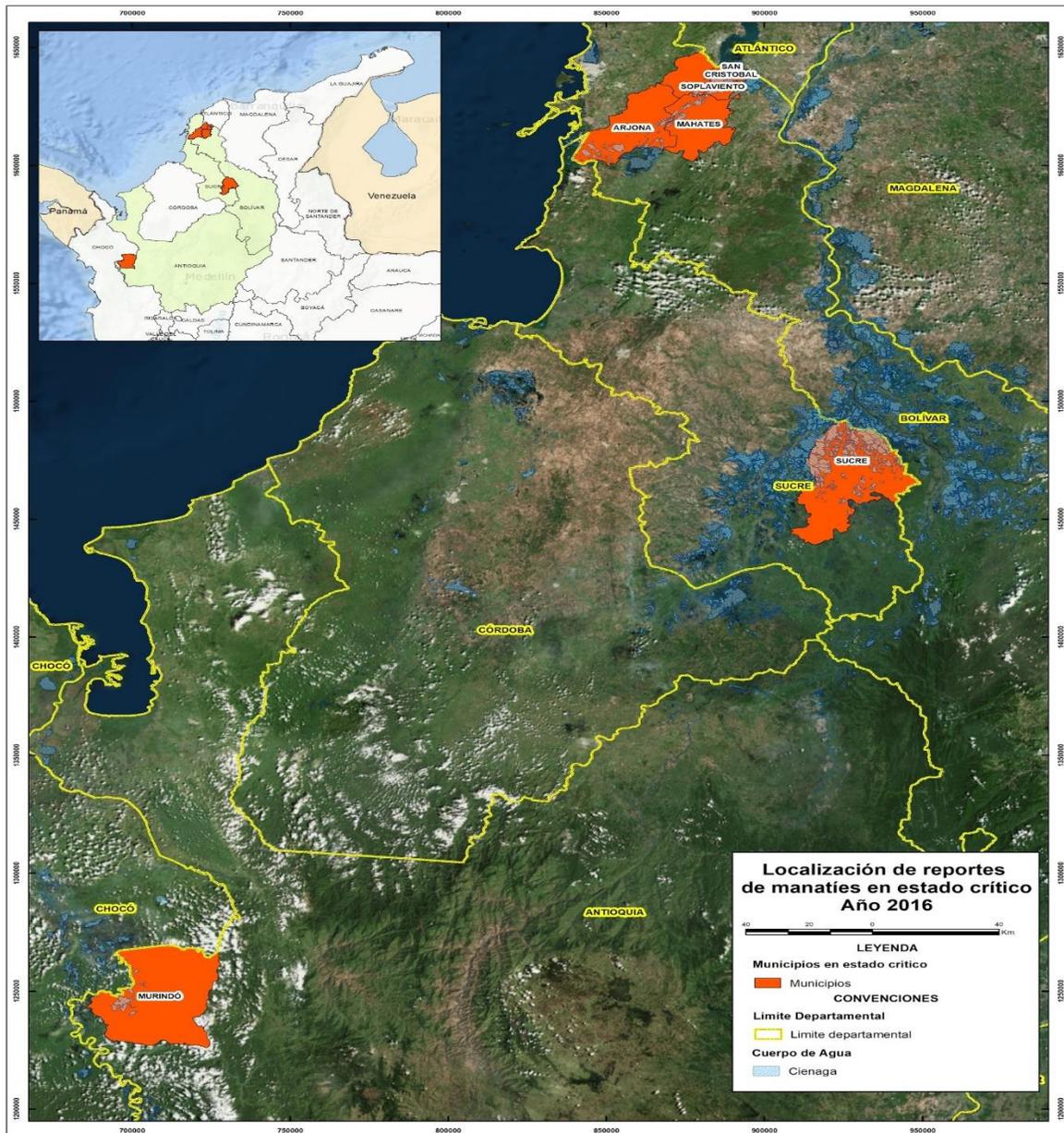


Figure 1. Areas where the death of manatees were recorded.

FLORIDA

Updated Statewide Abundance Estimates for the Florida Manatee

The Florida Fish and Wildlife Conservation Commission (FWC) has conducted its second statewide Florida manatee abundance survey (Hostetler et al. 2018). Surveys were conducted December 2015 on Florida's west coast and December 2016 on the east coast. Our best estimate of statewide abundance for the 2015-2016 period is 8,810 with 95% probability (Bayesian credible interval or CI) that the real abundance is between 7,520 and 10,280 manatees. The best estimate for Florida's west coast was 4,810 (CI: 3,820–6,010) and 4,000 (CI: 3,240–4,910) for the east coast. These intervals are important to consider as they describe the uncertainty surrounding the estimates. The statewide point estimate of 8,810 by itself is of limited usefulness because it does not make known the uncertainty associated with this estimate. If our statistical assumptions are correct, the credible interval tells us that we are 95% confident that the true population size lies between the lower and upper bounds. Given the amount of uncertainty in the estimates, because of issues like manatees being submerged where they cannot be seen by observers, observers missing manatees that are available to be seen, and observers not being able to sample all locations where manatees could be, our credible intervals are broad.

Our newer abundance survey method differs from the older synoptic survey method in several key ways: 1) it takes place over the course of a week or more for each coast; 2) it is scheduled for a time of year when all Florida manatees should be in the state but are more spread out instead of congregated at warm water and winter habitats; and 3) two observers on each flight each independently count the number of manatees they see at each location. This method is preferable because: 1) it samples all likely manatee habitat in the State of Florida including the Florida Panhandle; 2) it accounts for important sources of error, such as manatees that are not seen and detected by observers during the survey; and 3) it provides a statistically sound framework for estimating statewide manatee abundance.

Designing a new method for estimating manatee abundance has been challenging because manatees occur over large, diverse habitats which makes it difficult to apply traditional statistically sound survey methods. To meet this challenge, our innovative approach was designed, tested and vetted by experts. However, there are limitations which, as explained in Martin et al. (2015) and the new report, we believe may have led to an underestimate of abundance.

-Jeffery A. Hostetler¹, Holly H. Edwards¹, Julien Martin², Paul Schueller³ (¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Saint Petersburg, Florida, USA; ²US Geological Survey, Wetland and Aquatic Research Center, Gainesville, Florida, USA; ³Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Gainesville, Florida, USA; Email¹: holly.edwards@myfwc.com).

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(Photo courtesy of the U.S. Geological Survey, Sirenia Project)

GABON

Unfortunate manatee of the new year in Libreville (Gabon)

There are flies flying over in my laundry room. Yet at night, flies give way to mosquitoes. This is no doubt due to the foul odor of the decaying manatee that stuck on my clothes despite the fact that I washed them.

On January 2, 2019, a manatee carcass was discovered on the beach on the southern part of Libreville. Something that greatly astonished the onlookers who gathered from the moment of removing the carcass with a multiple question:

- Do we still have manatees in Gabon?
- How is it that there is a manatee from the sea?
- But don't they live only in lakes, lagoons and rivers?

It was amazing to see people interested in a species fully protected by the law of Gabon but unknown to most of the population.

The most fantastic thing was the connection of information. The presence of this manatee carcass on the sand, out of sight, on the beach of Libreville, was reported to me through a friend of a friend of mine via social networks.

Having recognized the species which everyone did not know, she hastened and sent it to me. After seeing the video sent, I immediately started the car to check this information with my own eyes without forgetting to make few phone calls to the relevant authorities specialized in this field.

It was after 2 km of walking, under a burning sun that we found it in full decomposition. As soon as the agents of the National Parks Agency of Gabon (ANPN) arrived, we proceeded to take measurements and start sampling. It was an adult female manatee in the prime of life. Based on its length it measured at 2m80cm and its weight can exceed 200 kg.

This new carcass at the seaside in the estuary is further evidence that the distribution of manatees in Gabon is not limited only to lakes, rivers and lagoons. It can also be expanded into the sea. More scientific research is needed in the marine environment as well.

-Christy Achtone Nkollo-Kema Kema (PhD Student - Laboratoire de Recherches Appliquées et de Conseils (LAGRAC), Université Omar Bongo de Libreville, Gabon; Email: christyachtone@gmail.com).

(Photos on next page)

Photo 1: Unfortunate manatee



© Yvon Makosso,2019

Photo 2: Sampling



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INDIA

‘Dugong Scholarship Program’ in India: a positive incentivization of wildlife conservation values in fisher communities

Background:

In India, dugongs occur in small, fragmented and isolated populations spread across three regions of Andaman and Nicobar Islands, Gulf of Mannar & Palk Bay, Tamil Nadu and Gulf of Kutch, Gujarat (Fig. 1) (Pandey et al. 2010, Sivakumar and Nair 2013, D’Souza et al. 2013). Dugong mortality incidents are frequent (over 25 strandings in last two years) arising from frequent gill net entanglements, continued illegal hunting for meat and increasing vessel traffic. Although the exact causes of these deaths are still to be quantified, these threats persist in all regions exacerbated with rapidly declining seagrass habitat in near shore areas (Marsh et al. 2002, Thangaradjou and Bhatt, 2018). Therefore, recovering dugongs entails targeted, multidisciplinary research and participatory action that flows into seascape management and advocacy for policy changes (Sivakumar 2006, Choudhury and Sivakumar 2008, Pandey et al. 2010, Sivakumar and Nair 2013, D’Souza et al. 2013).

With this knowledge of continued decline in dugong populations and loss of seagrass habitats in its distribution range, in 2016, the Ministry of Environment, Forest & Climate Change (MoEFCC) of the Government of India entrusted the Wildlife Institute of India, Dehradun, India (WII) through the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) to implement the “National Action Plan for Dugong Conservation in India”, alternatively referred to as the Dugong

Recovery Program. Under this program, we aim to (a) assess and monitor the Dugong populations and seagrass habitats (b) implement site-specific management actions to recover populations and restore critical dugong habitats; (c) establish and enhance participatory conservation efforts involving regional stakeholders and (d) improve the capacity of enforcement and management agencies to ensure integrated protection and management of Dugong, seagrass habitats as well as other co-occurring species.

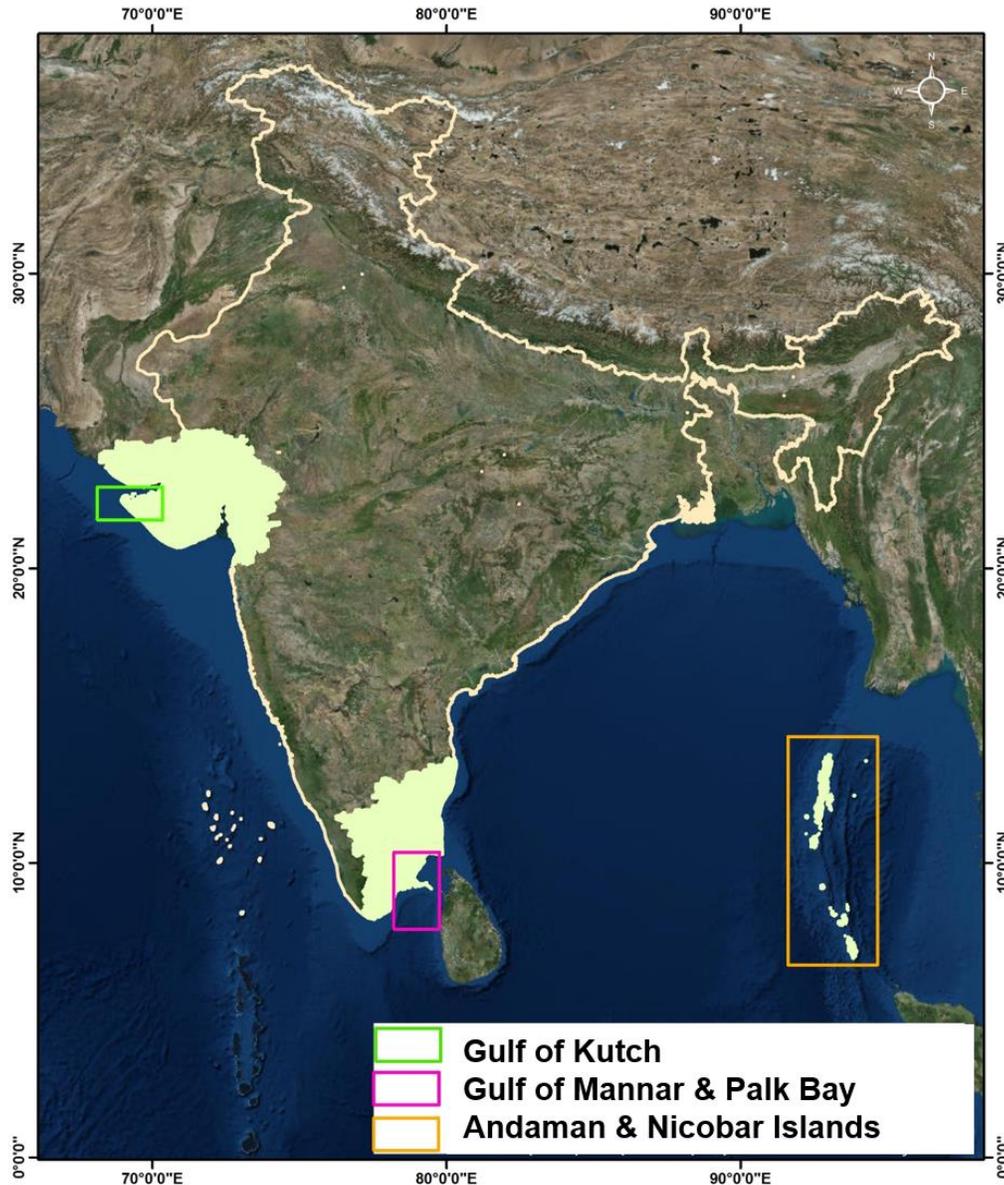


Figure 1: The present distribution range of Dugongs in India in isolated patches in the area of Gulf of Kutch (Gujarat), Gulf of Mannar & Palk bay (Tamil Nadu) and Andaman & Nicobar Islands.

Comprehensive surveys at all the field sites revealed lack of our understanding of traditional knowledge of fisher communities about dugongs and seagrasses (Sivakumar & Nair, 2013). Tapping this crucial resource for improving our knowledge about dugong distribution and habitat use was vital for

implementing any conservation action. Moreover, since fishery comes in direct conflict with dugong populations as impacts of gill-netting and vessel traffic are well-known, the inclusion of fisher communities in the entire conservation effort were of paramount importance. Here, we present insights from a unique participatory management scheme implemented under the program titled the “Dugong Scholarship Program” (hereafter, DSP). In this scholarship program, we involved the school-going children of the fisherfolk community living along the dugong range coastal states of India, the most important stakeholder community for holistic dugong conservation.

Methods:

Our initial surveys to implement dugong recovery program (which includes conducting dugong awareness programs in government schools) brought to our attention the high school drop-out rates of fisherfolk children and a complete disconnect between policy and communities with respect to dugong conservation in all the study sites. This understanding planted the idea of an integrated community-centric approach to conservation by involving school-going children of fisher communities in the conservation process. Under the participatory management component of the program, we started DSP as a flagship scheme for positive incentivization to encourage particular conservation practices in the fisher communities.

DSP is a novel approach in the country to conserve wildlife by supporting education of children of fisherfolk dependent on the critical dugong habitats. In the first phase of this program, we conducted holistic awareness programs followed by a written examination on general marine conservation issues in government schools at all the three range states. We received an overwhelming response with participation of over 900 children from 27 government schools from all the three states. We selected 150 students who qualified the exams on merit as “*Dugong Ambassadors*” and supported them with “*Dugong Scholarship*” of 500 INR/month for an initial period of two years.

Implementing DSP at school-level helped us to form a strong Dugong Volunteer Network in the study areas with parents and relatives of Dugong Ambassadors joining as the volunteers. We conducted community workshops for parents and relatives of the *Dugong Ambassadors* and informed them about the importance of their knowledge for conserving dugongs. We distributed logbooks to document the dugong sightings by the sea-going fisher parents/relatives of the *Dugong Ambassadors* (Fig. 2).

Results:

In the last two years, the DSP is proving to positively influence fisherfolk into dugong conservation. The prime benefits of this scheme are the formation of an over 1000 strong Dugong Volunteer Network (combined of all the three sites) which is helping to not only generate data on dugong distribution but also undertaking real time conservation efforts. We have been able to successfully rescue 6 dugongs from fishnet entanglements (Fig. 3) and have reported two cases of poaching to the State Forest Department (all at Palk Bay, Tamil Nadu). The logbooks being filled up by the *Dugong Ambassadors* with information on dugong sightings from their fisher parents is being recorded into scientific datasheets by our team, which will be used to generate region-specific dugong distribution maps.

Way forward:

In order to further strengthen the Dugong Volunteer Network, we are expanding the DSP with inclusion of more schools and doubling the number of Dugong Ambassadors in the dugong range states (Fig. 4). The datasets generated through this flow of information will be used to assess the current and historic distribution of dugongs in the area with additional information on the status of seagrass habitats. Further, we aim to quantify this data to generate spatial distribution maps for prioritizing sampling areas for intensive surveys. We hope that this unique inclusive conservation strategy will also help reduce the drop-out rates in the schools and encourage good environmental practices in the school children from an early age.

-K. Sivakumar^{#1}, J.A. Johnson², Anant Pande¹, Swapnali Gole¹, Madhu Magesh¹, Sohini Dudhat¹, Rukmini Shekar¹, Sameeha Pathan¹, Sagar Rajpurkar¹, Chinmaya Ghanekar², Diksha Dikshit¹, Himani Saini¹, Sumit Prajapati¹, Prachi Hatkar¹, Deven Mehta¹; (¹Endangered Species Management Department, Wildlife Institute of India, Chandrabani, Dehradun 248001, India; ²Habitat Ecology Department, Wildlife Institute of India, Chandrabani, Dehradun 248001, India; ([#]Corresponding Author: ksivakumar@wii.gov.in).



Figure 2: Social surveys and community workshop with fisher communities.



Figure 3: Rescuing fishnet entangled dugong supported by the Dugong Volunteer Network.



Figure 4: Conducting Dugong Scholarship Programme in the government schools across the three dugong range states.

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JAPAN

The world's northernmost dugong population is likely to be at serious and imminent risk of extinction!

The world's northernmost dugong population occurs in the Ryukyu Islands, a chain of Japanese islands that stretch southwest from [Kyushu](#) to [Taiwan](#). The largest island is [Okinawa Island](#).

This dugong population, which is extremely small and isolated, has been seriously reduced by hunting, which ceased in the 1970s, and incidental bycatch in gill nets, a threat which is ongoing. This population is listed as Critically Endangered under Japanese legislation.

The dugong is listed as a National Treasure in Japan and Ryukyu population is of great cultural significance. Many years ago I had the privilege of visiting a sacred shrine that was decorated with dugong skulls on a small island in the Ryukyus. I understand that there are several such shrines.



This August 2018 file aerial photo shows preliminary construction work off Henoko, in Nago city, Okinawa prefecture, Japan, where the Japanese government plans to relocate a U.S. air base from one area of Okinawa's main island to another. (Koji Harada/Kyodo News via AP)

For more than 20 years, the dugong has been a symbol of the campaign against plans to construct a new Marine base on landfill in the coastal waters at Henoko on the Island of Okinawa for the United States. Construction of the base will destroy valuable dugong habitat and most of the recent work on dugongs and seagrasses in the Okinawan region has been carried out to inform the campaign. I

understand that much less is known about dugongs and their habitats in the waters surrounding the other smaller islands nearby.

A dead dugong was found at a fishing port in Okinawa Prefecture on March 18 2019. It is considered highly likely that the dugong is one of only three that have been confirmed to inhabit the waters around Okinawa's main island. The prefectural government's natural conservation division is examining the cause of the death of this animal, but no conclusions have been released. The dugong, a large adult about 3 meters long, was found floating near a breakwater at the fishing port of Unten in Nakijin in the southernmost prefecture, according to the local fisheries cooperative.

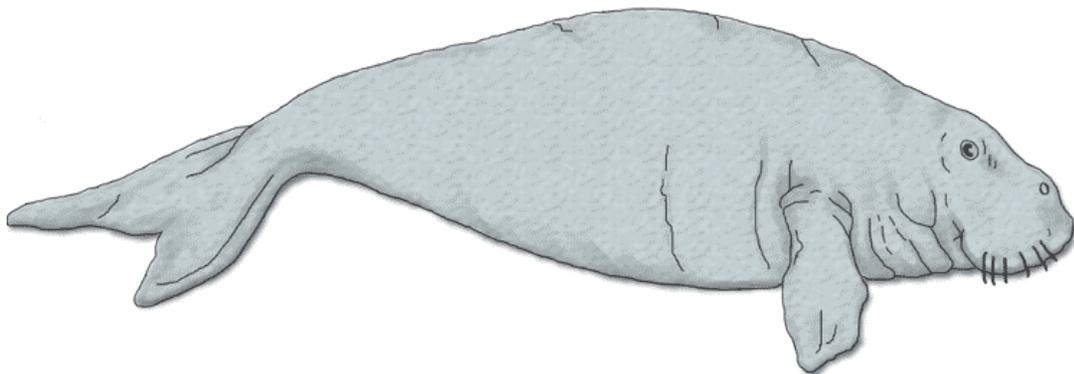
The fate of the other two dugongs known from the waters of Okinawa's main island is also of great concern. One dugong has not been seen since July 2015 and the other has not been spotted since September last year.

The Sirenia Specialist Group has decided to respond to this situation by:

- Conducting a status assessment of the Ryukyus sub-population against IUCN criteria to help focus attention on all current threats including bycatch and habitat loss. The next target submission date for Red List updates is 23 August with probably publication in early December 2019.
- Organizing a small expert workshop that will finalize the IUCN Red List assessment and develop an Action Plan that summarizes the latest information on dugongs and their habitats in the archipelago, outlines future, protection/enforcement needs, perhaps including Marine Protected Areas and an Important Marine Mammal Area.

We hope that this information can then be used by the various grassroots groups that care about dugongs in the Ryukyu Islands and discussed in the local, national and international press. These initiatives should provide NGOs with the information they need to apply the political pressure to help save these dugongs and their habitats from all the threats that they face.

-Helene Marsh (Emeritus Professor, Environmental Science, James Cook University, Townsville, Qld 48111, Australia; Email: helene.marsh@jcu.edu.au).



Sirenews – Dugong
(Free Web clipart)

MADAGASCAR

Dugong sightings and seagrass status in Sahamalaza Biosphere Reserve, Madagascar

Situated in the northwestern coast of Madagascar (-14.16389°S and 45.70139°E), the Marine Park of Sahamalaza Biosphere Reserve is of great biodiversity importance that includes many endangered species, extensive coral reefs, largest mangroves, islets/islands, extensive and well-developed seagrass habitat. The limited information about the population has been a key obstacle to enhancing the protection of the species. To sustainably ensure the conservation of migratory species, the Association, COSAP Sahamalaza Miaro Dugong implemented between 2015 and 2018 a project that was intended *“To improve the protection of endangered dugongs and the seagrass ecosystems in the northwestern coastlines through community-based monitoring, capacity building and applied conservation strategy”* in the framework of GEF Dugong and Seagrass Project.

Interview surveys and community-based monitoring were conducted for collecting baseline information on dugong population and seagrass. Interview surveys using the CMS standardized dugong catch/by-catch questionnaires were undertaken in 20 fishing villages by the members of COSAP Sahamalaza Miaro Dugong between December 2015 and February 2016. Concerning monitoring, the members of the communities received training on dugong and seagrass combined with community-based monitoring methods. Monthly-based monitoring were undertaken during the project period; coordinates of the sightings were recorded when units of GPS were available. A field expedition was undertaken to collect ground truth data on seagrass distribution reported by the community. Seagrass data were used for evaluating the status of this habitat in the northwestern coast using IUCN/Red List of Ecosystem (IUCN/RLE) criteria.

These interview surveys revealed that dugongs were abundant during the 1990s in the coastal waters of Sahamalaza. However, the extent of exploitation of marine resources has been among the main drivers of dugong population decline. Therefore, a small number of individual dugongs still inhabit the coastal waters of this zone. The interview surveys revealed that large meadows of seagrass were present (Razafindrakoto & Cosap Miaro Dugong 2016).

The community-based monitoring confirmed the responses from the interviewees concerning dugong occurrence in the coastal waters of Sahamalaza. The rarity of this species has resulted in the low number of sightings made (Fig. 1). In 2016, three groups of mother and calf pairs were observed in a total of seven groups between February and October; the remaining of the observations were solitary dugongs. Only two observations of a solitary mother with her calf were made in 2017; the calf appears to be still a new-born. No mortality of dugongs was reported during the project period.

The seagrass habitat of Sahamalaza was shown in good condition covering a surface of 6465 ha. The validation of the status of seagrass under IUCN/RLE criteria is still in process.



Figure 1 : Groups of dugongs that were geo-located during the project period

Implementing the local conservation planning will be a high priority to maintain the enthusiasm of the community on the conservation of dugongs and seagrass.

-**Yvette Razafindrakoto**¹, **Raymond Isaia**² (¹COKETES Project, Direction Générale des Forêts, Nanisana, Antananarivo Madagascar); ²COSAP Sahamalaza Miaro Dugong, Madagascar National Parks Sahamalaza, Analalava, Maromandia, Madagascar; Email¹: razafyve@yahoo.com).

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MALAYSIA

Educating communities to encourage them to manage their own dugong and seagrass resources in Johor, Malaysia

Universiti Sains Malaysia was one of the active partners of the Global dugong and seagrass conservation project running a local project entitled “Community Understanding and Management of Dugong and Seagrass resources in Johor, Malaysia” (MY3). Johor is a state in peninsular Malaysia which is regarded to be the last stronghold for dugongs. Two islands namely Sibu and Tinggi island was chosen for this study as there were frequent dugong sightings here. The general aim of this project was to assist local communities to understand ecological and economic importance of conserving dugong and seagrass and improve local capacity to manage these resources more effectively. It involved an education program and a trial community-based management initiative from 2015 to 2018.

Education programme:

In 2016 and 2017, posters and A4 stickers were explained and distributed to local communities and resorts in Sibu and Tinggi (see Fig. 1). A best practice demonstration for the same communities followed (see Fig. 2) which included discussing topics such as seagrass degradation and its prevention, coastal development and seagrass, safe boat manoeuvring and dugong watching, and first response for stranding or entanglements] events (live or dead). Similarly, workshops were conducted in Tinggi island and Mersing with teachers using a dugong storybook called ‘The Adventures of Karum the dugong’ to impart knowledge on the threats and conservation issues faced by the dugong. We also conducted the first beach clean-up in Sibu Island to encourage the community to be interested in waste management. In the final phase in 2018, buoys were placed at the seagrass borders so that communities were aware of where the seagrass meadows so that they could go slow to avoid hitting a dugong or causing damage to seagrass.

Management Initiatives:

The education program was intended to equip the local communities with the knowledge and capabilities to conduct best practices and then manage dugong and seagrass resource on their own. Community members who showed interest to become eco-leaders were asked to trial management initiatives which included decreasing open burning, the 3R’s, (reducing, reusing, and recycling), composting, taking on a role of ‘guardians’ of a particular area, lowering boat speeds in dugong and seagrass areas, preventing physical damage of seagrass, safe interactions with dugongs, reporting illegal activities to management authorities, and mentoring a selected group of people to conduct management. Activities such as open burning, recycling, reusing, being guardians for an area, slowing down in seagrass areas, mentoring and strengthening relations with the management authorities appear to be harder to do than reducing waste, picking up litter and seagrass degradation prevention. It was found that there was no waste management on the island and the resorts and villages did their own managing albeit unsustainably.

Recommendations:

Relevant and interactive education programs should be conducted and could include beach clean-up, waste management methods, dugong conservation, understanding the ecological importance of dugong and seagrass to fisheries, mentoring and empowering one another, composting, and the 3 R’s

(Reduce, reuse and recycle). It is suggested that fishermen are a targeted audience as they are often the hardest to contact and engage in conservation. The prevalence of incentive programs in exchange for conservation (as economics and subsistence was a common subject) and developing a comprehensive plan for waste management is the way forward for these communities. Please check out our Facebook page **Community management of dugongs and seagrass in Malaysia**.

-**Leela Rajamani** (Marine/Dugong Conservation, Centre for Marine and Coastal Studies, Universiti Sains Malaysia, Malaysia; Email: leelarajamani@usm.my).



Figure 1: Poster and A4 stickers that were distributed to the local communities.



Ong Ke Shin

Figure 2: Best Practice demonstration at Tinggi island, Johor

SYMPOSIA/CONFERENCES

THIRD LATIN AMERICAN SYMPOSIUM FOR MANATEE RESEARCH AND CONSERVATION (SILAMA), 4th NOVEMBER 2018



Introduction

The Order Sirenia is represented in Latin America by two species: the Antillean manatee (*Trichechus manatus manatus*) and the Amazonian manatee (*T. inunguis*). In the region, manatees occur mainly in developing countries, sometimes under severe economic and social depletion situations, making the implementation of monitoring and conservation programs a considerable challenge for governments and stakeholders. Under these scenarios, the regional networks emerge as a key strategy to facilitate the mechanisms of action for the local conservation of manatees and their habitats. For those reasons, one of the most important missions of the Sirenia Specialist Group of the IUCN is to facilitate communication between members and strengthen cooperation and knowledge sharing in the region. Under this framework, we established the Latin American Symposium for Manatee Research and Conservation (SILAMA), that was held by the first time during the 16th Meeting of Specialists on

Aquatic Mammals of South America (RT), in Cartagena, Colombia 2014 (Castelblanco-Martínez & Marmontel 2015). The second SILAMA was held in Valparaiso, Chile 2016 during the 17th RT. The third version of the SILAMA took place within the 18th Meeting of Specialists on Aquatic Mammals of South America, on 4th October, in the city of Lima, Peru.

The objectives of the SILAMA since its first version were: (1) to review the progress in research and conservation of manatee populations in Latin America; (2) to exchange experiences and advances in the management and conservation of these species both in wildlife and in captivity; (3) to discuss methodological approaches that allow meeting current needs, and that fit to local ecological and economic conditions; (4) to make recommendations to promote international cooperation for research and conservation of manatees in Latin America; and (5) to synthesize the results in a technical report available to the public, scientific community, stakeholders and decision makers.

Oral and poster presentations

Specialists from across Latin America and the Caribbean were openly invited to submit their abstracts by way of short oral presentations or posters. The abstracts were sent to one or two reviewers who read and graded the document through a pre-designed questionnaire. Research and conservation results from Peru, Mexico, Brazil, Colombia, Venezuela and Puerto Rico were presented through 18 oral presentations and nine posters (Abstracts are presented in this issue of *Sirenews*). The agenda of oral presentations included four sessions: Biology and monitoring of wild populations, Risk and conservation of wild populations, Research in captivity and rehabilitation, and Health and veterinary medicine. We also had three invited lectures: Robert K. Bonde (University of Florida), Roberto Sánchez Okrucky (Dolphin Discovery) and João Borges Gomes (Fundação Mamíferos Aquáticos, Brazil).

The John Reynolds Award

Within the symposium, we offered the "John Reynolds Award to the most relevant work for manatee research and conservation in Latin America" in the modalities of Oral Presentation and Poster. Dr. John Reynolds was a Mote Senior Scientist who passed away on 23 Dec. 2017. He was deeply committed with manatee conservation and impacted the career of countless marine mammal researchers all over the world. By naming the award after John we hope to make a modest tribute to his legacy to manatee conservation and research in Latin America. The members of the ad hoc jury were: Dr. Antonio Mignucci-Giannoni, Dr. Robert K. Bonde, Dr. Roberto Sanchez Okrucky, Dr. João Borges Gomes and Dr. León David Olivera-Gómez. The jury decided to award the following presentations:

- Oral presentation: Juan Sánchez Babilonia (CREA, Peru). "Experiences in rescue, rehabilitation and release of Amazonian manatee *Trichechus inunguis* (Sirenia:Trichechidae)"
- First poster presentation: Alexandra Fernandes Costa (NGI Costa dos Corais, Instituto Chico Mendes de Conservação da Biodiversidade, Brazil). "Feeding success in release process of an Antillean manatee (*Trichechus manatus*) in North East of Brazil"
- Second poster presentation: Katerin Arévalo-Gonzalez (Colombia). "New threats to Sirenian conservation in Colombia: presence of potentially zoonotic parasites in wild manatees"

Acknowledgements

This event was possible thanks to the generous support of Yaqupacha, Save the Manatee Club and Lowry Park Zoo. Veracruzana University provided a travel grant to GKA-G. We are also grateful to the University Cayetano Heredia which provided logistical help during the symposium. We thank the reviewers who kindly offered their time to read and review the abstracts: A. Alvarez-Alemán, D.C. Barragán-Barrera, R.E. Díaz-Gamboa, H.M. Domínguez-Tejo, E. Morteo, I. Normande, L. D. Olivera-Gómez, F. de O. Luna, E.A. Ramos, and F. Riet-Sapriza.

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-**Nataly Castelblanco-Martínez**^{1,2,3} (castelblanco.nataly@gmail.com), **Gloria Katerin Arévalo-González**^{3,4} (katarevalo@gmail.com), **Sarah Sofía Landeo-Yauri**⁵ (sslandeo@gmail.com), **Ana Carolina Oliveira de Meirelles**⁶ (cameirelles@aquasis.org) and **Miriam Marmontel**⁷ (marmontel@mamiraua.org.br) (¹Consejo Nacional de Ciencia y Tecnología; ²Universidad de Quintana Roo; ³Fundación Internacional para la Naturaleza y la Sostenibilidad; ⁴Universidad Veracruzana; ⁵Universidad Nacional Autónoma de México; ⁶Associação de Pesquisa e Preservação de Ecossistemas Aquáticos; ⁷Instituto Mamirauá; Email¹: castelblanco.nataly@gmail.com).

ABSTRACTS

ABSTRACTS OF THE THIRD LATIN AMERICAN SYMPOSIUM FOR MANATEE RESEARCH AND CONSERVATION (SILAMA), 4th NOVEMBER 2018

Keynote Speakers

History of manatee genetics and their unique biology

Robert K. Bonde
U.S. Geological Survey and University of Florida
rbonde@gmail.com

Over the last several decades we have provided insights into manatee adaption and survival based on pioneering genetic studies. These studies have given us tools to gauge their adaption and utilization of specific regional habitats throughout their range. I will outline the history of manatee genetic research to assist in interpreting global manatee population survival.

Manatees are generalist megaherbivores adapted for life in tropical environments. They have evolved over the last several million years into a well-suited ecological niche, unchecked by human perturbations until the last 10,000 years. However, in the last few hundred years, manatees have been exposed to excessive hunting, incidental take by fishermen, habitat destruction, and technologies that are the result of human population growth and development, including threats due to motor boats and fishery interactions. These threats have been so severe

that manatee populations in many areas of their distribution have been reduced or even extirpated. Public education and conservation efforts have allowed the manatee populations to grow during the last four decades in some areas, but populations remain threatened throughout most of their range. Current regional populations may become extinct if action is not aggressively taken. Many strategies for stabilizing these populations include enhancing existing habitats for manatee use, such as reducing the mortality due to anthropogenic causes, protecting vegetative habitats, and ensuring water quality.

Manatees have been studied extensively for the past 40+ years through the use of individual photo-identification of distinctly scarred individuals, radio tracking, habitat assessment and feeding ecology, cause of death determination, biomedical health evaluation including genetics and fitness parameters, and aerial surveys. Results have given both researchers and managers tools for better understanding their biology and habitat requirements worldwide. The long-lived, highly mobile, slow-breeding manatee has exceptional resilience capabilities. Various behavioral, anatomical, and morphological features unique to manatees have enabled them to do well in their tropical-to-subtropical aquatic environments. Lessons learned are applied in a variety of scenarios to enhance conservation practices in many countries, especially with the implementation of models to help forecast potential for long-term persistence.

Development of a new satellite monitoring technology applied to Antillean manatees (*Trichechus manatus manatus*)

João Carlos Gomes Borges^{1*}, Jean Paul Dubut², José Eduardo Mantovani³, Raphael Dantas Círiaco³, Sebastião Silva Dos Santos¹, Miriam Marmontel⁴, Jociery Einhardt-Vergara Parente

(1) Nupesc, Fundação Mamíferos Aquáticos

(2) Nortronic, Sistemas Eletrônicos do Nordeste

(3) Instituto Metrópole Digital, Nortronic - Sistemas Eletrônicos do Nordeste

(4) Grupo de Pesquisa em Mamíferos Aquáticos Amazônicos, Instituto de Desenvolvimento Sustentável Mamirauá

*joao@mamiferosaquaticos.org.br

The reintroductions of Antillean manatees in Brazil began in 1994 and are considered indispensable as conservation strategy for the species. However, so far manufacturing of satellite monitoring equipment for manatees did not exist in Brazil, leading to high costs of equipments' acquisition and importation. Therefore, our objective was to develop local satellite transmitters with GPS locator for the monitoring of the Antillean manatees. The designed satellite transmitters used Globalstar system architected from a SPOT messenger module, which was programmed to receive commands from the controller board, generated by a PIC microcontroller from Microchip. The device also has a VFH transmitter. Initially, the transmission was programmed in a six-hour cycle, in which the system remained on and transmitted the coordinates during two hours, following by four hours off. The geographic coordinates were provided by GlobalStar, which enabled the visualization of maps through Google Maps and Google Earth. The equipment was placed within a housing measuring 16.5 cm and weighing 1.9 kg, and it was attached to the animals by means of traditional accessories. Several tests performed out of the water and with captive manatees proved a good buoyancy of the housing, allowing all patterns of manatee movements. Regarding the transmission mechanisms, the location was acquired quite satisfactorily, with excellent accuracy of the coordinates received. With respect to VHF, this allows to assist the field monitoring, enabling the researcher to locate the animal for the necessary

studies or to recover the transmitters for maintenance / repair. In conclusion, we constructed a new device built from inexpensive materials, available in the Brazilian domestic market. The final product is a feasible technically and economically accessible equipment compared to other technologies. Based on all the studies carried out, the equipment and the designed system are suitable for the monitoring activities of free-living marine manatees.

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The importance of manatees kept under human care in Mexico

MVZ Roberto Sánchez Okrucky
Grupo Dolphin Discovery. Cancún, México.
okrucky@dolphindiscovery.com

Nowadays, the importance of maintaining and taking care of priority species, such the Caribbean manatee, in controlled habitats is evident. Due to the threats faced by the wild population of manatees in our country (Mexico), human intervention is required for habitat's management and for manatees in critical conditions care. The lessons learnt about captive manatees in the last 20 years are invaluable and applicable to the conservation of this species. Thanks to inter-institutional support in Mexico, progress has been made in environmental education, conservation, reproduction, genetics, veterinary and preventive medicine, among others. The possibility of having the captive individuals at hand has contributed to numerous research projects focused on their species conservation. The easy and rapid collection of biological material, in most cases obtained by means of operant conditioning, and therefore avoiding the physical containment of individuals, is attractive to many researchers. The care of orphan calves, the knowledge of normal physiological values, diseases and treatments, new diagnostic techniques, behavioral studies during natural processes such as copulation, gestation, birth and lactation have helped us to better understand species reproduction and its complex physiology. On the other hand, we want to remark the great work in bringing awareness that these charismatic animals achieve with the people who have the opportunity to interact with the species through direct contact.

ORAL PRESENTATIONS

Discovering and conserving manatees from the Carare River basin, Santander, Colombia

Katerin Arévalo-González^{1,2,3}, Elmer Rentería-Maturana², Cesar Rodríguez-Jiménez^{2,4,5}; James Murillo Osorio², Epifanio Rentería⁵, Julio Palacios⁵, Nataly Castelblanco-Martínez^{3,7}; Carlos A. Saavedra-Rodríguez⁸, María Antonia Espitia⁸

(1) Facultad de Ciencias Biológicas y Agropecuarias, Universidad Veracruzana

(2) Cabildo Verde Sabana de Torres

(3) Fundación Internacional para la Naturaleza y la Sustentabilidad - FINS

(4) Water Resources Department, Delft University of Technology

(5) Escuela de Ingeniería Forestal, Instituto Tecnológico de Costa Rica

(6) Grupo Comunitario Guardianes del Manatí Bocas del Carare y Riberas del San Juan

(7) Consejo Nacional de Ciencia y Tecnología/Universidad de Quintana Roo

(8) Programa Colombia, Wildlife Conservation Society

Corresponding author: katarevalo@gmail.com

The manatee is one of the most iconic and threatened species of the Magdalena Medio basin in Colombia, where there are suitable sites for its presence. However, its permanence and conservation status are unknown. The “Proyecto Vida Silvestre” or “Wildlife Project” provides strategies for the biodiversity conservation at a landscape scale through the implementation of conservation activities targeting local species such as the Caribbean manatee *Trichechus manatus manatus*. Through the diagnosis and characterization of the manatee population and its habitat, strategic zones were identified for the protection of the species in the Carare-San Juan Wetland Complex. The project also included the rehabilitation of degraded areas, training of fishermen in good conditions practices and attention to incidental captures. A monitoring, control and surveillance local group was permanently linked in all processes. After two years of implementation, the San Juan River and Ciénaga La San Juana were identified as priority areas for the species. They have declared the Natural Reserve of the Civil Society Hágora Santa Marta, adjacent to the Ciénaga, and negotiations are held with other owners and government authorities to develop regional conservation strategies. We supported the implementation of sustainable livestock and rehabilitation activities for the recovery of protective riverbeds in two farms of 37 and 60 Has. The local group named "Guardianes del Manatí" has 12 community members who will continue to ensure the protection of manatee habitat, as well as its survival. It is expected that the strategies will last and that the zones of presence of the manatee will be declared as protected areas.

Acknowledgments: To all the organizations that made possible the Wildlife Project and the communities for their support and reciprocity: Bocas del Carare, Riberas del San Juan, Bocas de Barbacoas, San Vicente de Chucurí. This work was funded by Ecopetrol SA, Fundación Julio Mario Santo Domingo, WCS and the 10 executing organizations of the Wildlife Project.

Capture of Antillean manatee (*Trichechus manatus*) in Brazil

Fernanda Loffler Niemeyer Attademo^{1,2,3,4}, Iran Campello Normande⁵, Glaucia Pereira de Sousa¹, Flávio José de Lima Silva³, Carlos Augusto da Bôaviagem Freire³, Cristine Pereira Negrão⁶, Alexandra Fernandes Costa⁵, Iara Braga Sommer², Fábria de Oliveira Luna¹

(1) Centro Nacional de Pesquisa e Conservação de Mamíferos Aquáticos, Instituto Chico Mendes de Conservação da Biodiversidade

(2) Centro Nacional de Pesquisa e Conservação de Biodiversidade Marinha do Nordeste, Instituto Chico Mendes de Conservação da Biodiversidade

(3) Projeto Cetáceos da Costa Branca, Universidade Estadual do Rio Grande do Norte,

(4) Instituto Brasileiro para Medicina da Conservação – Tríade

(5) NGI Costa dos Corais, Instituto Chico Mendes de Conservação da Biodiversidade

(6) Projeto Áreas Marinhas e Costeiras Protegidas – GEF Mar

(7) Associação de Pesquisa e Preservação de Ecossistemas Aquáticos - AQUASIS

Corresponding author: niemeyerattademo@yahoo.com.br

Studies of Antillean manatee (*Trichechus manatus*) in Brazil have been advancing in recent years, however, most of the data are still from captive animals. Aiming to increase knowledge and conservation actions for the species, ICMBio and its partners have been conducting expeditions of capture and tagging of free-living *T. manatus*. This work aimed to report the methodology of capture of free-living marine manatees with the use of vessels in Brazil. Between 2012 and 2017 six capture expeditions were carried out, two in Ceará (2012 and 2013), one in Paraíba (2016) and three in Alagoas (2013, 2016 and 2017). The methodology and structural design of the vessel was based on the US methodology and adapted to the environmental conditions at the catch sites in Brazil. The vessel has a 28-foot outboard 150-HP outboard and a purse seine made of polyamide nylon six meters high and 200 meters long, launched after viewing the animal. The capture effort varied between four and 20 days, resulting in 13 captured animals (mean of 2.3 SD = 2.11 animals). Captures occurred in the four phases of the moon. The new moon was the most successful (64.2%), followed by waning moons (23.1%) and growing moons (7.7%). Successful catches occurred in Ceará, in April (n = 1) and May (n = 5) and in Alagoas in March (n = 1), October (n = 4) and November (n = 2). Of the captured animals, 09 were native and four reintroduced (three in AL and one in PB), being two pups, two juveniles and nine adults. Biological samples and morphometric measurements were collected. The individuals were microchipped and received GPS transmitters. Participation in a network of institutions in Brazil and abroad, with expertise in capturing, handling and behavior of the animals in the various capture sites contributed decisively with the success of the expeditions, reducing anthropic interference in the animal and the environment. It is recommended that the effort be concentrated in priority areas, contributing to the acquisition of information on the habitat use and health of a given population or management group.

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Importance of the captivity for the reintroduction success of the Antillean manatee (*Trichechus manatus*) in Brazil

Fernanda Loffler Niemeyer Attademo^{1,2,3,4}, Iran Campelo Normande⁵, Gláucia Pereira Souza¹, Augusto Carlos da Boavigem Freire^{1,2}, Flávio José de Lima Silva², João Carlos Gomes Borges⁶, Alexandra Costa⁵, Iara Braga Sommer⁴, Fábria de Oliveira Luna¹.

(1) Centro Nacional de Pesquisa e Conservação de Mamíferos Aquáticos, Instituto Chico Mendes de Conservação da Biodiversidade

(2) Projeto Cetáceos da Costa Branca, Universidade Estadual do Rio Grande do Norte

(3) Instituto Brasileiro para Medicina da Conservação – Tríade.

(4) Centro nacional de Pesquisa e Conservação de Biodiversidade Marinha do Nordeste, Instituto Chico Mendes de Conservação da Biodiversidade.

(5) Área de proteção Ambiental da Costa dos Corais, Instituto Chico Mendes de Conservação da Biodiversidade.

(6) Programa Nacional para a Conservação dos Peixes-Bois Marinhos. Projeto Viva o Peixe-Boi Marinho. Fundação Mamíferos Aquáticos

Corresponding author: niemeyerattademo@yahoo.com.br

Rehabilitation and subsequent reintroduction of Antillean Manatees (*Trichechus manatus*) rescued in Brazil, are fundamental steps for the conservation of the species. However, the processes between the rescue and reintroduction require specificities so that they occur in different types of enclosure. At first, the animals remain in artificial pools of rehabilitation, supplied with sea water submitted to physical and chemical treatment. When the animals reach an expected development and have a satisfactory clinical condition, they are translocated to acclimatization captivity, built in a natural environment. The objective of this study was to compare the rehabilitation and acclimatization sites of manatees in Brazil. The permanency period and mortality rates of the different types of captivity between 1980 and 2018 were analyzed. In the rehabilitation captivity, the animals live with other animals of the same species only at around one year of age and do not have access to natural conditions. As for acclimatization, the limitation of space is made with natural material (woods) and the mangrove itself, when in the estuary. In addition, animals live together with other species of animals, dynamics and variation of the tide. The age of the first translocation occurred between two and twenty-four years, being 62.3% (n = 33) with up to four years and only 3.8% (n = 2) with age greater than seven years. The permanency period of the animals in acclimatization captivity was on average 148 days between the years 1994 and 2004 and 486 days from 2004 to the present. In the rehabilitation captivity, the mortality rate was 31.3% (31/99). In the acclimatization rooms the mortality rate was lower, being in Paraíba 28.6% (4/14) and Alagoas 2.5% (1/40). After reintroduction, the success rate of these animals has been over 75%. In spite of the initial need of the rehabilitation rooms, the permanence of these animals in the acclimatization captivities allows a greater possibility of adaptation after the release, besides allowing a better quality of life, in conditions close to what will find after the release.

Acknowledgments: Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Centro Nacional de Pesquisa e Conservação de Mamíferos Aquáticos (CMA), área de Proteção Ambiental Costa dos Corais (APACC), Projeto Cetáceos da Costa Branca (PCCB) Centro de Estudos e Monitoramento Ambiental (CEMAM), Fundação Mamíferos Aquáticos (FMA), Instituto Mamíferos Aquáticos (IMA), Fundação Toyota SOS Mata Atlântica, Projeto GEF-Mar, Fundação O Boticário de Proteção à Natureza, FUNBIO.

Characterization of the Antillean manatees (*Trichechus manatus*) captured in the northeast of Brazil

Fernanda Loffler Niemeyer Attademo^{1,2,3,4}, Iran Campello Normande⁵, Glaucia Pereira de Sousa¹, Flávio José de Lima Silva³, Augusto Carlos da Bôaviagem Freire³, Cristine Pereira Negrão⁷, Alexandra Fernandes Costa⁶, Iara Braga Sommer², Fábria de Oliveira Luna¹

(1) Centro Nacional de Pesquisa e Conservação de Mamíferos Aquáticos, Instituto Chico Mendes de Conservação da Biodiversidade

(2) Centro Nacional de Pesquisa e Conservação de Biodiversidade Marinha do Nordeste, Instituto Chico Mendes de Conservação da Biodiversidade

(3) Projeto Cetáceos da Costa Branca, Universidade Estadual do Rio Grande do Norte,

(4) Instituto Brasileiro para Medicina da Conservação – Tríade

(5) NGI Costa dos Corais, Instituto Chico Mendes de Conservação da Biodiversidade

(6) Projeto Áreas Marinhas e Costeiras Protegidas – GEF Mar

(7) Associação de Pesquisa e Preservação de Ecossistemas Aquáticos - AQUASIS

Corresponding author: niemeyerattademo@yahoo.com.br

The capture and marking of free-living Antillean Manatee (*Trichechus manatus*) in Brazil is being carried out by ICMBio and partner institutions to study the health and use of areas of these animals, as well as the habitat in which they are inserted. These activities seek to understand the population dynamics in the analyzed sites and propose management actions directed to the species. This study intends to describe the state of health of the animals captured in Brazil. In the period from 2007 to 2017, seven expeditions of attempts to capture manatees in free life in the states of Ceará, Paraíba, Pernambuco and Alagoas were carried out. Except in Pernambuco, all catches were made with a vessel built exclusively for this type of activity. In the period were captured 14 animals, six males (42.9%) and eight females (57.1%); divided into age groups: three pups (21.4%), two juveniles (14.3%) and nine adults (64.3%). In Ceará, the mean total length (TC) of adults was 314.5cm (268 ± 413) and weight 429kg (313 ± 672). In Alagoas, the mean of adults and TC = 295 cm (266 ± 310) and weight 506 kg (335 ± 630). In Pernambuco, the only specimen presented CT = 290 cm and weight = 459 kg. All captured animals were considered to have an excellent body score and to date, no clinical alterations have been observed. It is noteworthy that in Alagoas, several groups of mothers with different age groups were found. Hemogram tests were within the normal range described for the species. Bacteriological examinations were performed on nasal swabs: *Escherichia coli*, *Pseudomonas* sp., *Streptococcus* sp., *Corynebacterium* sp., And on oral swabs: *Enterobacter aerogenes*, *E. coli*, *Micrococcus* sp. and *Corynebacterium* sp. No animals were positive for *Salmonella* sp., Nor in serology (anti-*Leptospira* spp., Anti-*Toxoplasma gondii* and anti-*Brucella abortus*). It was concluded that the populations of manatees in the evaluated sites have been healthy, and that this information can help in making decisions that promote the conservation of the species, among them the identification of places for release.

Acknowledgments: Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Centro Nacional de Pesquisa e Conservação de Mamíferos Aquáticos (CMA), área de Proteção Ambiental Costa dos Corais (APACC), Projeto Cetáceos da Costa Branca (PCCB), Centro de Estudos e Monitoramento Ambiental (CEMAM), Associação de Pesquisa e Preservação de Ecossistemas Aquáticos (Aquasis), US Geological Survey (USGS), Universidade da Flórida (UF), Petrobras, Fundação Toyota SOS Mata Atlântica, Projeto GEF-Mar, Fundação O Boticário de Proteção à Natureza, FUNBIO

“The manatees, lifeguards of the river”: social perception of the manatee by local communities of the Hondo river

Mildred Fabiola Corona Figueroa¹, José Ney Ríos Ramírez¹, Nataly Castelblanco-Martínez^{2,3,4}, Sergio José Vilchez Mendoza¹, Luis Diego Delgado Rodríguez¹ y Carlos Alberto Niño-Torres^{2,4}.

(1) Centro Agronómico Tropical de Investigación y Enseñanza - CATIE

(2) Universidad de Quintana Roo

(3) Consejo Nacional de Ciencia y Tecnología - CONACYT

(4) Fundación Internacional para la Naturaleza y la Sustentabilidad -FINS

Corresponding author: mildred.corona@catie.ac.cr

The Hondo River, as well as Chetumal Bay (Mexico), is a traditional habitat for the Antillean manatee *Trichechus manatus manatus*, an endangered species according to the IUCN. Despite its vulnerability and importance for this species, the river is not considered part of the Manatee Sanctuary and, therefore, has no special protection. The objective of this study was to analyze the social perception related to the manatee and its habitat by the local communities of the Hondo River. During February to April 2018, 50 semi-structured interviews were applied to river users (fishermen, boatmen) in 16 Mexican communities located on the riverbank. The results indicate that 100% of the interviewees recognize the species and 82% have fishing as the main activity in the river. Also, 56% claimed to observe manatees in specific areas (e. g. in front of the pier of their community, tributary rivers) and for the remaining 44%, manatees are distributed in the navigable portion of the river from the mouth to La Union. There is a noticeable concern about the decrease in manatee abundance, since 48% of the interviewees informed a lesser number of observed manatees nowadays compared to one decade ago. They considered that the main causes of this decreasing are the augmentation of boat traffic, the river pollution resulting of cane cultivation practices, and the use of fishing nets. This study provides evidence of traditional ecological knowledge regarding manatee by the riverside, and the importance of the species for its tourism potential. We suggest a comprehensive manatee conservation program in the Hondo River, which includes the protection of its habitat, the implementation of good farming practices and the development of effective and constant educational campaigns, involving the local population and other key stakeholders of the basin.

Ontogenetic variation in the trophic ecology of the Amazonian manatee, *Trichechus inunguis*, using stable isotopes

Luciana Carvalho Crema¹, Vera Maria Ferreira Da Silva², Botta Silvina³, Trumbore Susan⁴, Piedade Maria Teresa Fernandez⁵

(1) Centro Nacional de Pesquisa e Conservação da Biodiversidade Amazônica, Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio

(2) Coordenação de Pesquisas em Biologia Aquática, Laboratório de Mamíferos Aquáticos, Instituto Nacional de Pesquisas da Amazônia

(3) Instituto de Oceanografia, Laboratório de Ecologia e Conservação da Megafauna Marinha, Universidade Federal do Rio Grande

(4) Department of Biogeochemical Processes, Max Planck Institute for Biogeochemistry

(5) Coordenação de Pesquisas em Biologia Aquática, Grupo Ecologia, Monitoramento e Uso Sustentável de Áreas Úmidas, Instituto Nacional de Pesquisas da Amazônia

Corresponding author: luciana.carvalho.crema@gmail.com

We evaluated the feeding habits of the Amazonian manatee (*Trichechus inunguis*) inhabiting blackwater (Negro River) and clearwater (Tapajós River) igapós (floodplains) using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values in dentin and bone collagen from different ontogenetic classes (lactating calves, juveniles and adults). There were no significant correlations between $\delta^{13}\text{C}$ or $\delta^{15}\text{N}$ values in the position of teeth in the dental arcade, showing that there was no variation among teeth. In the case of bones, values of both $\delta^{13}\text{C}$ or $\delta^{15}\text{N}$ were different between ontogenetic classes, being the lactating calves $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values more enriched in the heavier isotopes than adults. Bones showed more ^{13}C and ^{15}N -depleted $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values, respectively, than teeth. Food sources had $\delta^{13}\text{C}$ values typical of plants of C3 or C4 photosynthetic pathways. Mixing models showed that nursing females (inferred by isotopic values from lactating calves) had preference for consumption of C4 plants (mean of 47% in Tapajós and 41% in Negro Rivers). Juveniles had a mixed diet, while adults consumed primarily C3-plants in both Tapajós (mean = 67%) and Negro rivers (mean = 63%). Because of the low abundance of C4-plants in the Negro River, we hypothesize that the C4 signal of calves results from the nursing females movements to várzea where C4-species are more abundant, such as *Paspalum repens*, *Echinochola polystachya* and *Hymenachne amplexicaulis*. Results showed that the animals feed on a great variety of plants and algae with different photosynthetic pathways and the consumed proportions vary according to age and region. Therefore, food availability can represent, in case of the nursing females from Negro River, a determining factor to explain the seasonal migration of the species from the igapó to a nearby várzea. In contrast, food availability may explain a more resident behaviour for individuals from Tapajós River, as the lakes have C3 and C4 plants available during the flood pulse. Although there is no change in $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ among teeth, the large variation in these signals between individuals indicates the Amazonian manatee may switch its diet according to the availability of resources, its food preference or nutritional needs.

Characterization of side scan-sonar images produced by Amazonian River dolphins (*Inia geoffrensis*) to reduce potential confusion during surveys of Amazonian manatees (*Trichechus inunguis*)

Daniel Gonzalez-Socoloske¹, Camila Carvalho de Carvalho², Miriam Marmontel³

(1) Department of Biology, Andrews University

(2) Universidade Federal de Rio Grande, Laboratório de Ecologia e Conservação da Megafauna Marinha —EcoMega

(3) Instituto de Desenvolvimento Sustentável Mamirauá, Research Department

Corresponding author: gonzalezd@andrews.edu

Side-scan sonar (SSS) has been successfully used to detect West Indian and West African manatees, however confirmed sonar images of Amazonian manatees have not been obtained yet. One potential difficulty with this methodology is differentiating manatee images from other large aquatic vertebrates. While West Indian and West African manatees share habitat with small cetaceans in estuarine and marine habitats, their potential confusion in sonar images has been avoided because of their reluctance to approach the boat during surveys and their fast locomotion. In contrast, the Amazonian manatee shares most of its habitat with two cetaceans, the Amazonian River dolphin (ARD, *Inia* spp.) and the Tucuxi (*Sotalia fluviatilis*). In this study we characterize the sonar image produced by the ARD and make notes on behavior observed during surveys for Amazonian manatees. Boat surveys using SSS were conducted during the high (July 15-30, 2017)

and low (December 13-21, 2017) water seasons in Amanã Lake, Amanã Sustainable Development Reserve, Amazonas, Brazil. Sonar surveys were recorded and then analyzed with ReefMaster Sonar Viewer (v. 1.0.36). ARD produced a characteristic wavy tail in the shadow of the image. At slow speeds (1-3 km/h), the shadow looks like the body shape of the ARD with a low profile dorsal fin, a narrow beak, and a narrow tail with a fluke. At faster speeds (4-5 km/h), the acoustic image is elongated due to the ARD swimming alongside the boat. Unlike the acoustic images produced by manatees, ARD acoustic images contain sharper angles and the shadow is narrower. ARD in Lake Amanã repeatedly followed our boat for kilometers during several hours. They would swim under the boat and approach the SSS transducer, suggesting they could hear the sonar, but were not distressed by it. ARD were seen in small pods (1-4), however several pods would aggregate over time in relatively large numbers (10-20) around the boat. In conclusion, ARD acoustic images have different characteristics and can be reliably distinguished from known manatee acoustic images. Due to the behavior of ARD and their propensity to approach survey boats, care must be taken when surveying for Amazonian manatees.

Protocol proposal: Using small drones for detection of Antillean manatees

Sarah Sofía Landeo-Yauri¹, Nataly Castelblanco-Martínez^{2,3,4}, Carlos Alberto Niño-Torres^{3,4}, Eric Ramos^{4,5}, Yann Hénaut⁶, Jaime Dionisio Cuevas-Domínguez³.

- (1) Posgrado de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México
- (2) Catedras Jóvenes Investigadores, Consejo Nacional de Ciencia y Tecnología
- (3) Universidad de Quintana Roo
- (4) Fundación Internacional para la Naturaleza y la Sustentabilidad (FINS).
- (5) Animal Behavior & Comparative Psychology, The Graduate Center, City University of New York
- (6) El Colegio de la Frontera Sur

Corresponding author: sslandeo@gmail.com

The Antillean manatee (*Trichechus manatus manatus*) populations face several threats. Management plans for the species needs to be improved, based on up-to-date and continuous information. However, due to the costs involved for traditional census and monitoring methods, the acquisition of information is intermittent. It is necessary to explore alternative and affordable tools to facilitate the study and monitoring of manatee populations. In this sense, we aimed to test the effectiveness of small drones for detection of Antillean manatees. Three natural protected areas (ANP) were selected within the Mexican Caribbean: the Yum Balam Protected Area for Wildlife and Flora (YBPAWF, north), the Sian Ka'an Biosphere Reserve (SKBR, center) and the Manatee Sanctuary (MS, south). A DJI Phantom 3 Advanced drone was used to perform detection flights in these areas. In addition, tests were conducted on captive manatees to determine if the drone affects their behavior. Factors that affect the detection of manatees were assessed through surveys, using data collected in captive manatees' facilities. We performed 24 flights at the NPAs, flying the drone at 100 m of altitude (image covers 154 m of width), perpendicular to the coast and in a rectangular path with ≥ 1 km on its longest side, recording a video (2.7 K) during the flight. We covered 69.7 km, 9.03 km² and obtained 253 minutes of video. Two individuals (mother and calf) were recorded in the MS (N 18 ° 43'15.24 ", OR 88 ° 9'9"), two individuals in the SKBR (N 20 ° 6'23.04 "OR 87 ° 29'41.64" and N 19 ° 48'7.92 "OR 87 ° 29'17.52") and no individual in the YBPAWF. Tests in captivity indicated that the drone can affect the manatee's behavior, and that turbidity is the environmental factor with greatest effect on detection. It was proved that it is possible to detect free ranging manatees using small drones. We propose that detection flights

should follow transects (≥ 1 km) at 100m of altitude, at speed of 16 -20 km /hr, and recording a video (in maximum available quality) during the flight.

First assessment of Antillean manatee watching tourism in Mexico: a case study in the Sian Ka'an Biosphere Reserve, Quintana Roo

Sarah Sofía Landeo-Yauri¹, Nataly Castelblanco-Martínez^{2,3,4}, Carlos Alberto Niño-Torres^{3,4}, Yann Hénaut⁵, Eric Ramos^{4,6}

(1) Posgrado de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México

(2) Consejo Nacional de Ciencia y Tecnología

(3) Universidad de Quintana Roo

(4) Fundación Internacional para la Naturaleza y la Sustentabilidad - FINS

(5) El Colegio de la Frontera Sur

(6) Animal Behavior & Comparative Psychology, The Graduate Center, City University of New York

Corresponding author: sslandeo@gmail.com

In Mexico, little is known about tourism activities involving free ranging Antillean manatees (*Trichechus manatus manatus*). To our knowledge, manatee watching with touristic purposes is only carried at the Sian Ka'an Biosphere Reserve (SKBR). In addition to the economic benefit for tourism operators, this activity represents an opportunity for bringing awareness to visitors. However, non-regulated tourism activities could be harmful for the manatees in the area, posing risks of boat collision, direct harassment and displacements. Consequently, we aimed to obtain a first assessment of manatee related tourism in the SKRB. In October (2017), 10 tourism operators were interviewed about their activities and knowledge of the manatees in their work area. From the information gathered, two fixed points were selected to register information on boat-manatee interactions, using a DJI Phantom 3 Advanced drone. Videos (4-13 minutes long) were recorded between 20 and 100 meters of altitude. The ImageJ software was used to calculate speeds and distances between boats and manatees. We found five companies and cooperatives working in the area offering the possibility of sighting manatees, although only one of them have wildlife observation tours as main activity. All interviewed claimed that manatees were mostly seen on the various sinkholes of the Caapechén and Bocapaila lagoons. From interviews, at least two manatees are usually encountered per tour. We recorded 57 minutes of video during eight flights at two sinkholes. Two types of manatee watching were recorded: from a stationary boat and from a boat in motion (calculated speed of 3.6 km / hr). The minimum distance manatee-boat was 0 m for the boat in motion case, and 8.38 m for the stationary boat. Considering this, the last method entails less risk for the animals. It is advisable to keep on collecting information about the manatee watching on the SKRB (using small drones, for example). Guidelines for a sustainable manatee related tourism should be agreed on, considering the opinions and experience of the tourism operators of SKRB.

Evaluation of huama (*Pistia stratiotes*) intake by Amazonian manatees (*Trichechus inunguis*) of different ages and weight

Darwin Loja¹, Edgar Dávila¹, Javier Velásquez¹, Carlos Marcial Perea Sicchar¹, Luis Sigler², Juan Sánchez-Babilonia¹.

(1) Programa de Mamíferos Acuáticos, Centro de Rescate Amazónico - CREA

(2) Conservation Biologist, The Dallas World Aquarium
Corresponding author: rloja17814@hotmail.com

The Amazonian manatee (*Trichechus inunguis*) is a non ruminant herbivorous aquatic mammal. At the Amazonian Rescue Center (ARC, Iquitos, Perú) manatees are fed with “huama” (*Pistia stratiotes*), an aquatic macrophyte. In natural environments, *P. stratiotes* reproduces rapidly, being able to create ecological problems as eutrophication and proliferation of insects harmful to health. On the other hand, studies on captive manatee feeding are scarce in Perú, and there is little information available concerning the amount of *P. stratiotes* that Amazonian manatees can feed on. Our research aims to calculate the “huama” consumption by Amazonian manatees and to analyze the nutritional content of this plant. The study was conducted on healthy manatees kept in captivity. The individuals were 6 calves (4 females and 2 males) and 2 adult females, with an average weight of 57.15 kg (28.90 ± 241.65). Each manatee was weighed weekly. *P. stratiotes* was offered daily (*ad libitum*) and the remnants weighed the next day. Our results show in average the amount of *P. stratiotes* ingested by each manatee: “Indiana” 0.77 kg (± 0.401), “Yara” 12.99 kg (± 3.082), “Rita” 3.61 kg (± 1.239), “Ivanna” 3.38 kg (± 2.109), “Anonimux” 3.14 kg (± 0.931), “Bretaña” 23.24 kg (± 2.474), “G4” 60.70 kg (± 11.474) and “Daniela” 2.98 kg (± 0.995). The percentage of *P. stratiotes* intake in relation to the manatees recent weight was 1.52%, 20.02%, 10.52%, 11.70%, 7.67%, 31.62%, 25.12% and 1.75% respectively. The nutritional content of fresh *P. stratiotes* was evaluated, obtaining mean values of humidity (93.40%), ash (0.93%), fat (0.60%), protein (1.30%), carbohydrates (3.77%), calories (25.68%) and total solids (6.6%) of the vegetable sample. Among the values obtained we remark that 5 manatees consume more than 8% of their body weight per day, however it should be noted that this high values could be due to the high water content (93.40%) and the low nutritional content of *P. stratiotes*. In consequence it is necessary to carry out similar studies with different species of aquatic plants and manatees of homogeneous weights by age group.

Historically high levels of boat-related mortality threat the Antillean manatee along the Caribbean coast of Belize and Mexico

Nataly Castelblanco-Martínez^{1,2,3}, Jamal Galves⁴, Eric Angel Ramos^{3,5}, Linda Searle⁶, Carlos Alberto Niño-Torres^{2,3}, Janneth A. Padilla-Saldívar⁷, D Anderson⁸

(1) Consejo Nacional de Ciencia y Tecnología

(2) Universidad de Quintana Roo

(3) Fundación Internacional para la Naturaleza y la Sustentabilidad - FINS

(4) Sea to Shore Alliance

(5) The Graduate Center, The City University of New York

(6) ECOMAR

(7) El Colegio de la Frontera Sur

(8) Cascadia Research Collective

Corresponding author: castelblanco.nataly@gmail.com

Manatees *Trichechus manatus manatus* occupying the Caribbean coast of Mexico (Mx) and the entire coast of Belize (Bz) belong to the same sub-population, and mortality analysis must be conducted on a regional scale. Here, we updated the review of manatee mortality cases reported between 2008 and 2018 in the southern Caribbean of Mexico and in Belize to understand the

mortality dynamics of manatees in this area. We reviewed information of stranded animals (date, locality, size, sex, and probable cause of death) obtained from stranding network reports, social media, local newspapers, interviews with local people and personal records. Systematic data triangulation was conducted on the preliminary database to compare concurrently collected data and to delete duplicates. The resulting coordinates provided raw data for kernel density estimation, used as interpolation method for estimating probability densities of strandings. The current database contains 326 records of dead manatees along the coasts of Mexico (14 females; 18 males; 5 unknown) and Belize (83 females; 62 males; 144 unknown), with 88.6% of casualties occurring in Belize. The causes of death were undetermined (Mx=75.67%, Bz=58.47%), watercraft collision (Mx=0.0%, Bz=30.45%), perinatal (animals that were less than 150 cm in total length that did not die from human related causes) (Mx=21.62%, Bz=7.26%) and illness (Mx=2.77%, Bz=0.3%). Other causes reported for Belize (33.93%) were bycatch, poaching, drowning and hurricane-related deaths. The cause of death was not determined for most of the cases occurring in Mexico, highlighting the need of deeper carcass assessment and pathology studies. On the other hand, the majority (99%) of manatees reported dead for Belize were not examined through a comprehensive necropsy; therefore, it is important to strength the actions of stranding networks. Our records indicate an alarming increase in boat-related mortality for Belize, with obvious hotspots in Belize River and Placencia, and areas of concern in Southern Lagoon and Rio Hondo. Also, we report the first case of a female manatee killed by watercraft-collision in Mexico, in the Biosphere Reserve of Sian Ka'an apparently in 2015. This case was not included in the database due to incomplete information. Our study area is the only part of the subspecies distribution where boat collisions are implicated in historically-high manatee mortality rates per year. This preliminary analysis signals an uncontrolled and unattended threat for this endangered marine mammal in the Caribbean. Education programs, creation of boat-speed control zones, and strict law enforcement, are necessary to help alleviate watercraft-related mortality.

Manatee habitat characterization using side-scan sonar

Mindy Jean McLarty¹, Daniel Gonzalez-Socoloske¹, Anmari Alvarez-Aleman^{2,3}, Jorge Angulo-Valdes³

(1) Department of Biology, Andrews University, Berrien Springs

(2) Centro de Investigaciones Marinas, Universidad de La Habana

(3) School of Natural Resources and Environment, University of Florida

Corresponding author: mclartym@andrews.edu

In this study, the reliability of low-cost side-scan sonar to accurately identify soft substrates such as grass and mud was tested. Benthic substrates can be hard to classify from the surface, necessitating an alternative survey approach. A total area of 11.5 km² was surveyed with a Humminbird® side-scan sonar unit in a large, brackish mangrove lagoon system on Isla de la Juventud, Cuba. Individual points were opportunistically ground-truthed for comparison with the sonar recordings to provide a measure of accuracy. Five substrate types were identified: Dense seagrass, sparse seagrass, mangrove soil, mangrove soil with rock, and silt. A zoned benthic substrate map was created from the sonar recordings using Quantum Geographic Information System (QGIS) software. Dense seagrass was most accurately identified when compared with the observed substrates at the ground-truthed points. Sparse seagrass had the lowest accuracy. A bathymetric map was created from the sonar recordings using ReefMaster software. Depths

ranged from 0 m to 10.3 m. Manatee sighting locations were overlaid on these maps to make a preliminary assessment of habitat use. A total of 95 sightings were recorded between 2007 and 2014. There was a significant difference in the number of sightings by substrate type. Manatees were sighted in areas characterized as mangrove soil, silt, and dense seagrass, with most sightings recorded in mangrove soil areas. There was a significant difference in sightings by depth with most sightings occurring in areas 2–6 meters deep.

Growth modelling of Amazonian manatee (*Trichechus inunguis*) in captivity

Pierina Mendoza¹, Juan Sánchez ², Rony Riveros ³, Javier Velasquez², Edgard Dávila², Darwin Loja² and Carlos Vilchez¹

(1) Zootecnia, Universidad Nacional Agraria la Molina

(2) Mamíferos Acuáticos, Centro de Rescate Amazónico - CREA

(3) Universidade Estatal de São Paulo UNESP

Corresponding author: mend.yeng.pieri@outlook.com

The knowledge of the parameters that affect the growth of the manatee in captivity is important in the conservation terms. This information is vital for make decisions about the nutritional management of rescued calves. During this work, the data of biometrics (total length) and body weight, from one Amazonian manatee of each sex in captivity, was recorded since their rescue to their pre-liberation (48.5±2.5 months). Two non-linear function were separately performed for both animals for each variable: Gompertz function $BW = BW_m \cdot \exp(-b \cdot \exp(-k \cdot \text{age}))$ and Von Bertalanffy function $TL = TL_m \cdot (1 - b \cdot \exp(-k \cdot \text{age}))^3$, were delineated for body weight (BW) and total length (TL), respectively. Were obtained the follow parameters: BW_m , TL_m , k and b ; where BW_m and TL_m are asymptotic parameters, k expresses the ratio of the maximum growth rate, and b is used to calculate the inflection point: $\ln(b)/k$. Subsequently, the first derivative of both functions was adjusted for observe the growth's variation of both variables in reference to age. Finally, the following function evaluation indicators were obtained: Adjusted coefficient of determination (R^2_{aj}), Akaike information criterion (AIC) and Bayesian information criterion (BIC). The data was obtained from the Gauss-Newton iterative method ($P < 0.001$), using the R-Project statistical software. The functions obtained the follow indicators: AIC (250 and 234) and BIC (257 and 241) from Gompertz and AIC (274 and 246) and BIC (280 and 253) from Von Bertalanffy equations; in female and male growth curves, respectively. The function reached convergence and generated the follow parameters of estimation: BW_m of 126.3 and 103.5; LT_m of 248.8 and 267.0, for female and male; respectively. In conclusion, the non-linear Gompertz and Von Bertalanffy functions are suitable for describe the performance of the growth curve of Amazonian manatee in captivity and the body weight and total length dimorphism can be differentiated between both sexes.

Parameters of blood biochemistry of the Amazonian manatee (*Trichechus inunguis*) by age group

Pierina Mendoza¹, Rony Riveros², Darwin Loja³, Edgard Dávila³, Juan Sánchez³, Javier Velásquez³ and Carlos Vilchez¹

(1) Zootecnia, Universidad Nacional Agraria la Molina

(2) Zootecnia, Universidad Estatal de São Paulo UNESP

(3) Mamíferos Acuáticos, Centro de Rescate Amazónico - CREA
Corresponding author: mend.yeng.pieri@outlook.com

The Amazonian manatee (*Trichechus inunguis*) is distributed in the Amazon basin, which conservation state is vulnerable. The frequent rescue of individuals with pathological affections and nutritional deficiencies. The values of the blood parameters, by age group, give a reference of the physiological estate of the animal, to facilitate the monitoring of the health state of the animals in rehabilitation. The objective was to report comparative ranges of blood biochemistry by age group of the Amazonian manatee in captivity, and to compare with previous reports of *T. inunguis* (TI) and *T. manatus* (TM). Blood samples of 15 clinically healthy animals were analyzed, divided in three age groups to analyze their blood samples: 8 calves (9.2 to 12.23 months), 4 juveniles (1.3 to 4.3 years) and 3 adults (5 to 8.6 years). A sample of 10 ml of blood was obtained in post-fasting by puncture in the ventral section of the pectoral fin. A group of data from animals of different age and species of manatee were obtained from bibliography references. The data were subjected to an ANOVA under a factorial arrangement (2x3). A second evaluation was made between the parameters of both species under a simple ANOVA. Later, a comparison of the means between the data obtained and the consulted bibliography, as well as between the age groups and species; with the Tukey test ($p < 0.05$); using the statistical software Minitab. The evaluated blood parameters were, glucose levels(mg/dL), creatinine(mg/dL), urea(mg/dL), cholesterol(mg/dL), triglycerides(mg/dL), albumin(g/dL) and total protein(g/dL). The results were presented the average and the standard deviation ($\mu \pm SD$). The obtained values were significantly higher than previous reports in TI, factors such as environmental factors, genetics and diet could influence this difference, being the first report in TI in Peru. The blood cholesterol values showed a significant difference ($p < 0.05$) between calves and adults, the last group being the group with the lowest levels. Significant difference was observed with TM ($p < 0.05$) about the values of glucose (TI < TM), urea (TI > TM), albumin (TI > TM) and cholesterol (TI > TM). In conclusion, the *T. inunguis* presents blood chemistry values different from the *T. manatus*. cholesterol values vary with the age in *T. inunguis*.

Protocol for healing skin lacerations infected with *Klebsiella* in Amazonian manatees (*Trichechus inunguis*)

José Antonio Nolasco¹, Heather Robertson¹, Jairo Garnica Rodríguez¹

(1) Rainforest Awareness Rescue Education Center - RAREC

Corresponding author: nolascovet@hotmail.com, hrobertson@nashvillezoo.org

When an Amazonian manatee is rescued from poachers, it is often covered in cuts, lacerations, and other skin lesions. These are the result from the mistreatment that manatees suffer at the hands of poachers. Skin lesions undermine the manatee's immune system, which could bring complications during the rehabilitation process. A specific protocol was followed for one particular Amazonian manatee specimen, which was rescued from extremely harsh conditions. It had been kept in contaminated water, inside a small cooler container which restricted its movement and caused it to injure itself. The manatee presented lacerations in the dorsal area, in the abdomen, and in the tail. The skin antibiogram revealed the presence of *Klebsiella* spp., filamentous fungi, gram negative bacilli, and gram positive cocci. The selected topical treatment included gentamicin in IV form for 4 days, and daily cleaning of the wounds with chlorhexidine gluconate (4%) as well as

silver sulfadiazine, for 14 days. The treatment was successful and the lacerations disappeared. This protocol allows us to treat severe cases of skin lacerations in recently rescued Amazonian manatees, increasing the success rate of a fast recovery during their rehabilitation process.

Protocol for treatment of *Citrobacter* infection resulting in pneumonia due to water inhalation in Amazonian manatees (*Trichechus inunguis*)

José Antonio Nolasco¹, Heather Robertson¹, Jairo Garnica Rodríguez¹

(1) Rainforest Awareness Rescue Education Center - RAREC

Corresponding author: nolascovet@hotmail.com, hrobertson@nashvillezoo.org

The leading cause of death of Amazonian manatees that are kept in captivity are the complications from colitis which result in pneumonia due to water inhalation in the majority of the cases. The present protocol was applied to an Amazonian manatee (*Trichechus inunguis*), which presented the following symptoms: Floating in the surface of its pool, difficulty breathing (dyspnea), and unusually short intervals between air intakes. The diagnosis was a combination of colitis and gastritis which generated mechanical pressure on the diaphragm, and caused acute dyspnea and pneumonia due to water aspiration. The test results revealed lymphocytosis, neutropenia, thrombocytopenia, elevated concentration of urea and creatinine, and the presence of *Citrobacter*. A protocol was implemented to treat the pneumonia, with oxygen therapy and a bronchodilator, plus a stomach tube, which were helpful in relieving the gastritis and lower the stomach PH. The systematic treatment was performed according to the antibiogram for *Citrobacter*, along with hydrating enemas. The patient responded to the treatment, and as of right now, its breathing frequency is normal. This protocol will allow us to treat cases of *Citrobacter* infection accompanied with pneumonia in Amazonian manatees, aided with oxygen therapy and tubing, thus improving the patient's response to treatment.

Experiences in the rescue, rehabilitation and liberation of Amazonian manatee *Trichechus inunguis* (Sirenia: Trichechidae), in the Peruvian Amazon

Juan Sánchez-Babilonia¹, Carlos Marcial Perea-Sicchar¹, Luis Javier Velásquez-Varela¹, Darwin Loja-Saavedra¹, Leonardo, Dávila-Panduro¹, Daryl Lee-Richardson² and Luis Sigler²

(1) Asociación para la Conservación de la Biodiversidad Amazónica – Dallas World Aquarium Zoo

(2) The Dallas World Aquarium

Corresponding author: juan.babilonia@gmail.com

In 2007, when we began our interest in the conservation of the Amazonian manatee, we developed an investigation related to the illegal trafficking of the species and that same year we counted 15 baby manatees that had died in captivity due to illegal trafficking. Until then, there was no private or state program to help prevent the local extinction of the Amazonian manatee. In this way, and with the purpose of curbing this problem, we began our work with the rescue of a small baby manatees. To date, thanks to this joint work, the rescue and successful rehabilitation of 40 manatees has been achieved; In 2011, the first release of manatees was made in Peru, at “El Dorado” lake, located in the heart of the Pacaya Samiria National Reserve, RNPS. This release was developed with the support of local communities, who after environmental education, are committed to the conservation of the species. Consecutively from 2012 to 2017 they have

continued with the tasks of release and monitoring of manatees, with 23 released manatees to date. Currently there are 10 manatees, distributed in the different environments that the Rescue Center, 4 adult manatees are already prepared to be released to their natural habitats.

Reintroduction and monitoring of *Trichechus inunguis* in Brazil: Difficulties and lessons

Diogo Alexandre de Souza^{1,2,3}, Vera M.F. da Silva^{1,3}, Mumi Kikuchi², J.A. Fonseca Neto^{1,3}

(1) National Institute for Amazonian Research - INPA

(2) Japan International Cooperation Agency - JICA

(3) Friends of Manatee Association - AMPA

Corresponding author: diogo.peixeboi@gmail.com

Due to illegal hunting and entanglement in fishing nets, orphaned Amazonian manatee are rescued and taken to INPA's rehabilitation center. The success of rehabilitation program generated a potential reintroducing group. Our objectives were assessing the adaptation of captive-raised Amazonian manatees after release, their movements, home-range and habitat use. The manatees were selected based on time in captivity, health conditions and behavior. Selected animals spent 1-2 years in a 13ha semi-natural lake for adaptation to environmental conditions. The released site was the Piagaçu-Purus Reserve due the appropriated habitat, presence of manatees, hunting decline, Protected Areas and support of local communities. Between 2016-2018, 10 males and 9 females manatees were released at the beginning of the rainy season, with VHF-transmitter belts. Trained ex-hunters monitored them from 2 to 638 days (2.550 locations; average 178 locations/animal). Individual differences in movement and space use was observed, but not between sex. The maximum displacement was 37km/day (average 2.3km/day), with the largest distances occurring at night, but without a standard activity. They move with the flood pulse of river, 1.1 and 5.2 km/day in high and low water season, respectively. The farthest distance recorded from the release site was 110km, but no difference was observed in home-range of males (581km²) and females (586km²). During high water, manatees spent 67% inside flooded forest (várzea) with abundant food, and low water, 73% of encounters were in deeper places of the Purus channel. Although kept together in captivity, after release, they spent 98% of the time separately, corroborating on the solitary behavior of the species. Interactions with wild manatees were recorded. The inclusion of the semi-captivity stage in the protocol showed 100% success for the manatee survival. The selection of suitable habitats, the survival of the individuals over at least one complete flood pulse and the absence of contact with humans are strong success indicators. Additionally, after eight months released, two manatees were recaptured, showing increased body size and weight. The difficulties and lessons learned are crucial to improve the management and to propose guidelines for the conservation of this endemic species and its habitats, involving local people.

POSTERS

Does the Antillean manatee *Trichechus manatus manatus* act as a vegetation dispersal agent?

Katerin Arévalo-González^{1,2}, Nataly Castelblanco-Martínez^{2,3}, Arturo Serrano¹

(1) Facultad de Ciencias Biológicas y Agropecuarias, Universidad Veracruzana

(2) Fundación Internacional para la Naturaleza y la Sustentabilidad - FINS

(3) Consejo Nacional de Ciencia y Tecnología/Universidad de Quintana Roo

Corresponding author: katarevalo@gmail.com

It has been reported that dugongs and manatees have an important role stimulating primary production, vegetative reproduction and seed dispersal of the plants they feed on, mainly through the fragmentation of vegetative structures during foraging, and the digging up of reproductive structures. Recently, seed intake and dispersal by dugongs and green turtles was verified, demonstrating that seeds can be transported over large distances and then excreted under optimum conditions to germinate. The objective of this research was to evaluate the potential role of the Antillean manatee as a dispersal agent of plant species associated with aquatic ecosystems. Between January and June of 2018, we made boat trips to collect feces of wild manatees in the Rio Hondo (n = 17) and Bahía Chetumal (n = 3), on the border between Mexico and Belize. The samples were stored separately and frozen at -10 ° C. Further, a macro and microhistological revision of the samples was carried out by using a binocular micro-estereoscopy (2X magnification). We recorded whole and fragmented seeds together with flowers and mollusks. The findings were photographed, separated and frozen for further identification. In total, 40% of the samples presented seeds, totalizing 12 seeds of three species of terrestrial dicotyledons. Eighty-seven percent of the seeds were found in the Rio Hondo. Although it is still necessary to determine the species of the seeds found and to corroborate their viability, the presence of whole seeds in the feces suggests that manatees could be helping the dispersion of some of the plant species they feed on, particularly dicotyledons.

New threats for the conservation of sirenians in Colombia: presence of potential zoonotic parasites in wild manatees

Katerin Arévalo-González^{1,2,3}, Juan Vélez^{4,5}, Joerg Hirzmann⁵, M.K. Lange⁵, Susana Caballero⁶, Jenny Chaparro-Gutiérrez⁴, Anja Taubert⁵, Carlos Herмосilla⁵

(1) Fundación Internacional para la Naturaleza y Sustentabilidad - FINS

(2) Cabildo Verde Sabana de Torres

(3) Facultad de Ciencias Biológicas y Agropecuarias, Universidad Veracruzana

(4) Grupo CIBAV, Escuela de Medicina Veterinaria, Universidad de Antioquia

(5) Instituto de Parasitología, Justus Liebig University Giessen

(6) Laboratorio de Ecología Molecular de Vertebrados Acuáticos - LEMVA, Universidad de Los Andes

Corresponding author: katarevalo@gmail.com

The Antillean manatee (*Trichechus manatus manatus*) is threatened mainly by hunting, incidental capture in fishing nets, reduction and destruction of its habitat. Several localities where the manatee inhabits have shown high levels of anthropogenic contamination of different types, in Colombia, threatening seriously the health of animal and human populations. Due to the lack of

knowledge about manatee parasites and the lack of epidemiological studies in the country, this survey was carried out, performing a coprological and phylogenetic analysis of the gastrointestinal parasites of West Indian manatees in Colombia. For this, 130 boat trips were made in the San Juan River and La Juana Swamp, Carare River basin, Santander, at different hydroclimatic seasons, between 2015-2016, searching for manatee feces along the banks and floating patches. Additionally, fecal samples of four rescued manatees were taken in 2017. These four manatees were rescued by the OMACHA Foundation and the CVS in the Sinú river basin, Córdoba. The samples were labeled, preserved in 70% alcohol and posteriorly analyzed by means of the sodium-acetic acid-formalin (SAF), sedimentation and flotation techniques. Moreover, carbol-fuchsin smears and specific copro-ELISAs for the detection of *Giardia* sp. and *Cryptosporidium* sp. antigens were performed. In general, 73% of 69 fecal samples were positive for at least one parasite, five species of protozoa and two metazoans were detected: *Eimeria nodulosa* (46.5%), two indeterminate species of *Eimeria* (42.4%), *Chiorchis fabaceus* (35.6%), *Entamoeba* sp. (14%), *Nudacotyle undicola* (4.1%) and *Giardia* sp. (1.4%). In addition, partial sequences of ribosomal genes of the trematodes and coccidian parasites were amplified by PCR, sequenced and used to infer their phylogenetic relationships. This is the first report on infections by *Entamoeba* sp., *Eimeria* spp. and *N. undicola* in Antillean manatees, and the first molecular analysis of manatee gastrointestinal flukes and coccidia. These results highlight the need to continue the monitoring and study of the parasitic agents and the health of the wild manatee populations, which are a fundamental sentinel species for public health in Colombia.

Grazing potential of a marine protected area for the release of marine manatees in Brazil

Alexandra Fernandes Costa^{1,2}, Matheus Felipe de Souza Dias da Silva³, Maria Danise de Oliveira Alves³, Iran Campello Normande¹, Paula Regina Fortunato do Nascimento³

(1) ICMBio Costa dos Corais, Instituto Chico Mendes de Conservação da Biodiversidade

(2) Projeto Áreas Marinhas e Costeiras Protegidas – GEF Mar

(3) Departamento de Biologia, Faculdade Frassinetti do Recife - FAFIRE

Corresponding author: alexandrafernadescosta@gmail.com

Marine Protected Areas are important tools for the conservation of endangered species. In Brazil, 36 Antillean manatees (*Trichechus manatus*) were released in the Costa dos Corais Environmental Protection Area (APACC - ICMBio Costa dos Corais) after a long period of rehabilitation in captivity. This species is considered an opportunistic herbivore, feeding on macroalgae, marine angiosperms and macrophytes. Food resources that occur throughout this Conservation Unit are essential for the evaluation of its effectiveness as a site for the release of newly rehabilitated manatees. The objective of this research was therefore to assess the richness of the marine vegetation present at the beaches where manatees occur. The methodology used was an intensive survey of plant species at low tide, at beaches where manatees occur, according to information obtained from fishermen, the APACC team and *in situ* observations. When necessary, free dives were carried out, with photographic and video recordings. Each site was georeferenced using handheld GPS map Garmin 60CSx. The collected samples were sorted after collection, washed for sediment removal and stored in glass pots in 4% formaldehyde solution for posterior laboratory analysis and species identification using specialized bibliography. A total of 11 beaches were surveyed in four days, with 71 taxa recorded, out of which 70 are macroalgae species and 1 marine angiosperm species, *Halodule wrightii* Ascherson (1868). Among the macroalgae species,

the most representative taxonomic group was Rhodophyta (n= 40; 57, 14%), followed by Chlorophyta (n= 16; 22, 86%) and Ochrophyta (n= 14; 20%). Meadows of *H. wrightii*, popularly known as shoal grass, were found in seven localities, in association with algae, mostly epiphytes. The results of this study demonstrate that the APACC region presents a range of marine vegetation species that are potentially grazed on by manatees, with emphasis on plant species such as shoal grass and red algae that are described in the literature as important food resources for manatees. New efforts should be directed towards determining the productivity through biomass assessment as well as seasonal monitoring of this food supply, with the objective to evaluate the support capacity of the environment all year round for the continuity of the manatee reintroduction program of the State of Alagoas.

Feeding success in the release process of a Antillean manatee (*Trichechus manatus*) in the northeast of Brazil

Alexandra Fernandes Costa^{1,2}, Fernanda Loffler Niemeyer Attademo^{2,3,4}, Catarina Flor⁵, Iara Braga Sommer⁴, Iran Campello Normande¹.

(1) ICMBio Costa dos Corais, Instituto Chico Mendes de Conservação da Biodiversidade

(2) Projeto Áreas Marinhas e Costeiras Protegidas – GEF Mar

(3) Projeto Cetáceos da Costa Branca, Universidade Estadual do Rio Grande do Norte

(4) Centro Nacional de Pesquisa e Conservação de Biodiversidade Marinha do Nordeste/ICMBio

(5) Programa de Voluntariado ICMBio

Corresponding author: alexandrafernadescosta@gmail.com

The Antillean manatee (*Trichechus manatus*) Reintroduction Program of Brazil has reintroduced 47 animals back to nature since 1994, in the states of Alagoas and Paraíba, Northeast of Brazil. The criteria used to select an animal for release include general health, acceptance of natural food items and acclimatization to the environment. The present study had the objective to analyse the feeding behaviour pre and post release of a marine manatee individual reintroduced in Alagoas State. Ivi is a female manatee rescued in Rio Grande do Norte State in December 2012 and transferred to ICMBio, in Pernambuco State where she remained in captivity in artificial swimming pools for 3 years and 9 months. In October 2016, Ivi was translocated to the acclimatization captivity area in the Tatuamunha River, where she received vegetables and foliage daily. In March 2018, she was isolated from the other animals and began to receive natural food items (*Sargassum* sp. and *Rupia maritima*) placed in submerged pipes. Ivi's feeding behaviour was monitored daily following standardized ethograms for manatees using the "all occurrences" method, with a total observation effort of 25 hours. The most frequent behaviour observed was slow displacement (n= 134; 35.4%), followed by feeding at the bottom (n= 66, 17.5%) and resting (n= 50, 13.2%). Ivi was released in the natural environment on 5th of April 2018 and continues to be monitored via satellite telemetry, VHF radio, in addition to presential observations. After release, Ivi's preferred sites were initially the Tatuamunha River (n= 437, 68%) and later the Manguaba River (n= 84; 13%), the latter with greater food supplies. The most frequent behavioural pattern observed was displacement (slow, fast, exploratory, n= 294, 47.27%); with total observation effort of 153.7 hours. Ivi has been observed interacting with other manatees in areas used both by reintroduced and native animals. During presential observations, Ivi has been seen feeding on *Eichornia* sp., mangrove leaves, as well as on shoal grass (*Halodule wrightii*). Continuous monitoring indicates that this animal demonstrates to be well adapted to the

environment, both in relation to the search for available food items, highlighting the importance of providing natural food before release, and in socializing with other manatees.

Growth rate of Antillean manatee vibrissae (*Trichechus manatus manatus* Linnaeus, 1758): a parameter to identify possible spatio-temporal variations in feeding habits

Natalia Garcés Cuartas¹, Carlos Alberto Niño Torres^{1,2}, Nataly Castelblanco Martínez^{1,2,3}

(1) Universidad de Quintana Roo, México.

(2) Fundación Internacional para la Naturaleza y la Sostenibilidad - FINS

(3) Consejo Nacional de Ciencia y Tecnología/Universidad de Quintana Roo

Corresponding author: garcesnatalia@gmail.com

Knowing growth rate of dermic structures such hair, vibrissae or whiskers, has been proved useful to clarify trophic aspects from population, community or ecosystem, in different temporal scales, by analyzing possible changes in chemical composition (stable isotopes, fatty acids and others) from the tissues. However, this information is still unknown for sirenians. During this study, the vibrissae growth rate was determined for 13 Antillean manatees kept in captivity (nine males and four females). An approximate area of 15 cm² was delineated with chalk in the upper part of the oral disc of each individual. As many vibrissae as possible were cut from the base, with the help of fine-tipped surgical scissors. This procedure was implemented every 14 days, for three months (March-May 2018), for a total of five repetitions per individual. The collected vibrissae were placed in Petri dishes, digitally photographed with a 5.0 MP video microscope camera, in a 2X magnification binocular stereoscopic microscope, for further measuring using the software ImageJ. The average growth rate was 0.54 ± 0.07 mm/day. Significant differences were found between sexes (U Test, $p < 0.05$) (females = 0.62 ± 0.07 mm / day, males = 0.50 ± 0.04 mm / day) but not between age classes (U Test, $p > 0.05$) (young= 0.59 ± 0.08 mm/day, adult= 0.52 ± 0.07 mm/day). Our results suggest that females have higher VGR than males, coinciding with Cerling et al. (2006) who found significant differences in elephant tail hair growth rate between females and males (0.81 ± 0.13 mm/day and 0.55 ± 0.11 mm/day, respectively). This information will be used in future studies of stable isotope analysis as a parameter to identify possible spatio-temporal variations in the feeding habits of wild Antillean manatees.

Veterinary case: A Caribbean manatee calf (*Trichechus manatus manatus*) rescued in the Orinoco River Delta, Venezuela

Carlos Javier Silva¹, Leonel Ovalle¹, Nataly Castelblanco-Martínez² y Katherine Morales³

(1) Bararida Zoological and Botanical Park

(2) Consejo Nacional de Ciencia y Tecnología/ Quintana Roo University

(3) Free exercise of the profession

Corresponding author: cjsvet@gmail.com

A female calf manatee (*Trichechus manatus manatus*) was captured on May 5 (2017) by a fisherman from the Warao ethnic group using harpoon. The location was Caño Guacajara (Latitude: 9.43229 Longitude: - 62.2218 UTM / Latitude 9 ° 25'56.03 "N Longitude 62 ° 13'16.90" W) Delta Amacuro state, Venezuela. On May 12, 2017, the calf was voluntarily delivered to authorities and then examined by the veterinary staff. A deep wound measuring 3.5 cm in depth

and 4 cm in length was detected in the calf's right shoulder and treated with oxygenated water and iodine soap solution. Inside the wound was placed a combination of iodine soap solution and Nitrofurazone. The calf initially received 2.7 ml of oxytetracycline 5% intramuscular. Morphometry was performed, estimating 3 weeks of age due to malnutrition. The existing dehydration was corrected by the administration of 150 ml of 0.9% NaCl VO through a No. 14 probe every 2.5 hours. At peduncle level were administered via intramuscular 210 mg of Enrofloxacin 5% and 2 of B complex vitamins. A daily treatment protocol was established twice a day. The calf was moved to Barquisimeto, Lara State, on a Bae jetstream 32 plane. On arrival, radiographs and ultrasound were performed, discarding fracture of ribs and pectoral fin bones on right side. The calf was moved to the PZBB, where blood samples were taken and oral hydration continued. Due to the absence of the suction reflex, the supply of milk substitutes was initiated using a probe. Bottle-feeding attempts were gradually made and accepted little by little. Despite the weight gain, the calf presented symptoms such as diarrhea and colic which were treated with the few drugs available in the country. After a week of having presented a hemorrhagic diarrhea, on July 4 (2017), the calf died. The necropsy confirmed macroscopically an enteric hemorrhagic cadre.

**Analysis of the local knowledge of Antillean manatee (*Trichechus manatus manatus*)
at Conil lagoon, Area de Protección de Flora y Fauna Yum Balam,
Quintana Roo, México.**

Carolina Velázquez-Mendoza¹, Nataly Castelblanco-Martínez², Fernando Córdova-Tapia³

(1) Facultad de Ciencias, Universidad Nacional Autónoma de México, Facultad de Ciencias, Universidad Nacional Autónoma de México

(2) Consejo Nacional de Ciencia y Tecnología/Universidad de Quintana Roo/ Fundación Internacional para la Naturaleza y la Sustentabilidad - FINS

(3) Centro de Investigación en Biodiversidad y Conservación, Universidad Autónoma del Estado de Morelos

Corresponding author: caro.vm8@gmail.com

The Antillean manatee (*Trichechus m. manatus*) plays an important role in the economy and culture of villages near the Caribbean Sea, where the manatee was considered an important source of resources, particularly meat, fat, skin and bones. In Mexico, manatee overexploitation and habitat loss have fragmented its distribution. The Conil Lagoon (Quintana Roo) belongs to the 'Area de Protección de Flora y Fauna' Yum Balam, a Natural Protected Area without a program of management since its decree in 1994. In this area, manatees have been poorly studied, but in recent years manatee sightings have become more frequent as well as the cases of dead manatees. The objective of this research was to describe the knowledge of the people living in the surroundings of the Conil Lagoon, about the presence of the manatee, its behavior and main threats. With this aim, 59 interviews were conducted in the near communities of Holbox and Chiquilá. The reported sightings were located mostly along the entire Lagoon and some of them in Yalikín River, a tributary of the lagoon. Furthermore, 37% of the interviewees consider fishing nets as the main threat to manatees. Regarding the frequency of sightings, 44% indicates a decrease but 36% pointed out the opposite. Some interviewees described the manatee's capture and sale methods. The manatee meat was cooked in piñón or was preserved in brine, the fat of the animal was also used to cook other dishes. Another use of manatee skin was as a cane. The collected information in this work could be used to develop strategies for manatee conservation in

the area. Local knowledge of the species is fundamental to develop studies of species that are difficult to detect. Also, it is important to rescue the cultural meaning of manatees for fishermen village in the Caribbean.

Environmental education in the Peruvian Amazon for the conservation of the Amazonian manatí *Trichechus inunguis* (Sirenia: Trichechidae)

Cristian Vélez Ramirez¹, Juan Sánchez Babilonia¹, Luis Javier Velásquez-Varela¹, Solange Garcia¹, Luz Salas¹, Carlos Perea¹, Daryl Lee-Richardson¹ & Luis Sigler¹

(1) Asociación para la Conservación de la Biodiversidad Amazónica – Dallas World Aquarium Zoo
Corresponding author: juan.babilonia@gmail.com

The Environmental Education Area of the Amazon Rescue Center – CREA aims to raise awareness regarding to the conservation of endangered wildlife species in the Peruvian Amazon by using different strategies. The program was launched in 2010, at that time was the topic was focused exclusively on the Amazonian manatee conservation, a vulnerable and unknown species. Through presentation in schools we spread the word about biology, conservation status and threats of this species, in that year we reached out more than 30,000 students from primary and secondary level. We complemented the presentations with field tours at CREA, manatees became from being an unknown specie to a symbol of the conservation in the Amazon. The following years we focused on working with villages, especially the ones nearby the release areas. Through workshops, puppet shows, presentation and other tools, we have raised the awareness regarding to role that play in nature not only manatees, but other wildlife. In addition, we promoted the managements plans as responsible way to use the natural resources. In the recent years, we have used our methodology 'Interpretation of Nature' as a main tool for our workshops, it is based on the use of the sense to create connection and interaction with nature. The core of our program are the EMOTIONS, we want that children to generate positive emotions with nature, we found out that the best way to learn are through games. We use the forest we have at CREA as a living classroom and playground to discover and fall in love with the nature and generate awareness regarding the Amazon conservation. So far, we have worked with nearly 80,000 students of Iquitos city and Amazonian villages, they are now our partners in conservation.

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Dr. James A. Powell, Executive Director
Clearwater Marine Aquarium Research Institute
249 Windward Passage
Clearwater, FL 33767
Email: jpowell@cmaquarium.org
Phone (cell): 941.661.2941
<http://www.cmaresearchinstitute.org>

NOTE FROM THE EDITORS: We would like to thank all of those who have contributed articles for *Sirenews*. On occasion, we have taken the liberty to make minor edits in an effort to accommodate our formatting style and provide clarity for our readership. However, we have restrained from making all grammatical edits in an effort to preserve the original intent of the submitting author.



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