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TRIBUTE TO DR. KANJANA ADULYANUKOSOL



On January 10, 2015, Dr. Kanjana Adulyanukosol passed away from liver cancer. Kanjana was the foremost dugong scientist in Thailand. In 1986, she began working as a marine biologist at the Phuket Marine Biological Center, at first studying algae. She began to study dugongs in 1988, and worked tirelessly to bring awareness of dugongs and their conservation to Thailand and beyond. In 1997, Kanjana conducted the first aerial survey for dugongs along the Andaman Coast of Thailand. Through her years as a scientist, then a Director for the Thai Department of Marine and Coastal Resources, she published over 20 papers and books on dugongs and marine mammals of

Thailand, including an extensive field guide, bringing Thai marine mammal science into the international marine mammal community for the first time. Her dedication to conducting top-quality scientific inquiry is an example to us all, as is Dr. Kanjana's commitment to spreading knowledge about marine mammals and their conservation to local communities. Her four children's picture books about dugongs and Bryde's whales have been published in Thai, English, Japanese and Braille.

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

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Dr. Kanjana was a wonderful and generous woman who inspired, mentored and challenged many of us, and became our lifelong friend. Her books and papers are an impressive scientific contribution, while her exhibits, posters and famous t-shirts became lessons and examples in the importance of reaching out beyond the scientific community. Her pioneering research on Bryde's whales in the upper Gulf of Thailand has brought us a wealth of valuable knowledge. She tirelessly communicated her message of marine mammal conservation to countless local communities. For myself and many others, to have known and loved Kanjana has shaped our lives and our science. To continue within her legacy will be the greatest honor. - **Ellen Hines**



BRAZILIAN MANATEES FOR GUADELOUPE

As has been publicized in other issues of *Sirenews*, the Parc National de Guadeloupe, in Guadeloupe (an Antillean Department of France) has been planning to conduct an experiment on reintroduction of manatees into its waters. Approximately a year ago, during Biodiversity Day, the Brazilian Secretary of Environment announced the transfer of five West Indian manatees (*Trichechus manatus*) from the country to this project, and the possible transport is planned to occur within the next few weeks. The species was considered, until last year, the most endangered species of aquatic mammal in Brazil, and listed as “critically endangered” in the country. The total population along the Brazilian coast is estimated to be 500 individuals, with a discontinuous and patchy distribution, suffering several anthropogenic threats and having been extirpated from three states in the past, due to hunting.

The specimens offered for the experiment would be wild manatees rescued as calves and rehabilitated, and presently captive at Centro Mamíferos Aquáticos (Aquatic Mammal Center) of ICMBio (Chico Mendes Institute for Biodiversity Conservation, an agency of the Secretary of Environment) in Pernambuco on the northeastern coast. Legal permits and a CITES export permit have been issued by IBAMA (Brazilian Institute for the Environment and Renewable Natural Resources), the Administrative Authority in the country for those matters. Unfortunately, this governmental decision was made without consultation with most of the experts who have been working alongside, and by invitation from the government, on the Action Plan for the species in Brazil, its Advisory Group and the Brazilian Aquatic Mammal Stranding Network (both National and North and Northeast regional branches). Some of those experts are members of the IUCN Sirenian Specialist Group (SSG) and SSG South American Region.

The situation has generated a lot of discomfort and concern among those experts and environmentalists, who have been trying to bring about a dialogue with the government, without success. We believe the contribution of any individual, both in the wild and captive, is extremely valuable for the recovery of the species in Brazil. Four of the animals targeted for export are adults who have proven good breeders. These animals are important for conducting research and conservation actions with the species in Brazil, and could be maintained in captivity in a natural setting, as part of a breeding and release or reintroduction program in the country, as has been done with several other animals over time. The fifth animal is a male juvenile suitable to be released back into the wild.

Together with the risk for and loss to Brazilian populations, our main arguments against this transfer are (i) potential health issues, as manatees from this region might introduce new pathogens to the Guadeloupe area; (ii) genetic differentiation and adaptive divergence of the Guianas and Brazilian clade, that separated from the Antillean clade (including Florida manatees) over 100,000 years ago, deeming them inadequate for reintroduction in the Caribbean region; (iii) possible presence of hybrids between Antillean and Amazonian manatees in the populations of northern South America; and (iv) the potential of interbreeding with other manatees around Guadeloupe, which generates a risk of outbreeding depression in populations near the reintroduction site.

The Brazilian government has taken important steps towards the conservation of manatees over the past 30 years, supported by the partnership of several non-profit institutions and universities. We believe Brazil should maintain this focus and interest in preserving and rescuing its endangered species, using scientific and conservation practice knowledge as powerful arguments to protect its national wildlife. Our arguments to avoid sending the animals to Guadeloupe should not be interpreted as a simple measure against a unilateral decision of the government, but rather a legitimate action of the society in favor of biodiversity conservation in our country. -**Amaral, RS** (IFAM); **Borges, JCG** (FMA, IUCN-SSG-SA); **Campos, AA** (Aquasis); **Carvalho, VL** (Aquasis); **Choi-Lima, KF** (Aquasis); **da Silva, VMF** (INPA, AMPA); **Gravena, W** (INPA, UFAM, AMPA); **Lazzarini, SM** (CPPMA, AMPA); **Lima, DS** (IEPA, IDSM); **Lima, RE** (MPEG); **Marmontel, M** (IDSM, IUCN-SSG, IUCN-SSG-SA); **Meirelles, ACO** (Aquasis, IUCN-SSG-SA); **Rosas, FCW** (INPA); **Silva, CPN** (Aquasis); **Souza, DA** (INPA, AMPA, IUCN-SSG-SA); **Santos, FR** (UFMG); **Silva, JCF** (AMPA); **Vergara-Parente, J** (FMA)

REMINDER: SIRENEWS DISTRIBUTION LIST

We are developing a distribution list for those interested in *Sirenews*. If you would like to receive copies of *Sirenews* via email each April and October please send your contact information (name, affiliation, email address) to ctaylor@sea2shore.org.

REMINDER: WORLD MANATEE DAY/MONTH - SEPTEMBER 7th

An international day for education campaigns is of great importance for manatee conservation. It could bring wider attention to the species than when organized on different dates by each country. We previously suggested a World Manatee Day/Month in September, particularly the 7th as it has already been celebrated in several other countries (Mexico, Puerto Rico, Colombia, Belize) for several years.

We would like to renew the invitation to raise awareness about the manatee, and also dugong, to all colleagues in the world working with these species. We suggest organizing activities that involve local people, fishermen communities and children but also people from different contexts of life, and to link those activities with those from other countries highlighting the importance of *Sirenia* conservation around the world. Several colleagues already have educational materials in various languages that they are happy to share with interested people.

The last invitation was sent on very short notice to organize events but we hope that this reminder will allow enough time for all interested parties to organize activities in September. We encourage individuals and organizations to let the *Sirenia* community know about the events they organize to promote collaboration and interaction with other countries. We wish to thank all of our

colleagues who already celebrate this important day for manatee conservation, and the ones who will celebrate in 2015 and in the future. -**Coralie Nourisson**^{1,2} and **Nataly Castelblanco-Martínez**^{3,4} (Coralie.nourisson@gmail.com; ¹CIBIO - Research Center in Biodiversity and Genetic Resources, University of Porto. Rua Padre Armando Quintas, 4485-661 Vairão, Portugal; ²Geomare AC, Mazatlán, Sinaloa, México; ³Turneffe Atoll Sustainability Association; ⁴Fundación Macuáticos Colombia).

IUCN SIRENIA SPECIALIST GROUP - SOUTH AMERICAN REGION MEETS IN CARTAGENA

On November 29, 2014, during the 16th Meeting of Specialists on Aquatic Mammals of South America (SOLAMAC), in Cartagena de Indias, Colombia, regional co-chairs of the Sirenia Specialist Group for South America, Dr. Nataly Castelblanco Martínez (Oceanic Society) and Dr. Miriam Marmontel (Instituto Mamirauá) with collaboration from Fundación Macuáticos Colombia, Fundación Natütama and Fundación Omacha, organized the first meeting of the IUCN Sirenia Specialist Group (SSG), South American Region. The event was supported by Yaqu Pacha, the Parc Zoologique de Paris, Save the Manatee Club and Cabildo Verde.

The goal was to enhance the coordination of regional manatee conservation efforts in South America. Members presented updates on the current activities and projects carried out for the two species of manatees (*Trichechus manatus* and *T. inunguis*) in South America, defined gaps in conservation and research, debated current topics that required specific positions by the group, and discussed strategies to address the problem of conservation of manatees in South America.

Brazil, Colombia, Peru, and Venezuela were represented in the meeting, which also included Dr. Benjamín Morales, Co-Chair of the SSG, Dr. John Reynolds (Mote Marine Lab) and Dr. Lorenzo Von Fersen (Yaqu Pacha).



Participants of the first meeting of the IUCN Sirenia Specialist Group (SSG), South American Region

Specific activities included presentations on the structure and functioning of the SSG (Benjamín Morales), studbook of South American manatees (Lorenzo von Fersen), genetics of South American manatees (Dr. Susana Caballero), working group discussions on conservation status and gaps in manatee

knowledge and status of manatees in captivity and rehabilitation, and a debate on manatee reintroduction in Guadeloupe Island.

Results of the meeting:

- Preliminary results on conservation status and gaps in manatee knowledge for South America were compiled in tables, which are still being discussed by email within the group.
- We discussed and summarized the number of individuals maintained in captivity for each country, as well as the number of rehabilitation centers, zoos, improvised facilities or semi captivity (soft release) places containing manatees.
- Brazilian experts present at the meeting demonstrated their concern and doubts about the Guadeloupe Reintroduction Project.

Acknowledgements: We especially thank Katherine Arévalo for logistical support.

-**Miriam Marmontel** (marmontel@mamiraua.org.br) and **Nataly Castelblanco-Martínez** (castelblanco.nataly@gmail.com)

FIRST LATIN AMERICAN SYMPOSIUM FOR MANATEE RESEARCH AND CONSERVATION (SILAMA) 1-4 DECEMBER 2014



On 1-4 December 2014, during the 16th Meeting of Specialists on Aquatic Mammals of South America, in Cartagena, Colombia, the First Latin American Symposium for Manatee Research and Conservation (SILAMA) was convened, with support from Yaqu Pacha, the Parc Zoologique de Paris, Save the Manatee Club and Cabildo Verde.

The objectives were to share experiences on advances in both *in situ* and *ex situ* manatee management, discuss innovative methodological approaches that address the current needs of research and conservation, and promote international cooperation for the conservation of manatees in Latin America. Research results from Colombia, Brazil, Venezuela, Peru, Belize, Mexico and French Guyana were presented through 28 oral presentations, 15 video-presentations and one invited lecture (Dr. John Reynolds).

The main topics presented and discussed at the SILAMA were:

1. Conservation state, abundance and distribution of manatees in Belize (areas of Bacalar Chico, Turneffe Atoll and Port of Honduras), Brazil (Bacia Potiguar), French Guyana, and Colombia (Puerto Nariño, Rio Lebrija).
2. Methods for monitoring and detection of manatees: side-scan sonar, aerial surveys, captures and telemetry, passive and active acoustics and interviews.

3. Techniques for describing movements and behavior of manatees (bioacoustics, motion sensors, etc).
4. Advances in manatee conservation programs involving local community, environmental education campaigns, the engagement of local researchers, and play as an educational strategy.
5. Challenges for manatee conservation under particular scenarios such as the presence of armed groups (Colombia), increased tourism (Mexico), or fishing activities (Belem, Brazil).
6. Recurring conservation issues as the stranding of calves on the northeastern coast of Brazil.
7. Proposal of alternative conservation strategies, such as manatee reintroduction in areas where it has been extirpated (Case Guadeloupe, France).
8. Advances in the management of captive manatees: genealogical records, pedigree studies (CMA, Brazil); improved milk formula for calves in rehabilitation programs, etc.
9. Advances in the understanding of the biology of the species (estimation of sexual maturity, physiology, intestinal biota, microbiota in cavities, infections).
10. Results of long-term programs of rescue, rehabilitation and release of manatees (Brazil, Colombia, Peru).
11. Advances in the understanding of genetics, phylogeography, genetic biodiversity and hybridization processes in Latin America.

Recommendations

- Given the increasing incidence of oil and mining in areas where manatees are distributed in Latin America, it was proposed to create a network that addresses this topic at regional levels, in order to discuss strategies to prevent or mitigate the negative consequences of those industrial activities.
- The exchange of experiences among researchers and conservationists from different nations is proposed to fill gaps in training on different topics such as implementation of conservation strategies (environmental education, integration of the local community) and use of research tools and management.
- It was proposed to develop training workshops that allow researchers to learn new techniques, for instance, the use and proper interpretation of side-scan sonar.
- SILAMA continuity is proposed for the next Meeting of Specialists on Aquatic Mammals of South America, in order to follow up on the different areas of knowledge and processes of manatee conservation at the regional level.

-**Nataly Castelblanco-Martínez** (castelblanco.nataly@gmail.com) and **Miriam Marmontel** (marmontel@mamiraua.org.br)

LOCAL NEWS

BELIZE

Baseline population study of West Indian manatee in the Port Honduras Marine Reserve (PHMR), Belize. Port Honduras Marine Reserve (PHMR) is located in southern Belize and covers an area of 414 km². The Toledo Institute for Development and Environment (TIDE) has an agreement with the Belize Fisheries Department to co-manage PHMR. Belize has the largest population of Antillean manatee by country in its range (O'Shea and Salisbury, 1991; Quintana-Rizzo and Reynolds, 2010), which is listed as endangered on the IUCN Red List (Self-Sullivan y Mignucci-Giannoni, 2008) and protected under Belize's Wildlife Protection Act of 1981. Manatees face the same threats throughout their range, which include habitat loss and degradation, boat strikes, pollution, human disturbance, natural disasters and, to

a lesser extent, hunting (Quintana-Rizzo y Reynolds, 2010). However, PHMR confronts a potentially new threat: potential fossil fuel exploration and exploitation. Providence Energy Group (PEG) has acquired the right to explore for oil during an eight year period in 250 km² in PHMR. If petroleum resources are found, PEG will have exploitation rights for over 25 years. US Capital has exploration and exploitation rights in Payne's Creek National Park (PCNP), which is adjacent to PHMR and also managed by TIDE.

Based on this new threat, TIDE and El Colegio de la Frontera Sur (Ecosur) developed a manatee baseline population study in PHMR and PCNP in order to obtain demographic and ecological information on the manatee population. The objectives of this project were to analyze the spatial distribution, relative abundance, mother and calf presence and areas most used by manatees in selected zones of PHMR and PCNP; and to establish management recommendations to minimize impacts on survivorship of manatees in PHMR and PCNP.

Throughout May 2014, interviews were conducted with fishermen and tour guides from the three stakeholder communities adjacent to PHMR, namely Monkey River, Punta Negra and Punta Gorda, to obtain recommendations on appropriate zone selection for the study (Figure 1). These stakeholders confirmed the previously selected study zones (Zone 1-Deep River, Zone 2-the Cayes and Zone 3-the PCNP wetlands) based on previous aerial surveys carried out in Belize. The users also recommended adding two more zones, Zones 4 and 5, in the areas of Golden Stream River and Rio Grande River, respectively.



Figure 1. Transi Gonzalez Medina, assisted by TIDE intern Kelci Miler of Texas A&M University, during interviews with Mr. Sonny Garbutt (left) and Mr. Richard Pitts (right), chairman of Monkey River Village, in Monkey River Village.

Fieldwork was carried out with the support of rangers based at TIDE's three ranger stations (PHMR, PCNP and TIDE Protected Private Lands). A total of 65 boat surveys were carried out between June 9 and October 3, 2014 with 121 manatees sighted. Groups with a maximum of three individuals were sighted in Deep River (zone 1) and Golden Stream (zone 4). PCNP (zone 3) had the largest groups (3-5 individuals) and showed the highest relative abundance index (Figure 2). The study revealed that 90% of the manatees sighted were adults and close to 10% were calves. Almost 60% of the calves were sighted in PCNP (zone 3). Manatees were mostly found when they were feeding or resting. Zones 1 and 3 showed the highest percentage of feeding, 19% of the total number for each zone. Zone 3 was observed to be mainly used for resting. Only one group of three individuals was sighted socializing in Zones 1 and the area with most manatee movement was the mouth of PCNP. Additionally, the

information gathered by PHMR rangers about boat traffic was used in contrast with the manatee sightings areas to analyze the impact of that activity.

The main conclusion of this study was that the areas with the highest index of relative abundance, PCNP (zone 3) and Deep River (zone 1), and the zone with greatest presence of females with calf, zone 3, correspond with both oil company concessions (Figure 3). It is expected that the oil activity could have an impact on species reproduction. Among other conclusions, PCNP is very important for manatee feeding, resting and reproduction. There is a higher presence of manatees in the coastal areas (Deep River, PCNP and Golden Stream). Females with calves are associated with fluvial lagoon systems and there is a constant movement between PCNP and Deep River. The manatee population in PHMR and PCNP can be considered “healthy” since around 10% of the manatees sighted were calves.

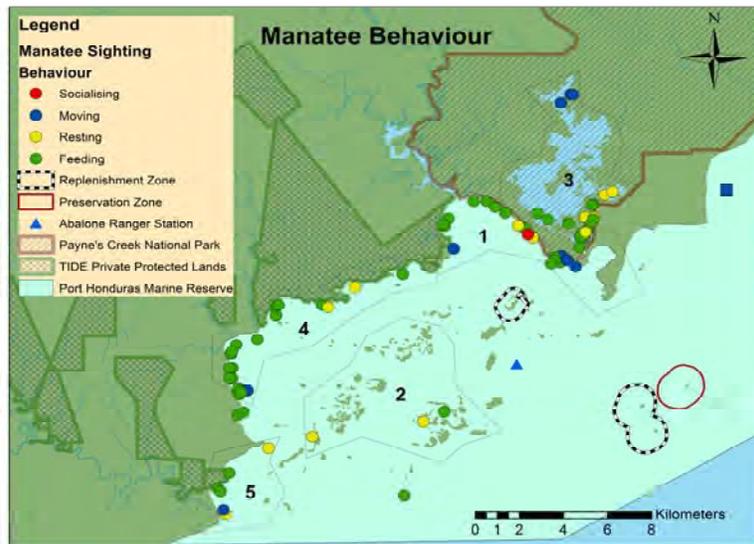


Figure 2. Manatee behaviour distribution map; 1=Deep River; 2= Cayes; 3=PCNP; 4=Golden Stream; 5= Rio Grande.

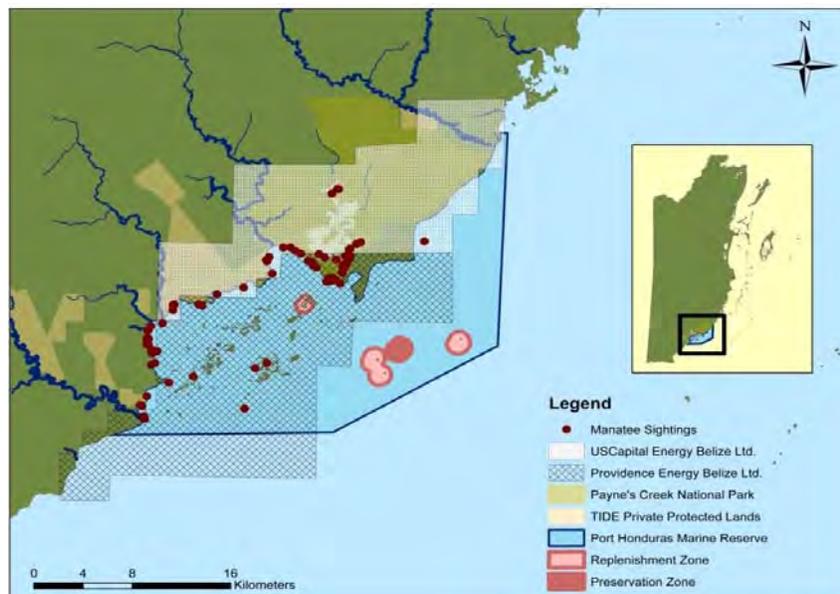


Figure 3. Confluence of concession and manatee presence

The recommendations derived from this study are:

- To use this information to reconsider the concession areas in PHMR and PCNP
- Exclude zones 1 and 3 from the potential oil activity area
- Take the advice from environmental agencies and conservation organizations (such as TIDE) into consideration if oil exploration and exploitation activities will be inevitably performed.
- An assessment of seagrass and mangrove coverage is needed to evaluate the status of manatee habitats and the possible effect that the new activity may have on them.
- Place new signage to reduce the speed of boats in the priority areas identified in order to avoid possible collisions originated by the potential increase of boat presence in PHMR and PCNP
- It is important to support a manatee photo-ID database, specifically improving effort in the dry season. Also, this ID database can support future manatee studies.

Additionally, an initiative of community collaboration was started during the development of this project. Some users of the reserve agreed to collect data about manatee sightings while performing their activities in PHMR. This action will generate more information about the species in the reserve and help to promote environmental awareness. -**Tránsito Gonzalez Medina** (Master's student in El Colegio de la Frontera Sur (Ecosur)-Université de Sherbrooke), **Benjamín Morales Vela** (Ecosur), **James Foley** (Science Director of Toledo Institute for Development and Environment-TIDE)

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BRAZIL

Population structure and hybridization between West Indian and Amazonian manatees using genetic markers and cytogenetic karyotyping. In Brazil, both the West Indian and Amazonian manatees are present. The Amazonian manatee is generally distributed from the headwaters to the mouth of the Amazon River. West Indian manatees are also present at the mouth of the Amazon River, but are primarily distributed along the coast. The complex estuary at the mouth of the Amazon River, with

several islands, is a sympatric area for the two species and it is believed that hybridization between them may occur there.

Using a combination of 16 microsatellites markers, mtDNA control region, and cytogenetic analyzes, the population structure and existence of hybridization between the two species were investigated. Samples from adjacent regions were compared: Estuary of the Amazon River (EAR; 7), North Coast (11), South Coast (21), and within the Amazon River (14). Five specific individuals were karyotyped for deeper genetic analyzes.

All manatees from the EAR grouped genetically with the Amazonian manatee and separate from the coastal manatees, while the individuals from the North consistently clustered with West Indian manatees from the South. Nevertheless, the North cluster shares a rare allele with the Amazonian manatee. Of the manatees physically identified as Amazonian manatees, none of them presented mixed ancestry. New haplotypes were identified for the EAR and Amazonian regions.

One individual, identified as a West Indian manatee, born in the wild near the border with French Guyana and suspected to be hybrid, was attributed 83.2% ancestry with the West Indian manatee and 16.8% with the Amazonian manatee. He also carried the haplotype, T01, which is present only in the Amazonian manatee and shares private alleles with them. This case was the only individual to present an intermediate karyotype between the two species. Surprisingly his daughter had a normal karyotype. Their karyotypes have been studied in detail and will be described.

The existence of a hybrid has been confirmed, however, hybridization does not appear to be frequent. Only one individual in the entire study was identified as a hybrid, but the limited number of samples leaves the possibility that more hybrids may be present. The potential hybrid zone is larger than suggested previously and could range as far as French Guyana, suggesting Amazonian manatees leave the Amazon basin and travel north. Further detailed genetic studies in the area north of Brazil, increasing the samples sizes, and combining molecular techniques need to be implemented to better understand the hybridization and define the potential hybrid zone. **-Fabia Luna¹, Coralie Nourisson^{2,3}, Margaret Hunter⁴, Fernanda Attademo¹, Robert Bonde⁴, Brian Gray⁵, and José Zanon De Oliveira Passavante⁶** (fabia.luna@icmbio.gov.br, ¹CMA/ICMBio, ²GEOMARE, ³CIBIO-InBIO Research Center in Biodiversity and Genetic Resources, ⁴U.S. Geological Survey, ⁵University of Florida, ⁶Universidade Federal de Pernambuco)

Population structure and genetic diversity of the West Indian manatee (Trichechus manatus) in Brazil. The West Indian manatee is classified as vulnerable by the IUCN and as critically endangered by the Brazilian government. Hunting since the Portuguese colonization era has severely decreased manatee abundance in Brazil. Currently hunting has decreased; however, new anthropogenic threats have been increasing, such as accidental death in fishing gear, habitat degradation, and a higher concentration of boats. Additionally, the low reproductive rate in manatees and the large number of stranded calves have limited the recovery potential of the populations.

The range of the West Indian manatee in Brazil is from Amapá state in the north to Alagoas state in the south, but there is discontinuity in many areas within Alagoas, Pernambuco, Ceará, Maranhão, and Pará states. The species is extinct in Espírito Santo, Bahia, and Sergipe states. There is an estimate of 500-1,000 West Indian manatees in Brazil. The genetic structure and diversity of the population was studied using 16 microsatellite markers on 76 manatee samples from different states and an additional 10 samples from north of Brazil which were used as an outgroup.

Three management units were identified along the Brazilian coast: (i) Northeast Coast of Brazil subpopulation AL-CE, (ii) Northeast Coast of Brazil subpopulation PI-MA, and (iii) Northwest of the Amazon River Estuary, composed of samples from Amapá state in Brazil and from Guyana and

Venezuela. All individuals from the Amazon River Estuary were identified as Amazonian manatees. The Northeast Coast of Brazil is separated into two subpopulations ($F_{ST}=0.10$ and $R_{ST}=0.30$) with low genetic diversity ($H_o=0.34$ and 0.33) but comparable to manatee population diversity in other countries. Manatees in Brazil do not appear to have seasonal migrations, which reinforces the separation of the subpopulations. The connectivity of the populations and genetic exchange appear to be lost due to historical hunting resulting in a depleted population and excessive anthropogenic habitat use and destruction. Manatees in the southeast are geographically isolated. To mitigate the gap in the distribution, and prevent genetic isolation in the area, some captive manatees have been released into this area.

For effective management and conservation the three management units and the Estuary of the Amazon River should be treated separately as each one has different threats and habitat uses. Actions that could be prioritized include: protection and restoration of habitat with the creation and implementation of specific protected areas and travel corridors that provide gene flow, and reduction or elimination of anthropogenic pressures on manatees. -**Fabia Luna**¹, **Coralie Nourisson**^{2,3}, **Margaret Hunter**⁴, **Fernanda Attademo**¹, **Robert Bonde**⁴, and **José Zanon De Oliveira Passavante**⁵ (fabia.luna@icmbio.gov.br, ¹CMA/ICMBio, ²GEOMARE, ³CIBIO-InBIO Research Center in Biodiversity and Genetic Resources, ⁴U.S. Geological Survey, ⁵Universidade Federal de Pernambuco)

Soft release of Amazonian manatees. For the third time, the Mamirauá Institute for Sustainable Development, in Western Brazilian Amazon, performed a release of Amazonian manatees back to the wild.

The first-ever release occurred in 2000, when a subadult male was returned to the waters of the Mamirauá Sustainable Development Reserve, near Tefé town, 700 km west of Manaus, the capital of the state of Amazonas (see Sirenews 33). Seven years later the Mamirauá Institute established a community-based manatee rehabilitation center in the Amanã reserve, under permit by the Brazilian environmental agency. In 2012 MISD conducted the 2nd release, of five rehabilitated calves, into the Amanã Lake (Sirenews 58).

The third successful release took place on 11 January 2015, when six Amazonian manatees were soft-released into a lake in the Amanã Reserve at the time isolated from the rest of the water system due to the dry period. Males Piti and Japurá, and females Castanha, Jurema, Jerusa and Luna, aged 2 to 7 years, arrived at the Center at a few months of age, between 86 and 114 cm and 11.5 and 45 kg. Most of them benefited from advancements from previous releases introduced at the Center, such as the setting of the center itself as a floating structure in a natural lake, the use of an underwater bottle to reduce human contact during feeding, the design of customized milk formula according to individual nutritional needs, the daily offering of native plant material and the soft release phase, in addition to rehabilitation in proximity to and with engagement from local communities.

Piti was the first inhabitant of the Center, and inaugurated it in 2007; he was released in 2012 but had to be brought back into captivity after losing weight his first time out. This time he was first again: he left the lake in early March and seems to be faring well, investigating water bodies nearby and taking advantage of the abundant aquatic vegetation in the area.

Prior to release animals underwent medical exams to ensure they did not carry diseases that could cause risks to the wild population, and were adapted with belt-mounted VHF transmitters built in cooperation with USGS-Sirenia Project in Gainesville, Florida, USA. All animals have been monitored since the moment of release. Two female manatees remain at the Center under rehabilitation. -**Miriam Marmontel** (marmontel@mamiraua.org.br, Instituto de Desenvolvimento Sustentável Mamirauá)

On a new Caribbean manatee calf rescued in Marajó Island, Brazil. On the morning of December 13 2014, a manatee calf (*Trichechus manatus manatus*) was rescued by fisherman near the Pesqueiro Village, Soure, Marajó Island, northeastern Pará State, Brazil. It was found during low tide on the beach in bright sunlight. Locals promptly called the federal environment officers and GEMAM personnel to rescue the manatee. Leleco, the name given to the manatee by locals, was a 0.8m, 8kg male with an umbilical stump (Figure 1). The next day, the GEMAM team returned to care for the calf. The same day a search for the mother started as locals informed officials that they had spotted an adult manatee in the area the previous day. The mother was not located and the team decided to transfer Leleco to the rehabilitation center in Salvaterra where Omar, the manatee calf rescued in July 2013, is under care (see Sirenews 60). On December 16, a veterinarian from the Brazilian Institute of Environment and Renewable Natural Resources of Brazil (IBAMA) and Federal University of Pará went to Salvaterra to give a clinical evaluation of the calf. During his quarantine, Leleco received four baby bottles daily filled with a recipe of soy-based milk. He had an ocular lesion in the right eye, probably caused by sun exposure during the stranding, which was treated with Tobramycin ophthalmic solution 0.3% and responded very well (Figure 2). By December 30 the calf had gained 4 kg and was apparently swimming and in much better condition.

On January 24 Leleco died. The results of the necropsy were: corneal opacities in both eyes; irregular lesions in the thoracic and ventral regions suggesting mycotic dermatitis; and heart alterations suggestive of myxomatous degeneration in the valves. In addition, the liver was congested and the intestinal contents were dehydrated. Leleco was the fourth Caribbean manatee calf rescued along the eastern coast of Marajó Island in the last seven years. It is strong evidence of regular use of the Marajó coastal habitats by manatees.

The rescue and rehabilitation of Leleco was a collaboration including the following organizations: IBAMA, ICMBio, GEMAM/Museu Paraense Emílio Goeldi and Universidade Federal do Pará. -**Maura E. M. Sousa^{1,3}, Bruna M. L. Martins^{1,4}, Jacqueline de Oliveira Vieira¹, Pedro S. B. Júnior², Valéria Duarte Cerqueira², Renata Emin-Lima¹, José de Sousa e Silva Júnior¹, and Salvatore Siciliano⁵**

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Figure 1: Mr. Catita, the fisherman who rescued the manatee calf on the beach. Photo: Andrei Cardoso

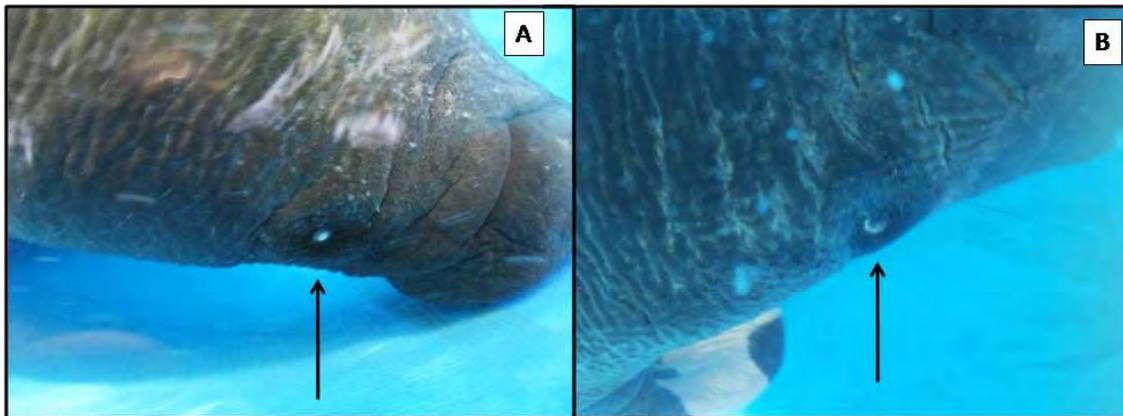


Figure 2: Ocular lesion in the right eye of the calf. A) 20 December 2014. B) 12 January 2015, after treatment with Tobramycin ophthalmic solution 0.3%. Photo: EMAM/MPEG

NEW CALEDONIA

Use of a Sit-down Personal Watercraft to Safely and Quickly Catch Dugongs (*Dugong dugon*) in the coral reef lagoons of New Caledonia. A sit-down Personal Watercraft (PWC, more commonly called “Jetski”) was used for the first time to satellite tag twelve dugongs (two individuals in 2012 and ten individuals in 2013) in the shallow coral reef lagoons of New Caledonia.

This logistical alternative to catching dugongs in shallow coral reef waters follows the rodeo technique which is the commonly used technique for catching dugongs to fit satellite/GPS transmitters. This technique consists of a close pursuit of an individual dugong using an outboard-powered speed-boat - also called a “catch-boat” - until the animal is fatigued and then caught manually by personnel jumping from the vessel. It is essential to use an appropriate catch-boat. Given the dugong’s short burst

capabilities during a pursuit, the catch-boat needs to be capable of accelerating to speeds of up to 20 km per hour within seconds and to have high maneuverability as dugongs can swim in unpredictable directions with great agility. Given the erratic swimming behavior of dugongs, the use of front steering boats allows drivers to keep the animals in their sight during the pursuit in order to reduce the risk of collisions. These criteria must be accounted for in dugong catching protocols to reduce the risk of an animal being hit by an outboard vessel.

The main advantage of the PWC is that it has a very shallow draft. This allowed the catching team to follow dugongs at speed in shallow patch reef areas. These areas could not be easily accessed using traditional catching outboard vessels. The PWC is also small and highly maneuverable and it can reach the required speed and slow down within a very short timeframe. The driver can sit or stand up and can easily follow the animal. These factors also allow the driver to place the jumper in an optimal zone for jumping (Figure 1.), increasing the chances of a successful and safe catch. The use of a PWC is also a safe way to approach dugongs because the PWC propeller is in the turbine, which is located inside the plastic shell. This feature eliminates any risk of dugongs or personnel being hit by propellers. Two people were seated on the vessel (a two-seated three meter Sea-Doo model): (1) a driver/secondary catcher, and (2) a primary catcher, who sat behind the driver. Two assisting vessels and a safety mother-ship were also used: (1) the first assisting vessel had two additional catchers and a pilot onboard and acted as a secondary catch-boat; (2) the second assisting boat had two assistants and a pilot. Their job was to secure the animals against their boat, measure and sex them, take a skin sample for genetics and help fit the satellite transmitter before releasing them.

Once a dugong was spotted, priority was given to the PWC to approach and pursue it. The dugong was allowed to surface and breathe at least twice prior to capture (Lanyon et al., 2006). Following the second breath, the driver maintained a reasonable sighting distance from the dugong and gradually approached from behind as the animal surfaced for its third breath (Figures 1a. and 1b.). When the animal reached the surface the driver positioned the PWC parallel and at a maximum distance of one meter from the animal to facilitate efficient jumping and catching (Figure 1c.). The capture began with the primary catcher jumping on the dugong and holding its caudal peduncle to prevent it from escaping (Figure 1d.). The secondary catch-boat slowly approached allowing the two catchers to jump in and secure the dugong from the front and to maintain its head at the surface to enable it to breathe freely. Details of the animal restraint protocol followed Lanyon et al. (2006).

The use of a PWC can improve the likelihood of catching dugongs quickly and safely in clear shallow reef habitats and increase the locations where animals can be caught. This technique could also be used to catch other species of marine wildlife that are caught using the rodeo technique, such as sea turtles (Limpus 1978). Results from the dugong satellite tagging project in New Caledonia will be incorporated in Christophe Cleguer's PhD thesis, which will be submitted in 2015. -**Christophe Cleguer**^{1,2,3}, **Claire Garrigue**³, **Shane Preston**¹, **Nikolai Liebsch**⁴, and **Helene Marsh**¹ (¹College of Marine and Environmental Sciences, James Cook University, Townsville, Queensland, Australia, E-mail: christophe.cleguer@my.jcu.edu.au; ²CoRéUs, Institut de Recherche pour le Développement, Nouméa, New Caledonia ; ³OpérationCétacés, Nouméa, New Caledonia ; ⁴The Queensland Brain Institute, ARC Centre of Excellence in Vision Science, University of Queensland, St Lucia, Queensland, Australia.)

Acknowledgments and permits: the research was funded by the New Caledonian dugong technical committee under the 2012-2015 Dugong Action Plan in New Caledonia. The field work for this project was completed under permits from the North province (N°60912-70-2012/JJC and 60912155-2013/JJC) and the South Province (N°3616-2011/ARR/DENV and 3157-2012/ARR/DENV) of New Caledonia and James Cook Animal Ethics Approval (# A1735 and A1936).

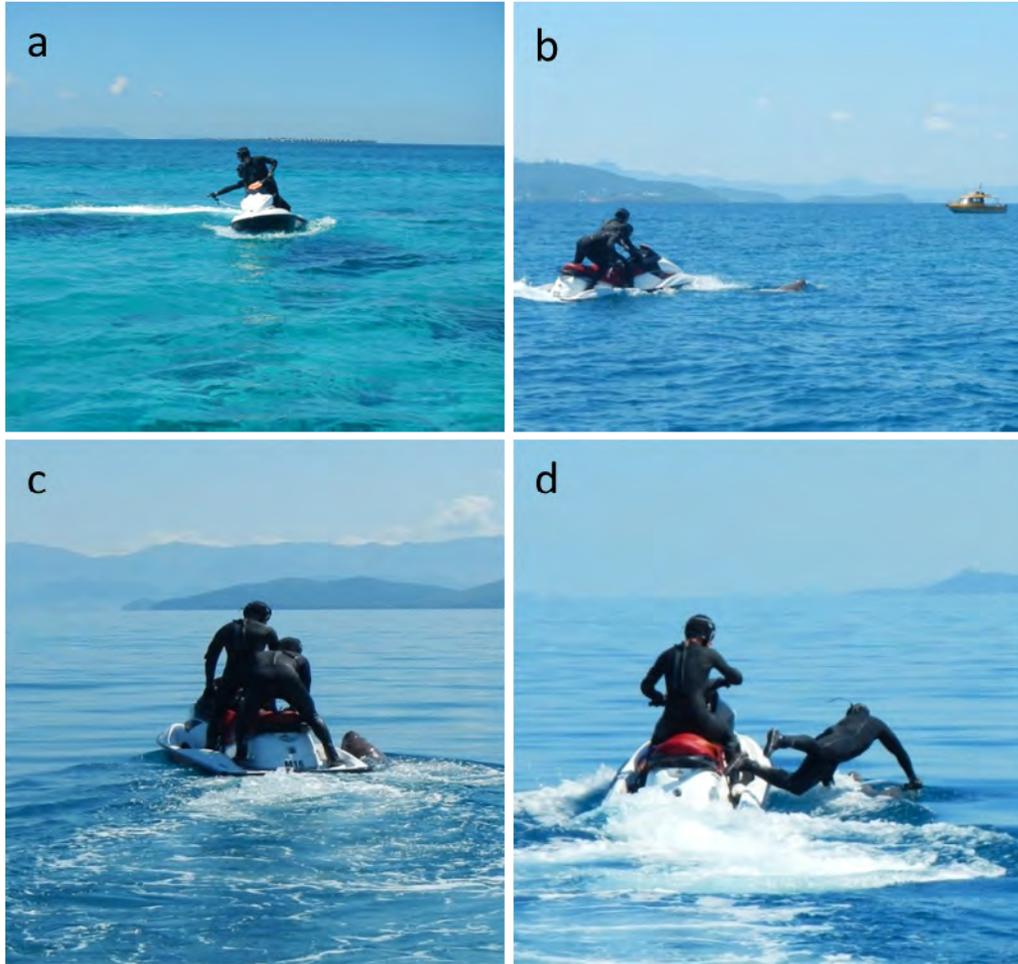


Figure 1. Use of a sit-down Personal Watercraft (PWC) to approach and catch dugongs in New Caledonia: (a) primary catchers pursuing a dugong in a shallow coral reef environment, the primary catcher is pointing at the animal; (b and c) PWC approaching the dugong at a catchable distance –note the safety boat in the background in (b); (d) primary catcher jumping from the back of the PWC onto the dugong’s tail to stop the animal.

QATAR

A New Initiative to Assess Dugongs of Qatar: Persistent Population or Population in Decline?

Dugongs of the Arabian Gulf are consistently referred to as the largest population of dugongs outside of Australia, and the most important region for dugongs in the western portion of their range. These statements are based upon Preen’s (1989) gulf-wide survey almost 30 years ago. While certain countries in the region, such as the United Arab Emirates (UAE), have made significant progress in understanding the natural history of Arabian Gulf dugongs, others have lagged behind. The State of Qatar shares two of the three most important regions within the Arabian Gulf for dugongs and was also home to the largest single dugong group ever recorded (674 individuals) during Preen’s surveys. Yet little work has been done in the past 30 years to understand the population abundance and distribution in Qatar’s coastal waters. Much has changed in the Arabian Gulf since Preen’s surveys. Coastal development, energy exploration, and drilling for natural gas and oil have transformed this region of the world. As a result, dugongs in Qatar face many threats including incidental fisheries bycatch and habitat degradation and loss. In addition, the extreme marine and physical environment of the Arabian Gulf, as well as the

northern limit of dugong distribution in this area, likely means that their life-history differs from populations in Australia. However, there are virtually no life history data for Qatari dugongs, and the species remains mostly unstudied in the State of Qatar.

This past June 2014, researchers from Texas A&M University, Qatar University and ExxonMobil Research Qatar signed a Tri-Party agreement to initiate research to begin to assess the dugong population in the State of Qatar and to collect data to investigate their natural history. We started with three basic objectives to ensure success and buy-in from government agencies. These included (1) conduct fishermen interviews to locate and estimate dugong numbers in Qatar in preparation for future aerial surveys, (2) create a stranding response team to characterize the number, length, sex, and circumstances of dugong strandings, as well as to conduct opportunistic necropsies, and (3) collect tusks for aging stranded dugongs. Our long-term goals include conducting aerial surveys of the entire Qatari coastline, collecting skin samples for population genetics, and to build up technical capacity for eventual capture of dugongs to deploy satellite tags.

To initiate this endeavor we conducted a 2-day dugong workshop on September 28-29 2014, hosted by Qatar University. The workshop reviewed the current state of knowledge of dugongs globally, but also specifically to both the Arabian Gulf and the State of Qatar. It outlined both the short-term and long-term objectives of members of the Tri-Party agreement and reached out to government agencies, academic institutions, non-governmental organizations and grass-roots organizations. The dugong workshop was enthusiastically received by all attending, which included ~45 individuals from the Ministry of the Environment, Ministry of the Environment Biotechnology Center, Ministry of Municipality and Urban Planning, Qatar National Master Plan Project, Private Engineering Office of Qatar, Qatar Petroleum Ras Laffan Industrial City, Qatar Management of Environmental Protection, Qatar Ministry of Defense, Qatar University Environmental Science Center, and Qatar University Department of Biology and Environmental Science. In addition to raising awareness of dugong conservation, the outcomes of this workshop included the establishment of a country-wide stranding response team in cooperation with the Ministry of the Environment (MOE) and the MOE ranger stations that are located throughout coastal Qatar.

Activities have included community outreach to local schools and grass-roots organizations such as the Qatar Natural History Club and Qatar Science Club. Additional training on beach surveys and biological sample collection has been conducted with the Private Engineering Office and Ministry of the Environment Rangers.

To date, fishermen surveys are on-going and the stranding team has surveyed 80% of the Qatar coastline. The stranding team has responded to reports of whole dugong carcasses washed on shore. In total, the stranding response/beach survey team has recovered 18 dugongs that range from code 2 (fresh carcass) to code 6 (only skeletal parts remaining). Two code 2 dugongs were necropsied and used to train local biologists regarding dugong anatomy and the procedures of a dugong necropsy following Eros et al. (2007). Several code 3 and 4 individuals were found wrapped in fishing nets or lines, and several additional individuals displayed evidence of drowning in fishery gear. As found in the UAE, bycatch is likely a serious issue for dugongs in Qatar.

In addition to beach surveys for stranded dugongs, the team has been conducting boat surveys, with the assistance of the Private Engineering Office, in the northwest region of Qatar. Between January and March 2015, four surveys were conducted. Several large groups have been located in this region and aerial photographs and videos have been collected using unmanned aerial vehicles. These images have been used to quantify group size. Currently the largest group encountered was comprised of ~500 individuals and is likely the progeny of the large herd documented by Preen (1989). Assessment and data collection of dugongs in the State of Qatar will continue with funding committed from ExxonMobil

Research Qatar. Planning for a second State of Qatar Dugong Workshop for next fall has begun, and the team is currently reaching out to colleagues in neighboring gulf coast states engaged in dugong conservation. -**Christopher D. Marshall, Ph.D.** (Texas A&M University, Department of Marine Biology); **Mehsin Al Ansi, Ph.D.** (Qatar University, Department of Biology and Environmental Sciences); and **Jennifer Dupont, Ph.D.** (ExxonMobil Research Qatar)

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UNITED STATES

Further Range Extension, and Market Demand, for the Extinct Steller's Sea Cow. Although hunted to extinction for its meat nearly 250 years ago, Steller's sea cow (*Hydrodamalis gigas*) not only continues to expand its known geographic range, but continues to be subject to commercial exploitation!

Several years ago it was shown that in relatively recent times (perhaps even as late as the 18th century, while sea cows were being exterminated by Europeans in the Commander Islands to the west), they were still present in the westernmost Aleutian Islands and figured in the oral history of the Aleut people. In fact, hunting and killing these largest of all sirenians – by herding them into shoal water and stranding them on a falling tide – was regarded as women's work (Domning et al., 2007).

Even more surprising is the latest discovery, that *Hydrodamalis* once occurred at least 1500 km and 8 degrees of latitude farther north than previously known: at St. Lawrence Island, almost up to the Bering Strait itself. Olaus Murie (1937) interpreted an Eskimo tradition as indicating that sea cows once existed at St. Lawrence, but until now no bones had been collected to substantiate this speculation. It turns out that dense bones, allegedly of sea cows, are being dug up there all the time by the local inhabitants, and sold for the manufacture of knife handles and other carvings available on the international market. Dr. Lorelei Crerar, a researcher at George Mason University in Virginia, has successfully extracted DNA of *H. gigas* from such bones – finally proving the former presence of sea cows in the northernmost part of the Bering Sea (Crerar et al., 2014).

Besides DNA, these bones also yielded radiocarbon dates, and stable isotopes of carbon and nitrogen. The dates place the sea cow samples in the period between 780-1030 CE -- roughly the same age as some *H. gigas* bones dated from Bering Island. The isotopes, however, indicate different diets for the sea cows from the two localities, confirming that the analyzed bones really represent distinct populations (and that the ones claimed to come from St. Lawrence were not smuggled out of the Commander Islands instead).

These results are of more than just academic interest. DNA analysis shows that not all of the bones being exported from St. Lawrence Island are sea cows, as claimed; some represent whales or other dense-boned marine mammal species that are protected under the U.S. Marine Mammal Protection Act, CITES, and/or other regulations. There is thus the real potential for circumventing such laws by trading in extant, protected species under the guise that the bones (which are typically incomplete and not

identifiable by gross morphology) represent the extinct, hence unregulated *H. gigas*. Customs and wildlife agents need to be alert to this possibility.

We have also come to realize how many other secrets *Hydrodamalis* has yet to give up. Did it once live even farther north, in the Arctic Ocean itself, as some old and unsubstantiated reports claimed (Domning, 1978: 135-138)? What was different about the diet of the St. Lawrence Island population? How long did it persist, and what role did it play in the culture of the island's human inhabitants? Why do most or all of the radiocarbon-dated sea cow bones from both there and the Commander Islands come from around a thousand years ago, when we know that the species survived in at least the latter area down to the 18th century?

The paramount implication is that archaeological work on St. Lawrence Island is urgently needed, to clarify the stratigraphical and archaeological context of the bones being so actively mined at this moment for commercial purposes. -**Daryl P. Domning** (Howard University, Washington, D.C., USA; ddomning@howard.edu)

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ABSTRACTS

Issues and opportunities associated with using manatee mortality data to evaluate the effectiveness of manatee protection efforts in Florida. C. Scott Calleson. 2014. *Endangered Species Research* Vol. 26: 127–136.

Protection zones to reduce risks to Florida manatees *Trichechus manatus latirostris* associated with boat operation have been in place since the 1990s or earlier in most areas considered important for the species. Despite the relatively long period of time protections have been in place, evaluating the effectiveness of these efforts has proven to be difficult. This paper discusses manatee mortality data, which is one of the most long-term sources of data available for analysis, and some of the difficulties associated with using these data to evaluate effectiveness. It then explores the concept of using differences in rates of change in mortality during three 10 yr periods as an evaluation metric. Rates were calculated for the state of Florida as a whole and for Treatment and No Treatment groups, with the Treatment group including all counties where comprehensive protection zones have been established. The only rates of change that were statistically different from one another were for boat-related deaths, both statewide and for the Treatment group, between the 1981–1990 and 2001–2010 periods. Statewide, the average rate of increase fell from 11.2 to 1.0% yr⁻¹, while, within the Treatment group, the rate fell from 12.4 to 1.2% yr⁻¹. These results provide evidence that protection efforts have likely helped to reduce boat-related mortality risks; however, the analysis does not account for some uncertainties associated with the mortality data, and the confidence intervals are fairly wide. Additional research and analyzes should be pursued to account for these issues and also to consider risks related to non-lethal manatee–boat collisions. Keywords: Florida manatee, *Trichechus manatus latirostris*, boat speed zones, mortality, risk reduction, effectiveness

Abstracts from SILAMA (First Latin American Symposium for Manatee Research and Conservation, 1-4 December 2014, Cartagena, Colombia): *Many proposals have been translated into English from Spanish or Portuguese - many thanks to Nataly Castelblanco-Martinez for providing numerous translations.

MANATEE CONSERVATION IN AREAS OF ARMED CONFLICT. CASE STUDY: COMPLEJO CENAGOSO EL TOTUMO, MIDDLE MAGDALENA, COLOMBIA. Aguilar Rodriguez, Belkis^{1*} & Castelblanco-Martínez, Nataly²; ¹Fundación Sirenas, ²Oceanic Society; belkisaguilar@gmail.com*

Manatees (*Trichechus manatus manatus*) face a variety of threats throughout their range, most of them associated with human activities. The protection of the species is a challenge in areas of armed conflict, due to the loss of management and control of natural resources by legal authorities. Colombia has been immersed in an internal conflict for more than 50 years, which involves local people, governmental players, subversive groups and extreme-right groups. During this long process of war, hundreds of hectares of primary forest have been devastated affecting the local flora and fauna. Nevertheless, it has been documented as well that the conflict itself has favored the survival of some ecosystems and species. The aim of this study was to analyze the situation of the manatee population in an area of persistent, localized conflict in Middle Magdalena, specifically in the Complejo Cenagoso El Totumo. From 7-15 June 2012, 16 interviews with local people were conducted and two workshops were developed. Additionally, boat surveys were conducted in the study area in search of manatees, and observers waited silently at two observation points. After 20 hours of effort, 313 sightings were obtained; and an estimate of at least seven different individuals was obtained in the same area. The simultaneous presence of two females with calves was also recorded. Our observations, along with the information provided by the villagers, suggested the presence and persistence of a healthy population of manatees. Interviewees reported that hunting of the species was banned by the different armed forces in the area, which, along with the preservation of forests and wetlands, could have played an important role for local conservation of the species. However, swamps destruction, the gradual loss of connectivity between them and the Magdalena River, and the increase of cattle and oil activities constitute potential and latent threats to the manatee population. Knowledge on the status of wild manatee populations in Colombia is still incipient, due to, among other reasons, the difficulties of accessing areas where the species occurs. The lack of updated and systematic manatee population information is a limiting factor for the structuring of conservation plans.

DISTRIBUTION AND CONSERVATION STATUS OF MANATEES IN THE LOWER LEBRIJA RIVER AND CIENAGA LA MARIA, MIDDLE MAGDALENA, COLOMBIA.

Aguilar Rodriguez, Belkis^{1*} & Castelblanco-Martínez, Nataly²; ¹Fundación Sirenas, ²Oceanic Society; belkisaguilar@gmail.com*

The middle and lower basin of the Magdalena River and its tributaries (Sogamoso, Lebrija, Scimitar, Simití, San Jorge, Cauca and Cesar Rivers) and associated swampy systems constitute the largest habitat for the manatee population in Colombia. Except for the Ciénaga de Paredes, little is known about the distribution and conservation status of the West Indian Manatee (*Trichechus manatus manatus*) in the Middle Magdalena. This is due to the violence that occurred in the area, lack of organizations interested in manatee research and little investment in science in the country. From 11-18 April 2013 we conducted exploratory research in the Lower Lebrija River. We conducted boat surveys, interviews and workshops to assess the presence and conservation status of the species. During the surveys, 16 manatee feeding areas were detected. Through interviews and the results of the workshop, it was possible to document the recent death of a manatee by entanglement in Lebrija River. During the fieldwork, it was established that entanglement, habitat loss by wetlands drying, pollution from oil spills and creation of ponds for fish farming are some of the more dangerous threats that affect manatees in the area.

TEST OF A MATERNAL MILK SUBSTITUTE FOR MANATEE CALVES: INFLUENCES ON BODY DEVELOPMENT AND SERUM BIOCHEMICAL PARAMETERS.

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The stranding of calves is the main threat to manatees (*Trichechus manatus manatus*) in northeastern Brazil. The rehabilitation of these animals requires close clinical and nutritional management so that they are able to be released. The aim

of this study was to test a substitute for maternal manatee milk and to evaluate its influence on body development and serum biochemical parameters of calves. Growth and weight gain were compared between two calves, a male and a female seven and 11 months of age, respectively, in the first seven months of life. Initially the animals received the same artificial formula with a basis of soybean and canola oil totaling 99.9kcal, 7.62g of fat, protein and 4.1-4.8 g of carbohydrates in 100ml. The bottles were provided five times a day, with an initial volume of 200ml, and an increase of 100 ml every two months. A substitute was tested in the male for two months. It consisted of bovine milk without lactose, soybean and unsalted butter, totaling 99.4kcal, 6.5 g of total fat, protein and 4.1g-6.1g of carbohydrates in 100ml. The biometrics and collected blood serum biochemical tests (ALT, AST, urea, creatinine, amylase, cholesterol and triglycerides) without fasting were assessed weekly. During the supply of the first formula, the male had an average weight gain of 0.70kg (\pm 1.03) and growth of 1.6cm (\pm 1.51) a month, and after the test, it had observed weight gain of 8.33kg (\pm 0.66) and growth of 3.5 cm (\pm 2.12) per month. For the corresponding periods, the female had an average weight gain of 2.02kg (\pm 1.48) and 1.5 kg (\pm 0.73), and growth of 1.2 cm (\pm 1.3) and 3 cm (\pm 0). There were no changes in liver, kidney and pancreas functioning in the animals. In the male, cholesterol levels increased from 123 to 221mg/dl, whereas the triglycerides ranged from 43 to 164mg/dL. In the female, the cholesterol ranked between 231 and 236mg/dL and triglycerides between 73 to 108mg/dL. The nutritional composition of the two formulas was similar, but the use of high saturated fats and animal ingredients in the new substitute allowed for better absorption of nutrients and a high feed conversion ratio. Despite this increase, the triglycerides fell in the normal range for the Antillean subspecies, while cholesterol was increased, but at a normal dosage compared to subspecies of Florida. The substitute has shown promising for the management of manatee calves, however long-term monitoring of serum biochemistry is recommended.

ESTIMATE OF SEXUAL MATURITY IN AMAZONIAN MANATEE *Trichechus inunguis*.

Amaral, Rodrigo S.^{1,2*}; Da Silva, Vera M F²; D’Affonsêca Neto, Anselmo²; Ribeiro, Daniella³; Lazzarini, Stella Maris³, Rosas, Fernando C W². ¹IFAM, ²INPA, ³AMAZONAS ENERGIA. rsamaral@gmail.com*

Sexual maturity is an important parameter for population studies as it is the moment at which the animal becomes physiologically capable of generating progeny. The age and body size at which the Amazonian manatee (*Trichechus inunguis*) reaches sexual maturity are unknown. Thus, the aim of this study was to determine the average age (IMS), the average length (CMS), and average weight (PMS) of sexual maturity in males and females of *T. inunguis* using the serum levels of testosterone, progesterone and estradiol as reference. We obtained blood samples and biometrics (weight and length) of 106 *T. inunguis* (57 F and 49 M) in a variety of known ages (1-39 years), all held in captivity in the AML / INPA or CPPMA / Amazon Energy; Brazil. Hormone levels were measured by enzyme immunoassay. Hormonal data were grouped according to each parameter (age, weight and overall length) and statistically analyzed to determine the indicator of sexual maturity. Thus, male testosterone levels above 0.7ng / ml and females with estradiol and progesterone levels above 1.0ng / ml were considered sexually mature. Then, IMS, CMS and PMS were determined. For this, we used three different models (sum algorithm of immature fractions, logistic regression and weighted average). For males, the IMS, CMS and PMS were seven years, 195.7 cm and 130.8 kg, respectively. For females, the mean values obtained were 6 years old, 178.4 cm and 119.1 kg, with no difference between the sexes (CV <10%). The results are consistent with previous estimates of IMS obtained for the species, as well as the values for the other Sirenia species. Despite the differences in size between Sirenian species, the results of SMP and DMI exhibit similar patterns of other Sirenian species when related to the size at birth and the maximum size for the species. This is the first study focused on determining sexual maturity in *T. inunguis* based on hormone levels. The estimate of sexual maturity is essential to study population dynamics of the species in the wild, as well as for proper management of the Amazonian manatee in captivity. Acknowledgements: CNPq (processo 301199/2014-0), Petrobras Sócioambiental (Projeto Mamíferos Aquáticos da Amazônia: Conservação e Pesquisa) and AMPA – Associação Amigos do Peixe-boi.

RESCUE, REHABILITATION AND RELEASE TO THE WILD OF MANATEES *Trichechus manatus* IN THE COLOMBIAN CARIBBEAN: A CONSERVATION PROGRAM.

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In the Colombian Caribbean basin, manatees are affected by adverse circumstances such as hunting, bycatch and recently drought events. The Corporación Autónoma Regional de los Valles del Sinú y San Jorge CVS and Omacha Foundation lead the "Manatee Project". One of the work programs is the rescue, rehabilitation and reintroduction of individuals of this species, which due to various reasons are kept in the facilities of the CVS' fishing farm in Lórica. Since 2009, three manatee neonates (two males and one female) were rescued in different conditions and were brought into

captivity for rehabilitation: Maria del Mar, rescued in Bocas del Rio Sinu, San Bernardo del Viento, Córdoba (September 2009); Lilo in Altos del Rosario, Magangue, Bolívar (May, 2010); and Jonás in Tacamocho, Córdoba, Bolívar (June, 2013). Rehabilitation processes are supported by the Manatee Conservation Center of Puerto Rico, enriching existing protocols according to the particular conditions for the species in Colombia. The newborn Lilo represented the hardest rehabilitation process. Lilo was in bad condition including a chronic lung infection, which led to his death after 20 days of treatment. Maria del Mar had a successful rescue and rehabilitation process, and to date more than three years have passed since her release into the Ciénaga Grande de Loricá. Her rehabilitation lasted over two years and currently she is monitored with VHF technology with the help of the community. She has become a symbol for manatee conservation in the area, being fully identified as a "sentinel species" of wetlands. The third neonate, Jonah, showed signs of dehydration and malnutrition at the time of his rescue, but he responded adequately to rehabilitation protocols. This project has obtained important information about the species in the Caribbean basin, identifying migration routes, observing herds of wild animals, and identifying feeding sites. In addition, each case has contributed to the expansion of veterinary and biological knowledge on managing manatees in Colombia and ultimately implementing effective conservation of this endangered species.

POPULATION ESTIMATE AND DISTRIBUTION OF MANATEES *Trichechus manatus*

(SIRENIA: Trichechidae) IN POTIGUAR BASIN, BRAZIL. Campello Normande, Iran^{1*}; Negrão, Cristine²; Oliveira, Iraê³; Savaget, Patrícia⁴; Vasconcelos, Amanda²; Silva, Flávio³; Luna, Fábila¹ & Zerbini, Alexandre⁵. ¹ICMBio, ²Associação de Pesquisa e Preservação de Ecossistemas Aquáticos – AQUASIS, ³UERN, Universidade do Estado do Rio Grande do Norte, ⁴CMA, ⁵Aqualie.
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Estimates of the manatee population in Brazil are considered difficult to obtain due to the low density of the species, their occurrence in dark waters and high operational costs. This study aimed to estimate the abundance of *T. manatus* in the Potiguar Basin (northeastern Brazil) through aerial surveys. A total of 165 parallel transects between the coastline and the isobath of 10m were traveled, totaling 1,726km of effort. The surveys were flown in a twin-engine high-wing aircraft (equipped with two bubble windows) at 150m altitude and a 170-200km/h speed. The survey was completed twice in April 2014, resulting in a total of 3,543km surveyed and 33 sightings recorded (30 during effective effort and three off effort). The sightings were more frequent in areas up to 5 m deep, possibly because more shallow areas are more appropriate for food and because of its proximity to fresh water sources. Manatee groups were sighted in almost the entire length of the study area, except between 35° 30'W and 36° 30'W and west of 38° W. A higher concentration of animals was found near the border between the states of Ceará and Rio Grande do Norte. The average group size was 1.47 (range 1-3 individuals) with more frequency of solitary individual sightings. A total of 16 sightings were used to estimate the probability of detection ($P = 0.66$, $CV = 00:22$). The abundance of manatees in the Potiguar Basin was estimated at 193 individuals ($CV = 0:35$, $95\% CI = 98-378$ individuals) indicating a relatively low density for this region. The results presented here should be used with caution due to: (i) the reduced sample size to adjust the detection function, (ii) the lack of a visibility bias estimate and (III) the inaccuracy of the estimate ($CV = 35\%$). A four-fold increase in sampling effort is needed to achieve a number desirable to build probability models of sighting detection that consider the environmental variables, and to increase the accuracy. It is recommended that this type of study be expanded to other manatee distribution areas, and increased protections be developed in important habitats for this species through the creation and implementation of protected areas or other management policies.

TURNEFFE ATOLL, BELIZE: A SALTY BUT RICH REFUGE FOR MANATEES?

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Antillean manatees *Trichechus manatus manatus* are found along coastal habitats throughout the Caribbean Sea and Antilles. Turneffe Atoll (TA), located approximately 35km from mainland Belize, is the only atoll in the world where manatees have been reported. Manatee monitoring in TA started in 2001, conducted by the Oceanic Society (OS) in collaboration with several researchers, stakeholders and organizations. Since then, 145 sightings have been recorded in our database, by boat-based surveys (14.96%), aerial surveys (38.77%), and opportunistic encounters (47.61%). Only one dead animal has been reported, but the cause of death remains unclear. Manatee group size varied from solitary (73.46%) to 9 individuals, with 8.16% of sightings corresponding to cow-calf pairs. We observed groups of greater than 3 individuals in 5.44% of sightings. Additionally, two adult manatees (one male and one pregnant female) were captured and tagged in partnership with Sea to Shore Alliance, Coastal Zone, and USGS. The presence of calves, reproductive groups and pregnant females confirms that manatees survive, mate and nurse regularly in TA. The atoll encompasses hundreds of mangrove islands enclosing shallow areas with dense seagrass beds, providing a variety of prime environments for manatees,

particularly in creeks and shoreline areas. However, manatees require periodic freshwater intake. The salinity of the lagoons can diminish during the rainy season, but fresh surface water is scarce to non-existent during the dry season. Despite the spatial and seasonal variability in salinity, no freshwater sources have been identified in TA, and travels toward the mainland seem to be necessary to access freshwater sources. Telemetry data from both captured manatees showed a consistent pattern of movement to and from the mainland, presumably to satisfy freshwater needs. Benefits of high-quality habitat at TA may compensate the cost of traveling from the mainland. Manatees in Belize have been impacted by human activities such as habitat degradation, entanglement in fishing nets, poaching, and especially watercraft collisions. The coastal area of Belize, with the densest population of manatees, is suffering drastic changes due to human activities, with predictable increases in boat traffic. Therefore, TA could play a significant role as a refuge for manatees in the future. Although TA was designated a Marine Reserve in 2012, there are few existing regulations for protecting manatees in the atoll. More information about TA manatees including robust statistical estimates of abundance and fine-scale habitat use and distribution are needed to assist with future conservation planning efforts.

ANTILLEAN MANATEES IN FRENCH GUIANA: AN ATTEMPT TO COUNT A SECRETIVE AQUATIC MAMMAL IN A HIGHLY COMPLEX HABITAT. Castelblanco Martínez, Nataly^{1*}; De Thoisy, Benoit²; Dos Reis, Virginie² & Barrioz, Sébastien. ¹Oceanic Society, ²Kwata. castelblanco.nataly@gmail.com*

In South America, manatees are distributed in coastal areas, estuaries, rivers and floodplains. Most of those environments are characterized by low water transparency. These facts, together with the secretive behavior of the species, make it difficult to conduct manatee counts. We used a non-invasive, multi-approach methodology to infer the relative abundance of Antillean manatees in French Guiana (FG). The territory was divided into nine units: Coswine, Mana, Iracoubo, Sinnamary, Kourou, Cayenne, Kaw, Approuague and Oyapock; covering the entire coastal area of the territory (approx. 330km of coastline and up to 80 km upstream the rivers). The research was conducted during the dry season and early rainy season (October 2013-April 2014), when the lowest levels of the rivers may facilitate encounters with manatees. The method consisted of boat-based strip transect sampling at slow speeds. The manatees were detected visually or by using Side-Scan Sonar (SSS). Once a potential manatee was detected by the SSS, we turned back and passed over the position at the same speed and trajectory to discard inanimate objects that could be mistaken for a manatee. If the suspected object moved away or changed its position, we determined it was an animal and waited for additional clues of manatee presence. A 100% positive record was defined when the manatee was spotted during or after the SSS detection. Otherwise, the photos were analyzed a posteriori based on shape, size and position. As a complementary method, we conducted silent waits from fixed points. Also, indirect evidence (feeding tracks) was recorded. We completed 47 days of field work, and an effective sampling time of 206.13 hours (84.88% of boat surveys and 15.11% from fixed points). In total, 994.9km of rivers were surveyed at 5.89 km/h in average. We recorded 112 instances of manatee presence (63 SSS captions, 14 direct sightings and 35 feeding tracks), or 0.54 per hour of survey. Only three SSS captions were confirmed in situ by direct sightings. All observed manatees were solitary, and no calves were sighted. Manatees were found in all study units, with the highest relative abundance in Approuague (1.04 ev/hr), Kourou (0.96 ev/hr) and Coswine (0.66 ev/hr). A gross data exploration yielded a minimum population size of around 43 manatees in FG, under the assumption of a low likelihood of connectivity between units. More elaborate analyzes of the collected information are needed to improve the population size calculation.

EFFECT OF TOURISM ON THE MANATEE PRESENCE, IN THE NORTH OF QUINTANA ROO, MEXICO, AFTER 15TH YEAR. Diaz Ortiz, Mireya¹; Castelblanco-Martínez, Nataly²; Nourisson, Coralie³; ¹Universidad Autónoma de Guadalajara, ²Oceanic Society, ³Centro de Investigação em Biodiversidade e Recursos Genéticos CIBIO; coralie.nourisson@cibio.up.pt*

The manatee is an endangered species and is protected by national and international laws throughout its range. In Mexico, manatees are present on the Gulf coast and in the Caribbean Sea. Annually, five million tourists visit beaches and inlets of the Mexican Caribbean, but the effects of this high influx of tourism on manatees are still unknown. Forty-eight interviews were conducted with local people to assess areas with manatee presence and knowledge about the species. The main areas reporting presence were the inlets of Xel-Ha and Xpu-Ha, on the north of the Yucatan Peninsula, in the tourist corridor Cancun-Tulum. All interviewees knew what a manatee was and could describe them, sometimes in great detail. Of those interviewed, 95.8% knew manatee feeding habits and 45.4% believed that the population was declining. From June to December 2013, 227.27 hours of observation were conducted to detect the presence of manatees in Xel-Ha and Xpu-Ha. Four different manatees in the estuary of Xpu-Ha (Relative Abundance Index = 0.82 manatees/hr) were detected. Manatees were present on 96.6% of the survey days and during 66.6 % of the time a cow-calf pair was observed. Behaviors such as feeding, playing and breathing were recorded, among others. In Xel-Ha no manatees were observed. Our results differ from those

obtained by a study done 15 years ago, in which eight manatees were observed in Xel-Ha and two in Xpu-Ha. They suggest that the change in presence and use of inlets by manatees is related to the number of tourists using the area. Xel-Ha receives on average 2,184 visitors per day, while Xpu-Ha averages only 22. In Mexico, manatees still used areas heavily impacted by tourism, such as north of Playa del Carmen and Holbox, probably moving from protected areas. The tourist corridor Cancun-Tulum is especially important for manatees as it is the contact area of the two manatee populations in Mexico and the protection of its coasts and inlets could be essential to ensure connectivity between populations. It is necessary to implement management strategies and environmental education that mitigate the effect of tourism in these areas.

ACTIVE AND PASSIVE ACOUSTICS FOR ABUNDANCE ESTIMATION OF ANTILLEAN MANATEES, *Trichechus manatus*. Fiedler Choi-Lima, Katherine¹; Umezaki, Juliana²; Meirelles, Ana Carolina²; Silva, Cristine Pereira Negrão²; Abessa, Denis Moledo de Souza³; Wedekin, Leonardo Liberali⁴ & Sousa-Lima, Renata⁵. ¹Universidade Federal do Ceará, ²Associação de Pesquisa e Preservação de Ecossistemas Aquáticos – AQUASIS, ³Universidade Estadual Paulista, ⁴Universidade de São Paulo – USP, ⁵Universidade Federal do Rio Grande do Norte – UFRN; katherine@aquasis.org*

One of the biggest challenges in the conservation of the manatees in Brazil is the determination of their population size, especially in areas where water quality, coupled with the cryptic behavior of the species, hampers their observation. Therefore manatee conservation is impaired by the challenge of detecting animals in the wild, especially in areas where the species has been hunted, because they become skittish, and in estuaries because of the turbid water. This ongoing study aims to show that new technological advances may in fact solve the problem of manatee detection in their habitat. Our approach is to use combined active (side scan sonar) and passive (hydrophone) acoustic methods to collect data for abundance estimation of manatees in estuaries. Our study site includes estuaries of the rivers Timonha and Ubatuba that separate the Brazilian states of Ceará and Piauí, where the Environmental Protected Area (APA) of the Parnaíba Delta is located. An area of 10km² was divided into three sectors and each sector was surveyed in linear transects at a speed of 6km/h aboard a wooden boat with a stern drive engine. Surveys were conducted in five consecutive days, twice a month. A Humminbird 998x SI combo sonar was turned on for two hours during the surveys while two experienced researchers took turns inspecting the images generated by the sonar. When the sonar image revealed a manatee it was recorded and saved for future estimated density and abundance analyzes using DISTANCE® 6.0. Following surveys of the entire transect the sonar and the boat engine were stopped and sound recordings were made using an HTI MIN-EXPORTABLE High Tech Ink® hydrophone connected to a MARANTZ® PMD661 recorder. A 30-minute to 1-hour recording session was conducted if manatees had been detected in the area. Manatee sounds recorded were analyzed in RAVEN Pro 1.5® and the following variables were collected to aid in individual call identity: signal duration, maximum and minimum fundamental frequencies, harmonic band with most energy, dominant frequency, and number of harmonics. Visual inspection of spectrograms was also used to assess individual call identity. Vocal identity was used as data for capture-recapture methods using MARK®. This is the first time this combined methodological approach has been used for manatee detection in Brazil. We hope to bring exciting results after the completion of the project and to expand and replicate the approach to other areas of manatee occurrence along the coast of Brazil.

***Pulmonicola cochleotrema* ASSOCIATED WITH RESPIRATORY INFECTION IN MANATEES (*Trichechus manatus manatus*).** Gomes Borges, João Carlos^{1*}, Molinari Jung, Larissa¹, Elisa Pitanga, Maria¹, Luz Carvalho, Vitor², Maria De Torres, Sandra³, Camara Alves, Leucio³. ¹Fundação Mamíferos Aquáticos, ²Associação de Pesquisa e Preservação de Ecossistemas Aquáticos, ³Universidade Federal Rural de Pernambuco. jcgborges@hotmail.com*

Although manatees are considered resistant to many diseases, the presence of certain pathogens may result in impaired health. The difficulties in achieving a satisfactory clinical evaluation bring limitations to the diagnosis of many etiologic agents. Thus, this study was aimed at reporting a clinical picture of a respiratory infection in manatees associated with the presence of the trematode *Pulmonicola cochleotrema*. The affected animal was a ten year-old female (274 kg; 242 cm LT), reintroduced in 2008 into the river Mamanguape (6 ° 45 '00:29 "South, 34 ° 55' 51.32" W), Paraíba, Brazil. Initially, the staff accompanying the displacement of this animal reported the presence of nasal secretion and parasites, the latter being collected and clarified in phenol for morphological identification by light microscopy. Based on these reports, the animal underwent a clinical evaluation, with observations of the respiratory pattern (frequency, noise and secretions). Subsequently, physical examination took place along with biological sampling in order to perform additional tests. The same procedure was repeated after 12 days. Based on this evidence, in the course of 20 days a therapeutic protocol was established with antibiotic (enrofloxacin 5 mg / kg / PO / SID), bronchodilators and mucolytic (Clenbuterol hydrochloride + Acetylcysteine 12 ml / PO / SID), food supplementation (vitamin and mineral) and anthelmintic dosing with ivermectin and praziquantel association (200

mg / kg / PO), with daily evaluations. According to laboratory analysis leukopenia was found, without other noteworthy evidence. The parasites exhibited an oval body, a subterminal oral sucker, and transverse aperture; branched intestinal cecum, dorsal to all organs; multilobulated and irregular ovaries; and lobed, opposite, rounded testes located at the posterior third of the body. According to the observed characteristics, the parasites were identified as digenetic trematodes of the Opisthorematidae family, species *Pulmonicola cochleotrema*. From the fourth day after the onset of the therapeutic protocol, clinical signs began to decline and were no longer found after the seventh day. Infections by *Pulmonicola cochleotrema* were observed in manatee carcasses in the state of Ceará, but with no association to pathological changes. This study is the first report of this trematode associated with clinical manifestations in a Brazilian sirenian.

BASELINE POPULATION STUDY OF THE WEST INDIAN MANATEE (*Trichechus manatus*) IN PORT HONDURAS MARINE RESERVE, BELIZE. González Medina, Tránsito^{1*}; Foley, James R.² & Morales Vela, Benjamín¹. ¹El Colegio de la Frontera Sur (ECOSUR), ²Toledo Institute for Development and Environment; transi.gm@gmail.com*

Belize has more Antillean manatees (*Trichechus manatus manatus*) than any other country in its range, and are currently affected by various threats such as habitat loss and degradation, boat strikes, illegal poaching and different types of fishing gear. Port Honduras Marine Reserve (PHMR) was created in 2000 and one incentive was to protect manatees from poaching by Belizean, Guatemalan and Honduran fishermen. At present, however, new human activities such as oil exploration and tourism development potentially may occur in PHMR and Payne's Creek National Park (PCNP) in the near future, emphasizing the need for a population study in these areas. In order to strengthen the development of management, conservation and monitoring strategies, the main objective of this study is to obtain demographic and ecological information on the manatee population in PHMR, as well as information on the potential areas with more disturbances for these animals inside PHMR. Priority objectives are (1) to analyze and identify spatial distribution, age classes, relative abundance and areas most used by *T. manatus* in PHMR and (2) to identify specific individuals using photo-identification and to create a photo database to determine the spatial distribution of individuals in the reserve. In order to have access to local knowledge, interviews with local communities were arranged before monitoring began to select the best survey areas. Monitoring was mainly conducted using boat surveys, and kayak surveys were used as a non-invasive method to minimize disturbance of the species in areas determined to be resting places for manatees. Patrol data on boat movements in PHMR was compared with manatee distribution data to identify areas of greatest risk to manatees from boat strikes and other disturbances to their behavior. Management recommendations such as full protection zones and boat channels avoiding manatee hotspots were then made to promote more effective conservation of manatees in PHMR and PCNP. Additionally, an initiative to involve the community in manatee conservation was developed. Some PHMR fishers have started to collaborate with TIDE by collecting data on manatee sightings. This information will be critical in promoting awareness of the importance of protecting manatees, and in generating a sense of stewardship among local fishers and tour operators to become conscientious boaters in areas where manatees are found.

SONAR, HYDROPHONES, AND BANANA LEAVES: USING INNOVATIVE METHODS TO STUDY SIRENEIANS IN LATIN AMERICA. González -Socoloske, Daniel; Andrews University; gonzalezd@andrews.edu*

Sirenian research is very difficult due to their elusive and cryptic behavior, and because they occupy large ranges with high levels of regional variation in terms of accessibility and complexity of the habitat. This is especially the case with manatees in Latin America. In contrast to Florida, manatees in tropical waters do not congregate due to thermal necessity and the majority of their habitat consists of rivers, lakes, and coastal areas with poor water visibility. Therefore, the research methods used in Florida do not necessarily work in Latin America. To effectively study manatees in these tropical areas it is necessary to implement innovative methodologies. This presentation summarizes three examples of innovative methods that have been implemented in a diverse set of habitats within Latin America, from freshwater lakes to coastal marine areas. The first example is the use of sonar to detect and study manatees. This methodology has been implemented in more than 15 sites representing 10 countries. The second example is the use of banana leaves in Panama to assist in manatee captures. The third and final example is the use of hydrophones to study manatee feeding ecology. All of these examples represent methodologies that were developed to solve complex problems that were site specific and may not be universally applied, which is why it is important to continue to explore and apply innovative methods to the unique challenges that each situation and site presents.

COMPARISON OF TWO ARTIFICIAL FEEDING PROGRAMS FOR AMAZONIAN MANATEE CALVES (*Trichechus inunguis*) IN REHABILITATION. Guerra Neto, Guilherme¹; Pavanato, Heloise¹ & Marmontel, Miriam¹. Instituto de Desenvolvimento Sustentável Mamirauá. guigulo@gmail.com*

The Centro de Reabilitação de Peixes-bois Amazônicos of the Instituto de Desenvolvimento Sustentável Mamirauá has rehabilitated orphaned calves during the past seven years. By March 2013, the milk diet (D1) was empirically employed and was based on weekly monitoring of the individual weight gain. The formula consisted of milk powder, established amounts of water and canola oil, following proportions from 15 to 45 g of milk in 100 ml of water according to the calf's weight. Taking into account the need to establish safe standards in bottle-feeding, to improve weight gain and growth and to reduce the rehabilitation period, a new study was started in April 2013. It was proposed to take into account the metabolism of the species by calculating Daily Calorie Needs for Maintenance (D2) after the period of adaptation to the artificial milk diet. For D2, the total volumes were calculated by the bottle considering the individual concentrations in grams per 100 ml of milk and water in kcal/ml. Dietary calculations were adjusted according to the subsequent weighing of calves. The objective of this study was to compare the weight gain in calves feeding on two different diets employed (D1 and D2), in the same period of time and without considering the *ad libitum* consumption of vegetation. The differences of weight gain of nine different calves were tested by an analysis of variance (ANOVA). To obtain a representative sample of the weight increase, only individuals adapted to the artificial milk diet and of similar age, total length and weight were considered. Thus, we considered only the period in which the animals showed progressive weight gain, and the limit for the completion of treatment was established with the start of weaning. The results show that the D2 diet was more efficient in weight gain in relation to the D1 diet ($\alpha = 0.05$, $p = 1.5 \cdot 10^{-11}$), with a mean weight increase per month of 6386 kg, while D1 had an average increase of 2861 kg. We conclude that the diet implemented from 2013 satisfied the nutritional needs of manatee calves in rehab. This study indicates that artificial feeding program based on daily NCM can be used for rehabilitation of manatee calves.

PRELIMINARY ANALYSIS OF OPPORTUNISTIC SIGHTINGS DATA SHOWS YEAR-ROUND PRESENCE AND SEASONALITY IN HABITAT USE BY MANATEES IN BACALAR CHICO, BELIZE. Jenko, Klavdija^{1*}; Castelblanco Martinez, Nataly²; Chapman, Jennifer¹ & Gough, Charlotte¹. ¹Blue Ventures, ²Oceanic Society; klavdija@blueventures.org*

Opportunistic sightings data of Antillean manatees (*Trichechus manatus manatus*) in Bacalar Chico Marine Reserve and National Park (BCMRNP) were recorded between March 2010 and December 2013, and focused manatee searches were conducted from January until August of 2013. Videos and photos of manatees were collected over the four-year period to build a photo-identification catalogue. Manatees were present in BCMRNP year-round, with a total of 230 individuals observed over 124 sighting events in four years. The sightings were unevenly distributed across the mangrove area and shallow backreef, indicating potential hot spots for the species within the reserve. Comparison of sighting frequencies between seasons showed no statistically significant difference ($H = 1.792$, 2 df, $P = 0.408$). Sightings were significantly more frequent in the sheltered mangroves than on the reef during Norte season ($U = 43.000$, 24 df, $P = 0.019$), suggesting some habitat preference during this time, however there were no significant differences between habitats during the dry (from March until June) and rainy (July until October) seasons. Manatees were often solitary or in small groups with almost 90% of sightings being comprised of less than four animals, and over 50% of sightings being lone individuals. Groups larger than four individuals were observed only in mangroves. Mother-calf pairs were also observed during the four year period. Five of the seven mother-calf sightings were made in the mangroves during the Norte season, suggesting that BCMRNP mangrove area may provide an important nursery ground. Analysis of the photo material enabled identification of six individuals based on their natural or human induced markings such as scars from boat propellers. Expanding our current photo-identification database will enable us to study individual life history traits and when compared with other databases gain information on connectivity within and outside of Belize. These preliminary results highlight important seasons and areas for manatees in the BCMRNP. Further research into the spatial and temporal usage patterns of manatees through the implementation of a manatee monitoring program will be crucial in the development of management for BCMRNP. Potential management actions might include communication and enforcement of laws for manatee-related tourism in BCMRNP, the introduction of No Wake Zones in high manatee-use areas, and temporal or spatial closures for boat traffic where manatees congregate in high concentrations and/or to limit disturbance to nursery grounds.

CONSERVATION AND MONITORING OF THE AMAZONIAN MANATEE (*Trichechus inunguis*) IN THE AREA OF PUERTO NARIÑO, COLOMBIA: LESSONS LEARNED. Kendall, Sarita¹; Peña, Luis Hernando¹; Ahue, Casimiro¹ & Orozco, Diana Luz¹. ¹Fundación Natutama - saritaken@yahoo.com*

The Amazonian manatee is found in the tributaries and rivers of the Amazon, Putumayo and lower Caqueta systems in Colombia. It is still hunted occasionally in the Putumayo, but we registered only three manatees hunted in the Colombian waters of the Amazon between 2003 and 2013. The reduction in hunting in the Colombian Amazon is due in part to a long-term conservation program centered on Puerto Nariño, beginning in 1998. The program consists of permanent monitoring by community fishermen, complemented by education activities carried out by Ticuna Indians, for the purpose of protecting manatees. Monitoring covers the Tarapoto lakes system and a neighboring stretch of the Amazon river from Zaragoza to Atacuari, with weekly surveys in canoes and wooden boats to register sightings and feeding areas throughout the year. Results are analyzed in workshops with the fishermen and educators and are distributed through the Natutama Interpretation Center and community activities. Between 2002 and 2013 we registered 3,594 sightings of manatees in the Puerto Nariño area, as well as documenting feeding areas, use of habitat and threats for each hydrological period. The data confirmed the importance of monitoring both sightings and feeding areas, as there were significantly higher numbers of feeding areas registered during high water (51.1% of the total for 2103, n= 180) than sightings (13.75% of all sightings in 2013, n=335) while the manatees were dispersed through the flooded forest. For the year 2013, 86.6% of all manatee sightings were of two animals or more; between 2002 and 2013 we registered the biggest groups (of 16 and 18 manatees) during annual migrations and the low water period, when there is less habitat available. The maximum number of animals sighted in one day was 27. In relation to mortality, more than ten manatees were released from fishing nets by local people and none was hunted in the Tarapoto lake system after 2003. We highlight ten lessons learned, including some methodological points and the importance of the example given by local and professional researchers. Above all, we stress the powerful effect of an education program rooted in regional culture.

APPLICATION OF ANIMAL-BORNE DIGITAL RECORDERS TO MONITOR THE MOVEMENT AND FEEDING EVENTS OF MANATEES. Kikuchi, Mumi^{1*}; Gonzalez-Socoloske, Daniel²; Akamatsu, Tomonari³; A. De Souza, Diogo⁴ & M. F. Da Silva, Vera⁴ - ¹Wildlife research center of Kyoto University, ²Department of Biology; Andrews University, ³Fisheries Research Agency, ⁴Aquatic Mammals Laboratory (LMA); National Institute of Amazonian Research (INPA) - mumikomo@gmail.com*

Animal-borne digital recorders have become a popular technique for monitoring the time-series behavior of aquatic species and sea birds. Innovative methods have been developed such as reconstructing 3D movements by geomagnetic recorders, monitoring feeding events using accelerometers attached to the cephalic region or by image recorders. The advantages of animal-borne digital recorders are direct continual observation of animal behavior even in the nighttime, and operation without any continual human effort. These techniques are mainly developed for diving species showing the characteristic underwater behavior. In this study, we focused on applying animal-borne digital recorders to manatees. Sirenia are the only extant herbivorous aquatic mammals. Two different types of animal-borne recorders, which record accelerations and underwater sound, were applied to captive Amazonian and Antillean manatees. Two captive-raised Amazonian manatees were released into the wild in 2009. Three-dimensional reconstruction of body movements after releasing into the wild was conducted. We found that the released manatees always swam in circles and gradually changed turning motions as they approached the abundant vegetation areas. Subject manatees kept turning in all directions in their surroundings and expanded their search area by using sensitive facial bristles. A sound recorder shed a light on each feeding event. Custom made software developed on Matlab extracted feeding events automatically. Compared to ground truth data obtained by manually listening, the program correctly detected 65–79% of the feeding events, with a 7.3% or lower false alarm rate, which suggests that this methodology is a useful recorder of manatee feeding events. The animal-borne data logging systems will be applicable to understanding manatee behavior. We believe the animal-borne recording system will open the way to a better understanding of manatees.

MONITORING OF AMAZONIAN MANATEES *Trichechus inunguis* REHABILITATED BY CREA SUGGESTS POST RELEASE ADAPTATION. Landeo-Yauri, Sarah^{1*} & Castelblanco-Martínez, Nataly². ¹Centro de Rescate Amazónico (CREA), ²Oceanic Society. sslandeo@gmail.com*

The Amazonian manatee *Trichechus inunguis* is endangered from illegal hunting. In Peru, Centro de Rescate Amazónico (CREA) rehabilitates and releases rescued manatees. Three females and two males were the first manatees

released by CREA, and were tracked by VHF telemetry from late July to the end of November 2011. The release area is within the Pacaya Samiria National Reserve (PSNR) and includes El Dorado Lake and adjacent water sources. Post release tracking allowed evaluation of the manatees' adaptation into free-living conditions. Behavior was recorded following *ad libitum* sampling methods, and daytime habitat use was determined considering available habitats (floating vegetation, open water, marginal vegetation) and manatees' locations recorded in each habitat. We obtained 140 locations during 80 search hours (approx.). Females showed greater residence time than males, which migrated out of the lake. According to usage vs. availability analysis, females selectively used the habitats in the basin, preferring floating vegetation ($\bar{t}_i = -1,667$) followed by open water ($\bar{t}_i = 0,667$) and lastly marginal vegetation ($\bar{t}_i = 1$). No relationship between sighting hour and sighting location (habitat type) was found ($X^2 = 3,813$, $P = 0,432$). Most idling behaviors were registered in areas with floating macrophytes and open water was mainly used for traveling. Environmental variation was recorded during the study period - water surface temperature ($F = 6,31$; $p = 0,003$); pH ($F = 31,89$; $p = 0,000$) - but environmental variables associated with manatee locations were not associated with occupancy. The data recorded (movements, habitat use) corresponded to previous reports for the species in natural habitats, and suggests that these rescued manatees responded well to free-living conditions after release. We recommend carrying on with the efforts of rescue, rehabilitation and release of manatees, as this work strengthens the strategy for their conservation.

OCCURRENCE OF MANATEES IN AREAS OF HIGH HUMAN IMPACT IN THE SURROUNDINGS OF BELÉM, AMAZON ESTUARY. Leão Miranda, Tayna^{1*}; Ramos, Iara¹; Melo Alves Dos Santos, Gabriel¹; Lúcia Figueiredo Rodrigues, Angélica¹; Luisa Da Silva, Maria¹ & Sena, Leonardo¹. ¹BioMA/UFGPA (Biologia e Conservação de Mamíferos Aquáticos da Amazônia/Universidade Federal do Pará). tayleaomi@gmail.com*

The Amazonian manatee (*Trichechus inunguis*) is widely distributed in the Amazon Basin, where local populations may use it as an alternative source of food. This species is considered vulnerable by the IUCN, and there are records of the hunting of manatees in the urban zone of Belém, the capital of the Pará State, Brazil. Thus, anthropogenic factors such as habitat degradation, overpopulation, and hunting pressure might be the main threats to Amazonian manatees close to this city. Our aim was to investigate the occurrence and the human perception of *T. inunguis* in Belém and surrounding areas. In order to gather ethno-ecological information we used semi-structured interviews with 21 people, including fishermen and other residents that are or were involved with fishery activities, from Icoaraci, Cotijuba, Outeiro (Belém), Arapiranga and Jutuba (Barcarena). We visited possible foraging refuges and characterized the environment where manatees could possibly occur, and collected vestiges of feeding on plants that were reported to have been recently visited by manatees. All interviewees confirmed the sighting of manatees predominantly black in color, and 23% of them also reported a ventral spot varying from white to yellow, which is characteristic of the Amazonian manatee. Concerning the ecology, respondents stated the animals prefer to feed in calm waters during the high tide, and are seen in higher frequency during the rainy season. Among the areas studied, Icoaraci, which has a prominent human impact, was the highest in frequency of reported sightings; in total, there were 15 sightings from 2013 to 2014, 66% of them from November to April (rainy season). Cotijuba showed the lowest frequency of reported sightings, restricted from February to March, reported by the interviewees as the reproduction season. The areas studied have common features, with a relatively high plant diversity, such as *Montrichardia linifera* (Schott, 1854), *Eichhornia crassipes* (Benoit Mure, 1879), and some grasses, e.g. *Eleocharis minima* (Pedersen & F. Mereles, 1837), which are described in the literature as part of the manatee diet. The areas of study are composed of an estuary with several small rivers and resting water areas, potential habitats for manatees. Boat traffic is intense, and even ferries and cargo ships are observed in those areas, factors which are known to disturb aquatic fauna, including manatees. Our results will shed light on the conservation of Amazonian manatees in highly impacted urban areas and will contribute to understanding the ecology of *Trichechus* spp. in the Amazonian estuary.

STRANDING OF A WEST INDIAN MANATEE (*Trichechus manatus*) ON THE NORTH COAST OF BRAZIL. Lima, Danielle^{1*}; Borges, João^{1,2}; Coutinho, Iranildo³; Guerra-Neto, Guilherme¹; Moreno, Eduardo¹; Sabioni, Luiz¹; Vergara-Parente, Jociery^{1,2,4} & Marmontel, Miriam¹. ¹Instituto de Desenvolvimento Sustentável Mamirauá, ²Fundação Mamíferos Aquáticos; ⁴Instituto de Tecnologia e Pesquisa ³Instituto Chico Mendes de Conservação da Biodiversidade (ICMBIO) - limadanielle@terra.com.br*

The stranding of West Indian manatee calves is one of the most serious threats to the species in Brazil. In the northeast coast, this factor is responsible for 25% of the mortality records and relates especially to the degradation of mangroves, considered optimal habitat for reproduction and parental care. However, the stranding of manatees in northern

Brazil, where the vegetation is abundant, is rare and the causal factors are poorly described scientifically. Considering the importance of the topic and the lack of information, this study aimed to report the stranding and the successful rescue of a baby manatee in the state of Amapá, in the extreme north of the country. In September 2013, local residents and firefighters of ESEC Maracá-Jipioca rescued a manatee calf (male, CT: 1 m, P: 19 kg) found stranded alive on the river Amapazinho, in the Coastal Estuarine Sector of Amapá State. In compliance with the guidelines of the Stranding Network and Information of Aquatic Mammals of Brazil, active institutions in the region provided technical input to ensure the survival and physical integrity of the animal, thus promoting the success of the rescue. Since then, the calf has been kept in the center of wild animals (Cetas / IBAMA) of the federal government, under multi-institutional technical advice. In order to obtain information about possible influencing factors of this stranding, because the area is in one of the most conserved and least populated stretches of the Brazilian coast, locals and fishermen in the region (n = 37) were interviewed in an opportunistic way between September 2013 and July 2014. From the reports and environmental analysis, it was considered unlikely that (1) there was a deliberate killing of the adult female, as this practice has not been recorded in the area for six years; (2) there was an absence of habitats conducive to calving, given the abundance of pristine areas in Amapá coast. The region is subject to macro tides (9.7 m) and is under the influence of a tidal bore (“pororoca” - waves up to 5 m and speeds between 10 and 18 km/h), which suggests the possibility the stranding was caused by such natural factors. All responders related this stranding to a spring tide (‘maré de sizígia’), known as tide-living, which took place in the days before the event. Possibly the amplitude of the waves and the speed of the tide caused the calf to strand, even though the region can be considered fully in terms of favorable habitat for manatee reproduction, as well as parental care.

PEDIGREE MONITORING OF MANATEES IN CAPTIVITY AT CMA/ICMBIO IN BRAZIL PROVIDE EVIDENCE OF INBREEDING. Luna, Fabia^{1*}; Nourisson, Coralie²; Hunter, Margaret^{3,4}; Davis, Michelle⁵; Attademo, Fernanda¹; Bonde, Robert^{3,4}; De Oliveira Passavante, José Zanon⁶.
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In captivity, it is well known that manatees breed and reproduce relatively easily. Calves are rescued and individuals transferred from irregular captive conditions to the CMA/ICMBio, where they are kept together. Since 1996, breeding occurred with no captive breeding reproduction plans or genetic information to help select the appropriate breeding pairs. This may have resulted in inbreeding. For properly managed captive programs, maintaining the genetic diversity and limiting inbreeding will increase the likelihood that animals will adapt to new environments and reproductively viable. By doing this it will ensure that rehabilitated manatees are fit for release into the wild. Captive-born manatees at CMA/ICMBio are part of an ex-situ population that is exhibited for public education. As there are more manatees than is necessary for education purposes, some of them were previously released in areas to help encourage use of travel corridors and provide admixture between neighboring populations. For this study twenty manatees were analyzed with 27 microsatellites markers and pedigrees were reconstructed using ML-RELATE, COANCESTRY, and CERVUS. Almost all the manatees in captivity at CMA/ICMBio indicated some level of relatedness among them and inbreeding was identified. Some of them had high levels, as the number of founders at CMA/ICMBio has been small and reproduction between related offspring was allowed to occur. The presence of a dominant breeding male, who fathered several calves, resulted in half sibling relationships and greatly increased the inter-relatedness in the captive population. Only one case of reproduction between parent and offspring was detected and resulted in a stillborn, which may have been due to the high level of inbreeding. Nevertheless, some inconsistencies were observed, such as two calves not assigned as offspring to their known mothers. To obtain more confidence, more markers are necessary. The results of this study permitted managers to make decisions about the future of the captive manatees in Brazil. The actual captive population is too large to be managed properly and it is recommended that appropriate manatees be released, while others are transferred to new facilities. It is not recommended to release several siblings in the same areas to avoid the potential for inbreeding. To avoid captive manatee inbreeding, artificial hybridization (one captive is a known hybrid), and overpopulation in captivity, it is necessary to forbid reproduction in captivity, thereby separating males and females into different facilities in order to maintain a healthy captive population and prevent accidental breeding in the future.

MICROBIOTA BY YEAST IN NATURAL CAVITIES OF CAPTIVE SIRENIANS IN BRAZIL: RELEVANCE FOR ANIMAL AND ENVIRONMENTAL HEALTH. Luz Carvalho, Vitor^{1*}; De Souza Collares Maia Castelo-Branco De Souza, Débora²; Nogueira Brilhante, Raimunda Sâmia²; Da Costa Sidrim, José Júlio²; Lazzarini, Stella Maris³; Loffler Niemeyer Attademo, Fernanda⁴; Oliveira De

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The composition of the microbiota by yeast in Sirenia is unknown, and there are few reports of fungal infections and antimicrobial susceptibility studies of these animals. The aim of this study was to characterize the microbial yeast of natural cavities of *Trichechus manatus* and *T. captive inunguis* in Brazil and evaluate the antifungal susceptibility profile of the isolates. The samples were obtained with sterile swabs from oral cavity, nostrils, genital and rectal openings of 26 *T. manatus* and 50 *T. inunguis*, male and female, of different ages. Samples were plated on Sabouraud agar containing chloramphenicol and maintained at 25 °C for five days. Isolated yeast colonies were identified by biochemical and micromorphological evidence. The strains of *Candida* spp. were submitted to the microdilution test to evaluate the sensitivity profile to antifungal agents itraconazole, fluconazole and amphotericin B. 141 strains were isolated, with 112 of *T. inunguis* (40 *Candida albicans*, 21 *C. parapsilosis*, *C. guilliermondii* 9, 3 *C. peliculosa*, 2 *C. tropicalis*, *C. glabrata* 2, 1 *C. famata*, 1 *C. krusei*, *C. novogengensis* 1, 1 *C. ciferri*, 28 *Trichosporon* sp., 2 *Rhodotorula* sp., *Cryptococcus laurentii* 1) and 29 *T. manatus* (12 *C. albicans*, *C. tropicalis* 4, 4 *C. famata*, 3 *C. guilliermondii*, *C. krusei* 1, 4 *Rhodotorula* sp., *Trichosporon* sp 1.). The genital opening showed the highest isolation rate and the nostrils the lowest for both hosts. No differences were observed in the isolation between males and females or between young, subadults and adults. Among the calves, only those with a poor clinical outcome were colonized by yeast. The minimum inhibitory concentrations (MICs) for amphotericin B ranging from 0.03 to 1mg/mL, compared to strains of *Candida* spp. (N = 105), resistance was not observed. The itraconazole and fluconazole MICs ranging from 0.03 to 16 mg/ml and 0.125 to 64 g/ml, respectively, observed resistance to at least one drug in 35.2% of isolates (32 *C. albicans* 4 *C. tropicalis* and *C. guilliermondii* 1), with similar prevalence in both host species. This work shows the importance of yeasts as constituents of the microbiota of manatees and as potential agents of opportunistic infections. It is believed that the main cause of high resistance levels are due to the diet of growth plants, since antifungals are widely used in agriculture. The impacts of reintroduction of animals colonized by resistant microorganisms into the wild should be monitored.

REINTRODUCING MANATEES TO THE WATERS OF GUADELOUPE: AN ATTEMPT TO ENHANCE CONSERVATION OF WEST INDIAN MANATEES IN THE WIDER CARIBBEAN. Magnin, Hervé¹; Lerebours, Boris^{1*}; Luna, Fabia²; Reynolds, John³ - ¹Parc national de la Guadeloupe, ²Instituto Chico Mendes de Conservação da Biodiversidade (ICMBIO), ³Mote Marine Laboratory. boris.lerebours@guadeloupe-parcnational.fr*

With support from the French Ministry of Ecology, the National Park of Guadeloupe has taken careful steps to assess the feasibility of reintroducing manatees to the waters of the Grand Cul-de-Sac-Marin (GCSM) a large protected area of 15,000 ha. Although manatees were extirpated from Guadeloupe over a hundred years, the waters of the GCSM are well protected, including enforced no-entry zones, and have relatively little boat traffic or other threats to manatees. Formal agreements with local fishing organizations and relationships with communities are attempting to secure local support of a reintroduction effort. An Expert Working Group of specialists in the biology and conservation of manatees is carefully guiding the process and extensive studies have been conducted to address the various scientific and technical components of the project. Even though large terrestrial mammals are reintroduced successfully as an accepted conservation measure, marine mammal reintroduction initiatives have been avoided until today with only one exception (sea otters on the west coast of the United States). Therefore, in light of the extreme rarity of marine mammal reintroductions globally, this program may provide an extremely useful model and good lessons to enhance species conservation. By showing that properly planned reintroductions can be an effective conservation tool for a large marine mammal, the project will become a valuable case study that can contribute to conservation of a range of endangered, threatened, or vulnerable stocks and species. The paradigm shift is essential and timely; the manatee reintroduction provides the case study. Among its various ambitions, the project aims to 1) promote a reintroduction and monitoring program that can encourage and promote success of similar efforts with marine mammals elsewhere in the world; 2) create a well-protected and well-studied population of manatees that could ultimately grow to become one of the larger and more stable groups for the species in a region where manatee status is precarious in the majority of range states; and 3) support research and conservation efforts for manatees elsewhere in the wider Caribbean. Thus, the project to reintroduce manatees to the waters of Guadeloupe could have extremely important and widespread regional impacts for improved conservation.

CURRENT STATUS AND THREAT FACTORS TO SOUTH AMERICAN MANATEES.

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In South America, Sirenia are represented by two species, *Trichechus manatus manatus*, the Antillean manatee (subspecies of *T. manatus*, the West Indian manatee), and *Trichechus inunguis*, the Amazonian manatee. According to criteria adopted by the International Union on Conservation of Nature (IUCN), the first species is considered endangered, while the latter is considered vulnerable of extinction. This classification may vary according to each range country that harbors populations of these species, as may vary the degree of protection offered by the set of national laws. Factors threatening the conservation and survivorship of populations are oftentimes shared between the species, however there are unique factors for each one. Among the main factors affecting the Antillean manatee are the alteration of coastal habitats and the stranding of dependent calves in the easternmost limit of the distribution. In the case of the Amazonian manatee, the main factors related to its conservation are those related to subsistence hunting, which includes both culling of adults and capture of calves. The latter adds to accidental entanglements throughout the region and increases the problem of captive rehabilitation and difficulties in future return of the animals to the natural environment. Recently, the confirmation of hybridization between the two species around the region of the mouth of the Amazon has raised concern among conservationists in relation to those individuals and the strategies for releasing rehabilitated Antillean manatees along the northern coast of South America.

STRANDINGS OF WEST INDIAN MANATEE CALVES IN THE SEMI-ARID COAST OF NORTHEAST BRAZIL: WHICH FACTORS MAY BE INVOLVED? Meirelles, Ana Carolina^{1*}; Carvalho, Vitor Luz¹; Silva & Cristine Pereira negrão¹. Associação de Pesquisa e Preservação de Ecossistemas Aquáticos – AQUASIS. cameirelles@yahoo.com.br*

The stranding West Indian manatee (*Trichechus manatus manatus*) calves is one of the main threats this Critically Endangered (CR) species faces in northeastern Brazil. The east coast of Ceará and west of Rio Grande do Norte (semi-arid coast) is the region with the highest incidence of strandings of this nature. The aim of this study was to identify and discuss the various factors that may be contributing to the high number of records over almost two decades. Typically, the pattern of mortality observed for mammals has a high rate at the initial stage of life, followed by a period of relatively low mortality and finally a period of increased mortality in senescent animals. In the study area, approximately 80% of registered strandings were neonates, an extremely high percentage for the species. The causes most often cited to explain this phenomenon are the degradation and loss of estuaries, which are the most appropriate areas to the birth of offspring and parental care in this region. This degradation has a greater effect on the semi-arid coast when compared to other regions of the species occurrence, due to the characteristics of the rivers, which are quickly silted due to the small size. The lack of these important areas increases the vulnerability of females and their offspring to adverse geo-environmental factors and/or disturbances caused by fishing boat activities and oil and gas exploration and production. This vulnerability associated with the recruitment of young and inexperienced females may negatively influence the maintenance of mother-calf units causing permanent separation of the couple. It is still unclear what factors (environmental, behavioral and/or anthropogenic) could influence the success or failure of a female rediscovering her calf after a separation. In addition to these factors, it is known that intensive hunting and observation of low genetic variability of manatees in the country are signs that the population went through a population bottleneck and may undergo various genetic problems, including those caused by the crossing of related individuals and a consequent inbreeding depression. Certain levels of inbreeding may affect the reproductive success of animals, including decreasing the survival of juveniles, the birth of weak animals or loss of maternal ability. Pedigree and inbreeding studies, in addition to determining age of the population are a priority to test the hypotheses discussed here, and to aid the management and release of rehabilitated calves.

ENVIRONMENTAL EDUCATION: A TOOL FOR THE CONSERVATION OF THE MANATEE *Trichechus manatus* IN SINÚ BASIN, CORDOBA, COLOMBIA. Mona Sanabria, Yenyfer^{1*}; Espinosa Forero, Rafael² & Caicedo Herrera, Dalila³. ¹Fundación Omacha, ²Corporación Autónoma Regional de los Valles del Sinu y del san Jorge –CVS. yenyfermona@gmail.com*

The manatee is considered a flagship species in the basin of the Sinu River. Since 2003, the Corporación Autónoma Regional de los Valles del Sinú y San Jorge CVS and the Omacha Foundation have been working on the formulation and implementation of the Manatee Management and Conservation Plan in the lower basin of the Sinu River, where one of the programs is environmental education. The topic "Environmental Education and Community Participation" was identified as a key tool in the process of sensitization and awareness to the community of fishermen, coastal and local inhabitants as well as the education sector. The methodology used is participatory, allowing the integration of scientific knowledge with traditional

and local knowledge through interviews, workshops, lectures, dialogues, recreational activities, training and monitoring in telemetry techniques. Relevant results include the formation of Friends of the Manatee Club, composed of students of the Lórica's educational institution Juliao David Sanches; the participation of people in monitoring activities; about 180 workshops from 2008-2013; 500 phone calls reporting sightings of manatees by the community; design and distribution of outreach material such as booklets, posters, and buttons; and more. The environmental education work has enabled a shift in consciousness in the community, joining efforts between institutions and strengthening social information in favor of the conservation of manatees in the area.

LOW GENETIC DIVERSITY OF THREATENED WEST INDIAN MANATEES (*Trichechus manatus*) IN THE SEMI-ARID NORTHEASTERN BRAZILIAN COAST. Moreira, Sávia¹; Rêgo, Pérciles¹; Meirelles, Ana Carolina²; Carvalho, Vitor Luz² & Araripe, Juliana^{2*}. ¹Universidade Federal do Pará, ²Associação de Pesquisa e Preservação de Ecossistemas Aquáticos – AQUASIS. saviamoreira@hotmail.com*

The West Indian manatee is a threatened aquatic mammal species in Brazil, with a population estimate of a few hundred individuals in the country's coastal region. Currently, the species has a fragmented distribution, from Amapá to Alagoas State, and is already extinct in three states (Sergipe, Bahia and Espírito Santo), as a consequence of intentional and accidental captures and habitat degradation. Previous studies identified a low genetic diversity for the species in Brazil, serving as a warning for manatee conservation in this region. In the semi-arid Brazilian northeastern coast there are records of numerous strandings, therefore genetic studies concerning stranded manatees in this region are essential for the conservation of the species. Thus, the objective of this study is to investigate the genetic diversity of West Indian manatees on the coast of Ceará and Rio Grande do Norte, northeastern Brazil. For the collection of molecular data, we sequenced the control region of the mitochondrial genome of 29 individuals, of which thirteen have never been used in other genetic studies. We analyzed 476 bp using the programs Bioedit and DNAsp. We discovered that a unique haplotype (M1) is common for all analyzed individuals. When comparing the region of this study with sequences from GENBANK, we found evidence for the existence of about 21 described haplotypes for the species, with the occurrence of three (one of these being a possible hybrid) of them on the Brazilian coast. On the northeastern coast, there are previous records of the unique haplotype we found in all individuals. Former studies indicate an elevated haplotypic diversity of the species in Guyana, Venezuela and Colombia, and extremely low values for Brazil and Florida. The nucleic diversity indices of Florida and Brazil are close to zero. In our research, both the haplotypic and nucleic diversity presented null values. These results reinforce that the population of West Indian manatees of the semi-arid region has low genetic diversity, reducing its evolutionary potential, which in the future may result in local extinction, as a consequence of factors like the fragmentation of habitats, which is intensified by the low population numbers in this region. Conservation actions for the species in this region should be intensified, and studies (ecological, environmental, educational and genetics) should be developed, outlining strategies to recover/improve the diversity of the species in this critical region.

HOME RANGE AND HABITAT USE BY MANATEES *Trichechus manatus* (SIRENIA: Trichechidae) in the Potiguar Basin, BRAZIL. Normande, Iran Campello^{1*}; Attademo, Fernanda Loffer Niemeyer¹; Viana Jr., Pitágoras Carlos¹ & Savaget, Patrícia Veloso¹. ¹Centro Nacional de Pesquisa e Conservação de Mamíferos Aquáticos/ICMBio. iran.normande@icmbio.gov.br*

Animal tagging using telemetry techniques allows for continuous monitoring of individuals, enabling the recognition of habitat use patterns and the identification of natural or human activity-induced seasonal migrations. This study aimed to determine the home range and recognize habitat use patterns of *Trichechus manatus* in the Potiguar Basin, northeastern Brazil. Native individuals were captured for the first time in the country through seine nets launched from a specially designed vessel. After transportation to the beach, morphometric measurements, collection of biological material, and tagging were performed. The marking system consisted of a belt attached to the tail peduncle, a nylon rod and a floating transmitter. Transmitters were used with GPS technology, equipped with PTT and VHF (TMT-462 models and 464-2 Telonics Inc.). The home range AV (95%) and Activity Centers AOC (50%) were calculated using the fixed Kernel method by HRT extension of ArcGIS. Six manatees (n = 6) were captured and monitored by satellite telemetry between May 2012 and April 2013, totaling 807 days and 6,193 point locations. The monitoring time ranged between 03 and 339 days (mean = 135.5 ± 127.24). Due to the short monitoring period, two individuals were excluded from analyzes. The adult male "MCE-01m" had the highest AV (155.56 km²) and COA (n = 5, 21.89 km²), while the adult female "MCE-04F" had the lowest AV (41.33 km²) and COA (n = 1 ; 6:18 km²), possibly because she was accompanied by a calf. The daily commute rate ranged from 5.35 to 11.10 km / day (mean = 7.28 ± 2.20). Areas up to 5 m deep were more widely used; however use of areas up to 10 m in depth was recorded. All COAs (n = 12) had seagrass occurrence and marine algae; and eight (67%) had occurrence

of water sinks, suggesting that such resources are important drivers of habitat use by manatees in the study area. Only three (25%) COAs were located near rivers and estuaries; however, no individual used these ecosystems. The methodology for capturing and monitoring proved to be effective; however, the sampling should be expanded to allow for conclusive inferences about the population. It is necessary to increase the protection of the habitat patches used intensively, as well as the displacement of corridors between them.

OVERVIEW OF GENETIC STUDIES ON MANATEES IN LATIN AMERICA: WHAT HAS BEEN DONE, WHAT IS NEEDED? Nourisson, Coralie¹. ¹Centro de Investigação em Biodiversidade e Recursos Genéticos CIBIO - coralie.nourisson@cibio.up.pt*

The first studies on manatee genetics were conducted in Florida, USA, and included manatees from Latin America. Those pioneering studies used mitochondrial DNA markers and some microsatellites in samples from various locations from Florida to Brazil. Thus, the phylogeographic structure of manatees was defined and three genetically distinct groups were identified. However, although these studies gave an important global overview, they were not sufficient for the local perspective, which is necessary when making well-informed decisions on manatee conservation. Studies of population structure at a finer scale were developed in several other countries, including Mexico, Puerto Rico, Belize, Colombia and Brazil for the West Indian manatee, and in Brazil, Peru and Colombia for the Amazonian manatee. These studies used the development of numerous microsatellite markers that allowed researchers to define distinct populations, as well as determine their genetic diversity and connectivity. They also defined reintroduction areas for rescued and rehabilitated individuals that helped in making informed management and conservation decisions. Recently, pedigree studies allowed management to avoid inbreeding and maintain healthier captive populations in Mexico and Brazil. Pedigree studies applied to wild populations will increase our knowledge about the reproduction of these species which are still largely unknown, such as the identification of dominant breeders and the level of inbreeding. With the recent sequencing of the Florida manatee genome, and the new tools of genomics and transcriptomics, local adaptation and the regional hybridization of South American species near the mouth of the Amazon River, are being studied. Studies on population structure, genetic diversity, pedigrees and genomics are now possible due to recent technical and economic advances. However, in many countries no manatee genetic studies are being conducted. Collaboration between genetic laboratories and research groups in the future will provide a better understanding of manatee biology. Also, the increase of these collaborations and the use of new techniques, will allow analyzes of manatee populations throughout their range in Latin America and will assist with their conservation. Finally, it is extremely important to remember that a primary component for genetic studies is the proper collection of samples.

INSIGHTS INTO THE INTESTINAL MICROBIOTA OF THE ANTILLEAN MANATEE

Trichechus manatus. Otorola Rodriguez, Paula Marcela - Antek - pausaota@gmail.com*

Intestinal microbiota is essential for metabolism in herbivorous mammals, releasing simple sugars from the complex plant polysaccharides. One of these polysaccharides is cellulose, which comprises 70% of plant biomass. The crystalline structure of cellulose makes it resilient to biological hydrolysis, but certain bacteria and fungi associated with the microbiota are able to hydrolyze it, by the production of cellulases. With the notable exception of ruminants, little is known about the intestinal microbial diversity from herbivorous vertebrates. In this study, we characterized the intestinal bacterial biota of the West Indian manatee *Trichechus manatus*, a strictly herbivorous, endangered, aquatic mammal. Characterization was done using two approaches: extracting total DNA from the samples, amplifying the rDNA 16s gene followed by DGGE run and sequencing of bands obtained; and by selecting cellulolytic microorganisms from the culturable fraction obtained from fecal samples and swabs collected directly from the anus. From the culture-independent approach were able to establish the presence of different genera, most of them belonging to the phylum Firmicutes, which could play a key role in the hydrolysis of cellulose. Four strains with cellulolytic activity in CMC agar were isolated and identified as members of the genus *Klebsiella*, for which cellulolytic capacity has not been reported. This is, to our knowledge, the first study providing information on the bacterial community associated with the intestinal tract of the West Indian manatee.

INTERVIEWS: TOOL OF KNOWLEDGE OF INTERACTION BETWEEN FISHERMEN AND MANATEES IN THE SINÚ BASIN OF RIVERS AND MAGDALENA, COLOMBIA.

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Within the framework of the study of bycatch and boat collisions of the Action Plan for the Conservation of Marine Mammals in the Caribbean and West Indian (MMAP), information was collected to determine the interaction that

communities inhabiting the basins of the Sinu and Magdalena rivers in Colombia have with manatees (*Trichechus manatus*). This species is considered endangered. In Colombia, it was distributed in the Atrato and Sinu River Basin and in Magdalena River Basin in San Jorge and Cauca rivers. Manatees suffered from high hunting pressure, which in the last 24 years has changed due to the efforts of researchers in conjunction with coastal communities. This work was executed in the Sinu and Magdalena Rivers. Between May and June 2013, 510 semi-structured interviews were conducted, 272 of which corresponded to the basin of the Sinu River between the Ciénaga Grande de Lorica and San Bernardo del Viento and 238 were performed in the basin the Magdalena River from Puerto Berrio to Barranquilla. Seventy-five percent of respondents were fishermen between 16 and 85 years of age, and the remaining respondents noted some activity associated with fishing. Eighty-seven percent of the younger fishermen aged between 15 and 35 years had never seen a manatee. The most frequent interactions corresponded to bycatch, ship strikes, hunting and chance encounters. Sixty-eight percent of interactions occurred during fishing operations when manatees were entangled in fishing gear and broke the gear. Thirteen percent of respondents said that hunting is or was common practice in the region and 95% of respondents claimed to have sighted manatees while conducting various activities in the rivers. There are various perceptions related to these animals, including interviewees expressing that they have different kinds of meat, that they keep the ecosystems alive, that they maintain deep water, and that manatees play a role in controlling aquatic macrophytes and retard the eutrophication process.

EXPERIENCES IN THE RESCUE, REHABILITATION AND RELEASE OF AMAZONIAN MANATEE *Trichechus inunguis* (Sirenia: Trichechidae), AND ENVIRONMENTAL EDUCATION IN THE PERUVIAN AMAZON. Sánchez Babilonia, Juan Justo- Centro de Rescate Amazónico (CREA) - jsanzbabi2012@hotmail.com*

In 2007, when our interest in the conservation of the Amazonian manatee began, we developed an investigation related to illegal trafficking of the species and the same year we accounted for 15 manatee calves who had died in captivity due to illegal trafficking. Until then, there was no private or state program that would help avoid local extinction of the Amazonian manatee. In order to alleviate this problem, we started our work with the rescue of a small manatee which we named 'Suramérica'. In October 2009, an interagency cooperation agreement between ACOBIA-DWAZOO, The Dallas World Aquarium, Instituto de Investigaciones de la Amazonía Peruana IIAP and the regional government of Loreto GORE was signed, leading to the creation of Fundación Iquitos – Centro de Rescate Amazónico (CREA), whose facilities are located in AQUAREC-IIAP on the road to Iquitos - Nauta 4.6 Km. To date, thanks to this joint effort, we have achieved successful rescue and rehabilitation of 27 manatees; in 2011, the first release of manatees was held in Peru in Cocha El Dorado, located in the heart of the Pacaya Samiria National Reserve, PSNR. This release was developed with the support of local communities, who received environmental education opportunities and are currently very committed to the conservation of the species. In 2012, 2013 and 2014 the task of releasing and monitoring animals has continued, with a total of 12 released manatees. As a complement to the rescue, rehabilitation and release program, in 2008 the environmental education program, "EduCREA" was developed, in order to generate environmental awareness and positive emotions in children and adults regarding the conservation of the different species of endangered Amazonian fauna and their ecosystems. We use different methodologies such as lectures, workshops, recreational activities, guided tours, media campaigns, etc.. To date we have been able to reach over 80,000 people in the city of Iquitos and in different cities and communities of the Amazon basin.

CURRENT SITUATION AND GENEALOGICAL RECORD OF ANTILLEAN MANATEES *Trichechus m. manatus* (Sirenia: Trichechidae) IN ZOOS AND AQUARIUMS OF LATIN AMERICA. Silva, Carlos Javier^{1*} & Mujica De Jorquera, Esmeralda¹. ¹Asociación Venezolana de Parques Zoológicos y Acuarios. cjsvet@gmail.com*

In Latin America, there are ten zoos and aquariums that keep Antillean manatees *Trichechus m. manatus* in their facilities. It is necessary to analyze the current situation of individuals of this species housed in *ex situ* conservation centers in Colombia, Mexico, Dominican Republic and Venezuela. For this, data were obtained from the database of the Latin American Association of Zoos and Aquariums and analyzed using a questionnaire in Excel, which was distributed. To analyze the current situation, the number of specimens and origin were considered, while for the studbook we considered the institution, identification number, gender, date of birth, date of admission to the collection, parents and origin. We obtained the following results: 34.78% specimens were acquired through rescue activities, 21.74% through confiscatory procedures, 28.26% were born in captivity and there is no origin information for 15.22% of the individuals. Between 1984 and 2014, the presence of 46 captive manatees was reported. To date (July 15, 2014) the reported captive population consists of 39 living individuals, of which 46.15% are male, 51.28% are females and 2.56% are undefined. Of the 46 known manatees, 73.91% came from the wild. Regarding the type of upbringing, 30.43% were raised artificially, 30.43% by their parents, 34.78% uninformed, 2.17% did not survive and 2.17% had mixed breeding. As for the reproductive status of the 39 currently living

specimens, 25.64% are calves, 5.13% are immature, 20.51% are without information and 48.72% are sexually active. The obtained genealogical record needs to be revised regularly, in order to update the demographics of the species in captivity and to propose an appropriate management plan. Captive breeding has been successful; however, with advances in genetic conservation, the origin of each specimen is important in cases of future reintroductions, as it is not recommended that reproduction of related animals or animal with undefined sources be allowed. Interagency cooperation for proper management for the species is required.

FIRST TRANSBOUNDARY MONITORING OF THE CARIBBEAN MANATEE AS A STRATEGY TO STUDY THIS POPULATION AT A REGIONAL LEVEL. Ubeda, Armando - LightHawk - aubeda@lighthawk.org*

The West Indian manatee *Trichechus manatus* is in danger of extinction, therefore periodic monitoring is a valuable tool for establishing the conservation status of populations. Due to the ecological character of their habitats, the method that best meets the research needs of the Caribbean manatee is aerial surveys. For several years, LightHawk has supported various organizations in Mexico and Central America with flights to monitor and research manatees. These flights have been useful to estimate local populations but have not been enough to understand the distribution of the species at a regional level, which is critical for its conservation. Manatees, like most marine mammals have an extensive home range and can travel hundreds of miles in a short time, often across political boundaries between countries. Due to these ecological and behavioral characteristics, it is necessary to develop a regional monitoring plan. Therefore, in 2013, LightHawk invited researchers in Mexico, Belize and Guatemala to conduct a continuous survey in the three countries using innovative protocols. The proposed sampling protocols used two independent observers and considered environmental variables, which can measure detection bias and estimate the number of manatees undetected by observers during sampling. Thus, it is possible to estimate the abundance of manatees in the region instead of providing only the minimum count of individuals. A team consisting of researchers from six countries (USA, Mexico, Belize, Guatemala, Nicaragua and Colombia) participated in a continuous monitoring from 2 to May 10 from Holbox (Yucatan Peninsula, Mexico) to Omoa Bay (Guatemala). Ten people participated in 41.3 flight hours spread over 11 routes. This type of continuous sampling is first of its kind to include three countries and using new methodologies. LightHawk aims to strengthen collaboration between researchers from these countries, encouraging regional training in sampling techniques, increasing knowledge about the distribution of this species at the regional level and contributing to the conservation of manatees in the region. One of the goals is to continue this monitoring program and research including other countries in the region.

RELEASE OF AMAZONIAN MANATEES *Trichechus inunguis* REHABILITATED AT THE CENTRO DE RESCATE AMAZÓNICO (CREA) - PERU: EXPERIENCES AND RECOMMENDATIONS. Velásquez Varela, Luis Javier¹; Sánchez Babilonia¹; Tapayuri Olivera, Kelly Romina¹; Aguilar Armas, José Carlos¹ & Guzmán Téllez, Javier Elías¹. Centro de Rescate Amazónico (CREA) - sslandeo@gmail.com*

Amazon Rescue Center CREA has had four release events from 2011 to date. Differences in features and number of individuals released, release area, *in situ* and whether monitoring protocols occurred during these events, however all released individuals were fitted with radio transmitters, allowing assessment of their condition during post-release. The first and second releases occurred within the Pacaya Samiria National Reserve and included a period of *in situ* acclimatization in a pre-release facility. Two males and three females in the first event and two females and one male in the second were released, with a monitoring time of five and two months, respectively. The third release event was developed as a pre-release phase, where a male and three females were released into the Lake Quistococha closed system and monitored for one year. The last event was held within the Regional Conservation Area Community Tamshiyacu Tahuayo, and included three females and one male, which did not go through a period of acclimatization *in situ*. The monitoring persists to this day. The experience gained through these processes allows us to suggest the importance of certain items for a successful release: Manatees must be released within the range of the species and within a protected area to reduce the risk of hunting; and nearby communities should be involved in the process of releasing and monitoring. It is suggested that the time of release is the low or descendent water to prevent individuals migrating just after release. The release area must have sufficient food availability, preferably including plant species which animals are used to. It is recommended that a period of acclimatization *in situ* is provided for animals to experience the natural conditions of the release area, where they can be fed vegetation of the area and be monitored closely. It is also suggested that releases include mixed groups of individuals with less time in captivity with individuals who have spent more time in captivity, to facilitate the adaptation of the latter. The information obtained through these release experiences aims to improve and implement future releases of manatees, so we consider it important information to document and disseminate.

PHYLOGENETIC RELATIONSHIPS AND POTENTIAL HYBRIDIZATION OF SOUTH AMERICAN SEA COWS (MAMMALIA, SIRENIA). Voss, Manja - Museum fuer Naturkunde Berlin - manja.voss@mfn-berlin.de*

The modern Sirenia, or sea cow, represents the only large aquatic herbivore. They are distributed across shallow tropical and subtropical waters and are known by the genus *Trichechus*, or manatees, on both sides of the Atlantic and the dugong in the Indo-Pacific region. *Trichechus* known from the Pliocene to Recent is represented by three living species, the West Indian (*T. manatus*), the Amazonian (*T. inunguis*) and the West African manatee (*T. senegalensis*). The West Indian and the West African manatees occur in both marine and freshwater environments, whereas the smallest of all Sirenia, the Amazonian manatee, is restricted to the freshwater systems of the Amazon basin. The interrelationships of these three manatee species are analyzed on the basis of a comprehensive phylogenetic analysis. For this purpose, the representatives of the whole order Sirenia including also the extinct species and as many as 202 morphological characters were employed. Of the extant genus *Trichechus*, more than 115 skulls and postcranial skeletons, about 90 of these representing *T. manatus*, have been investigated. In contrast to hitherto phylogenetic hypotheses based on morphological data the resulting phylogeny supports a more recent ancestor for the West Indian and Amazonian manatee than a sister group relationship between the West Indian with the West African manatee. This result is in agreement with some molecular approaches based on proteins and with sequence analyzes of the mitochondrial DNA control region, and provides support for the potential congruence between molecular and morphological data. Additionally, this study reveals intraspecific variation in both *T. inunguis* and *T. manatus*. Especially *T. manatus* is characterized by polymorphisms of the nasals, the parietals, the occipital and the lower jaw. Hence, this study aims to identify potential morphological hybrids between *T. manatus* and *T. inunguis*, which would be in accordance with molecular studies that corroborate the occurrence of interspecific hybridization between these two taxa. For this reason, special attention is paid to those skeletons of *T. manatus* that come from the hybridization area at the mouth of the Amazon River in Brazil, the Guyanas and probably the mouth of the Orinoco River showing intraspecific variation and overlapping character states with *T. inunguis*. These data are presented against the background of conservation strategies by summarizing the present distribution and distinct population structure especially of *T. manatus*.

CONSERVATION OF MARINE MAMMALS: A CASE STUDY FOR SIRENIANS. Reynolds, John - Mote Marine Laboratory - reynoldsemuq@aol.com*

The International Year of Biodiversity (2010) marked a time for reflection and assessment of accomplishments; sadly the Convention on Biological Diversity's target of reducing the rate of biological diversity loss by that date simply did not happen. For marine mammals, the recent global conservation record must acknowledge that three entire species (approximately 3%) have become extinct largely due to anthropogenic causes in the last half century or so. Although certain approaches to conservation may be applied generally to marine mammal taxa, this presentation uses the sirenians (manatees and dugong) as a case study. The four extant species of sirenians are all in danger of extirpation from parts of their ranges, if not outright extinction. The West African manatee seems especially vulnerable to disappearing due to a wide range of human-related (i.e., theoretically preventable) threats. Until and unless governments and communities fundamentally change the way in which they conduct their business, the ever-growing human population and its attendant needs are likely to continue to erode the ability of sirenians to survive. Regulatory tools (e.g., legal protection, Marine Protected Areas) exist in most range states, but conservation goals remain largely unachieved. Rather, a set of "enabling tools" may be more effective to ensure that sirenian populations persist. I provide ideas regarding (a) the role of science in conservation; (b) ways to help promote conservation in the face of poverty and food insecurity; (c) the urgent need to focus on human values and behaviors; and (d) multi-disciplinary partnerships and proactive vision and action to achieve conservation goals. Conservation can and does work...but not as a strictly scientific venture; it works when society elevates its value from an aesthetically pleasing concept and the social will to demand conservation exists.

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