MARINE MAMMAL RESEARCH UNIT
University of British Columbia

Alliance for Manatees Workshop on the Habitat of West Indian Manatees in South America

Technical Workshop Proceedings

October 14-17, 2024

Editors: Carol Meirelles & Andrew W. Trites

Hosted by:

Marine Mammal Research Unit
Institute for the Oceans and Fisheries
University of British Columbia
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Summary

The Alliance for Manatees brought researchers, conservationists, and institutional partners together to Brazil (Icapuí, Ceará) for a 4-day workshop designed to identify critical habitats, assess threats, and develop targeted conservation strategies to conserve West Indian manatees in South America.

Workshop participants gave presentations on the state of scientific knowledge about distributions and threats facing manatees in northeastern Brazil, northern Brazil, French Guiana, Suriname, Venezuela, and Colombia.

A major focus of the workshop was to evaluate and validate maps showing where suitable habitat remains for manatees in South America. The maps were drawn using data previously provided by the workshop participants.

Workshop participants subsequently worked in small groups to identify where the habitat model predictions matched with their field observations—and where they failed. This process of model validation identified knowledge gaps and additional data sources that will be used to refine the initial habitat predictions.

This Alliance for Manatees workshop marked an initial step in uniting scientists and knowledge holders from South American countries that have manatee populations. It identified knowledge gaps, emphasized the need for focused research to address key uncertainties, and determined ways in which the Alliance for Manatees can further the conservation of manatees in South America.

Workshop Structure

Goals. The workshop was designed to engage knowledge holders with technical expertise relevant to:

A. **Conserving manatee habitats** by identifying critical habitats needing protection
B. **Strengthening collaborations and partnerships** with South American researchers and institutions
C. **Sharing data** needed to build comprehensive databases for habitat modelling and conservation planning.
D. **Supporting policy advocacy** for effective manatee protection.

Participants. Workshop participants with technical knowledge about manatees were invited from 6 South American countries. These included 22 individuals working for state and federal governments, nonprofit organizations, and universities (Appendix A). Focus was on technical expertise rather than representation from specific groups.

Participants were encouraged to respect time and actively and openly engage and share insights with each other. A final reflection session allowed participants to share feedback on the workshop experience

Agenda. The workshop alternated between presentations by experts, group discussions and review of presented information (Appendix B). This encompassed 1) regional knowledge about manatees in 6 South American countries, 2) evaluation of model predictions showing suitable habitat, and 3) conservation priorities.

Workshop participants engaged in group activities to review habitat models, identify threats, and propose future steps. They took part in two group activities. The first evaluated habitat suitability maps and identified threats to manatees in different regions. The second group

activity discussed conservation priorities and proposed next steps, focusing on partnerships and future projects.

In addition to the group activities, workshop participants learned about the conservation initiatives of three organizations: 1) Aquasis, 2) the Pairi Daiza Foundation, and 3) the EAZA manatee breeding program. Presentations were also given on 4) the transportation of manatees, and on 5) manatees in captivity (see Appendix C).

Distributions and Threats by Region

Northeastern Brazil

Iran Normande addressed the distribution and threats facing manatees along Brazil's northeastern coast with an emphasis on cumulative human impacts on manatees and the urgent need for conservation action. Key points related to estimated population size, major threats, and conservation status updates included:

- **Population Estimate:** approximately 1,104 individuals, with a wide confidence interval ranging from 485 to 2,221, highlighting uncertainty in population size.
- **Primary Threats:**
  - *Human Activities:* Hunting, habitat loss from shrimp and salt farming, and urbanization.
  - *Environmental Degradation:* Seagrass loss, river silting, and pollution (plastic and water contamination).
  - *Boat Interactions:* Incidents with boats, including strikes and noise pollution.
  - *Fishing Gear Entanglement:* Issues from trawling and fixed traps.
  - *Climate Change:* Loss of habitat due to changing environmental conditions.
- **Conservation Status:** Manatees were classified as critically endangered in 2008, downgraded to endangered in 2018, with an uncertain outlook for 2024.
- **Future Actions:**
  - Address primary threats by collaborating with local industries to reduce habitat loss and pollution.
  - Increase monitoring of boat interactions and fishing gear entanglements in manatee habitats.
  - Develop public awareness campaigns to reduce hunting and improve conservation support.
  - Conduct research on the impacts of climate change on manatee habitat in Northeastern Brazil.

Northern Brazil

Gabriel Melo dos Santos presented information on the distribution and conservation challenges of manatees in northern Brazil. He highlighted two species, *Trichechus manatus* and *T. inunguis*, detailing a genetic hybrid zone discovered in the Amazon estuary and through ongoing PhD research utilizing next-generation sequencing to investigate population structure.

Gabriel emphasized the ecological importance of the region's mangrove forests, and discussed the complexities of hybridization, challenges in distinguishing species morphologically, and the need for improved collaboration with local fishermen to gather data. He noted that occurrences have been compiled for over 20 years through collaborative effort (SEA). He also noted that this region has the largest continuous strip of mangrove forests in the region, important habitat for manatees. And finally, he pointed out that manatees in this region eat various aquatic plants, grasses, and mangrove leaves.

One of the biggest challenges in northern Brazil is knowing what to do with rescued animals due to limited rehab facilities and a lack of government policy on handling rehab animals.

There are also conservation challenges related to hybridization due to considerable uncertainty in the extent of hybridization between the two manatee species. It is difficult to distinguish the species based on morphology alone. Ongoing genetic analysis is needed to determine hybrid prevalence and distribution, as well as to assess the possibility that hybrids are moving further into the Amazon River. A quick genetic testing method is needed.

Equally challenging is obtaining information on fishing interactions due to fishermen's fear of reporting.

Key point related to threats, conservation status and future actions in northern Brazil include:

- **Primary threats:**
  - Strandings
  - Incidental catch
  - Poaching, and
  - Lack of proper rehab facilities
- **Conservation status:** *T. manatus manatus* (endangered), *T. inunguis* (vulnerable)
- **Future Actions:**
  - Continue monitoring and collecting data on manatee occurrences in the northern coast of Brazil
  - Await results from Savia's genetic analysis to understand the extent of hybridization
  - Develop proper rehabilitation facilities in the northern coast of Brazil
  - Investigate the impact of seismic activity from oil and gas exploration on manatee populations

French Guiana

Benoit de Thoisy gave an overview of key issues concerning the French Guiana manatee population and highlighted a concerning trend of significant declines in abundance over the past decade.

Genetic analysis has revealed that 11 out of 12 sequenced manatees were hybrids, and only one was a pure manatee, but an Amazonian one, indicating the presence of hybrids along the coast where manatees extend into river systems.

The habitat in French Guiana is primarily mangroves with some unique rocky areas. It was assessed in a regional Red List five years prior, with various protected areas established. Despite these efforts, the species faces increasing threats from fishing activities, Brazilian fishermen incursions, local development, severe droughts, and inadequate rescue infrastructure.

Manatees present along most of the coast of French Guiana, and occur up to 50-80 km upstream in rivers

Environmental concerns, including the mortality of *Avicenna* mangroves and its uncertain impact on biodiversity, were raised, along with questions about survey methodologies and the challenges of capturing manatees for health assessments.

Action items included the need to explore the correlation between manatee abundance and proximity to the sea and reconsider attempts for manatee health assessments.

- **Primary threats:**
  - Fishing is a major threat, with increasing numbers of nets
  - Presence of Brazilian fishermen along the French Guiana coast
  - Local development projects, such as new bridge construction

- Limited infrastructure for manatee rescue and rehabilitation
- Severe drought and mangrove mortality in recent years

- **Future Actions:**
  - Explore the relationship between manatee abundance and distance from the sea
  - Consider attempting manatee captures for health assessments again

Suriname

Monique Pool focused on the monitoring and conservation efforts for dolphins and manatees in Suriname, with key insights shared on their historical distribution, habitats, and threats posed by industrial activities, particularly from TotalEnergies.

Manatees in Suriname occur in coastal, estuarine, and riverine habitats, including large swamps. Diets include Moko Moko (*Montrichardia arborescens*), Brantimaka (*Machaerium lunatum)*, mangrove species, and drifting water plants

Beginning with observations from as early as 2005, significant research advancements were noted, particularly the increase in manatee records due to enhanced marine spatial planning and data collection efforts.

Historical data, including a 1997 publication on manatees, was reviewed alongside recent sonar research, highlighting challenges in publishing findings. Furthermore, habitat conditions and ongoing threats from climate change and local industrial projects were discussed.

Research opportunities were identified, including the use of side-scan sonar for habitat assessment, while challenges such as limited local expertise and the need for clearer data on strandings and environmental quality were emphasized. Action items were proposed to conduct a manatee census, implement acoustic monitoring, assess habitat quality, and explore genetic research through biopsy sampling.

- **Primary Threats:**
  - TotalEnergies' investment in offshore industry. TotalEnergies plans to start drilling/production by 2028, possibly earlier
  - Plans to build multiple shore bases in important manatee habitats
  - Climate change, erosion, and caterpillars threatening mangrove forests
- **Conservation Status:**
  - Manatees fully protected under 1954 game law
- **Future Actions:**
  - Conduct manatee census in Suriname river estuary
  - Implement acoustic monitoring in survey design
  - Collect habitat quality data, including noise pollution and plant offer
  - Explore possibility of biopsy sampling for genetic and health studies

Venezuela

Adda Manzanilla Fuentes provided a detailed account of the manatee's situation in Venezuela, highlighting its distribution in Lake Maracaibo and the Orinoco River, as well as the serious threats it faces, including hunting, habitat destruction, and oil contamination, which led to the species being classified as critically endangered since 1978.

Recent research data were presented, including 19 direct sightings, 96 interviews with local inhabitants, and educational activities like the Manatee Cultural Art Festival.

Twenty manatee deaths were reported between 2003 and 2024, and the situation of manatees in captivity was discussed, along with recommendations to improve their conservation, such as declaring refuge areas,

increasing penalties for violating protection laws, and promoting environmental education in coastal communities.

- **Primary Threats:**
  - Hunting
  - Habitat destruction
  - Oil pollution
  - Lake Maracaibo eutrophication
- **Conservation Status:**
  - Protected since 1978, declared critically endangered
- **Future Actions:**
  - Declare areas as manatee refuges in Lake Maracaibo and Orinoco Delta
  - Request the Ministry of Environment to increase penalties for violations of protection laws
  - Increase conservation education in coastal areas
  - Regulate river and lake traffic
  - Conduct further research in distribution areas

Leonardo Sánchez and Yurasi Briceño also presented their manatee conservation initiative in Venezuela, which has expanded from Lake Maracaibo to other ecosystems, highlighting the success of the "Find the Manatee" campaign during the pandemic.

Updates were discussed regarding the distribution and threats faced by manatees, such as hunting and habitat degradation, noting that the current population is critically endangered, and estimated to number fewer than 25 individuals.

The conversation included comparisons of manatee habits in different Caribbean countries and the challenges the team faces in conducting field research in a context marked by security issues, criminal groups, fuel scarcity and resource shortages. They further noted an increase in sightings in marine areas, possibly due to social media.

Specific actions are being established to take successful activities from Lake Maracaibo to the Orinoco Delta, and implement ideas to prevent hunting in the Orinoco Delta region. Finally, there is a desire to update manatee distribution maps for Venezuela.

Colombia

Katerin Arévalo-González discussed the distribution and conservation of manatees in Colombia, highlighting the extensive freshwater habitats available across the Caribbean, Pacific, and Orinoco basins. Key points included the genetic differentiation in the middle and lower Magdalena regions, the recent sighting of a manatee in the Cauca River after a 50-year absence, and the limited research on manatee food sources, with both species being classified as endangered.

The presentation addressed multiple threats faced by manatees, such as habitat degradation from agriculture, pollution, inadequate stranding response, and the increasing issues of bycatch and climate change-induced impacts.

In addition, the introduction of an invasive hippo population was discussed, raising concerns about habitat overlap and potential ecological implications for manatees.

Action items included updating distribution information, and studying hippo-manatee interactions

- **Conservation Status:**
  - Both manatee species *(T. inunguis* and *T. manatus*) classified as endangered
  - Hunting is rare
  - Atrato River basin least studied, facing multiple threats
- **Primary Threats:**
  - Habitat degradation due to agricultural development
  - Pollution impact not well-studied
  - Stranding response infrastructure is poor

- Hunting decreasing, but bycatch and habitat degradation increasing
- Climate change affecting wetlands
- Conflict with fishermen in Magdalena region
- The invasive hippo population of about 180 individuals is spreading from initial location to coastal areas where it overlaps with manatee habitats. There is a need for scientific data to assess the hippo impact on manatees, which are believed to damage manatee migration corridors

- **Future Actions:**
  - Update and complement manatee distribution information with partners
  - Conduct studies on hippo-manatee interactions and impacts

Habitat Model Preliminary Results by Region

Carol Meirelles presented the results of her habitat suitability models for manatees between northeastern Brazil and Colombia. Her models were based on data sent to her by workshop participants.

The study area was divided into eight areas based on manatee distributions. The habitat modelling was performed using Maxent software.

Area 1 — Sergipe to Touros – state of Rio Grande do Norte (Northeastern Brazil)

Sightings and filtered telemetry data comprising 3,508 points were included in the model. Key findings revealed that human cumulative impact was the most significant factors affecting manatee presence, with lower probabilities observed in heavily impacted areas, while proximity to river mouths increased the likelihood of sightings.

A probability of presence map highlighted a gap in suitable habitat within the Pernambuco state. The discussion expanded on the cumulative impact index, examining how various environmental factors influence manatee habitat viability, ultimately emphasizing the unlikelihood of manatees surviving in regions with significant human interference.

Action items included sharing maps for review and ensuring the presenter was available for further discussion in the upcoming work group.

Area 2 — Touros, state of Rio Grande do Norte, to Cruz, state of Ceará (Northeastern Brazil)

The proximity to freshwater springs was the most significant determinant for manatee sightings in Area 2, with a probability of presence decreasing beyond 500 meters from these springs, while seagrass availability also plays a crucial role. The discussion included a presentation of habitat characteristics, demonstrating a patchy distribution of suitable environments, and specified that oceanographic conditions vary along the state of Ceará coast without notable influence from river mouths.

Challenges in data modeling were addressed, particularly regarding the fluctuating locations of freshwater springs and their impact on research outcomes, emphasizing the importance of acknowledging data limitations in future publications.

It was also noted that seagrass comprises 94% of the manatees' diet, confirmed through stable isotope studies, alongside a recognition that macroalgae, while available, are less nutritious.

Action items included verifying the coverage of the environmental layer and highlighting data limitations in the research publication.

Area 3 — Cruz, state of Ceará, to Travosa, state of Maranhão (Northeastern Brazil)

The analysis primarily focused on the Piauí Coast area, from Cruz, in the state of Ceará to the Lençóis Maranhenses coast, state of Maranhão,

with an emphasis on manatee presence along the coast. It highlighted the use of limited data, including Katherine Choi thesis, to estimate manatee populations in local rivers and the identification of manatee sightings.

Key factors influencing manatee presence were identified, notably the availability of freshwater and proximity to rivers, with a 70% likelihood of manatee presence near river mouths and underwater springs.

A habitat suitability map was created to visualize these factors. The presentation also detailed the rigorous modeling methodology employed, underscoring the need for careful presence data and the use of a grid-based approach to maintain data integrity while balancing quantity and representativeness.

Area 4 — Travosa, state of Maranhão, to São Caetano de Odivelas, state of Pará (Northern Brazil)

The presentation focused on habitat suitability and food sources for manatees in the Maranhão and Pará Reentrâncias, highlighting gaps in data and challenges in conservation efforts.

Key points included the model's failure to indicate suitable habitats in certain areas despite historical presence, likely due to extirpation rather than habitat quality, and an emphasis on the diversity of food sources like macroalgae and seagrasses.

Discussion with workshop participants also revealed limitations in the data, primarily sourced from strandings, complicating the understanding of manatee habitats, especially near river mouths where sightings are more frequent.

The workshop explored detection methods, including the potential use of hydrophones and the limitations of eDNA testing for accurate manatee monitoring.

Action items emerged, such as rerunning the habitat model with updated data and sharing pertinent research papers to inform future studies.

Area 5 — Inner waters of the Amazon estuary - estuaries, igarapés, and rivers (Northern Brazil)

Notable insights were derived from 115 stranding records concerning manatees, highlighting uncertainties surrounding the identification of manatee species in the area (West Indian, Amazon, or hybrid specimen?).

The discussion addressed the primary diet of manatees in the area, which consists of macrophytes, and the relevant habitat variables influencing their presence, revealing correlations between various environmental factors—such as suspended matter, dissolved oxygen, nitrates, pH, and surface currents—with manatee distribution.

Data visualization efforts showed overlays of variable maps, which pointed out negative correlations with phosphates and mismatches in suitable habitat areas.

Carol Meirelles acknowledged model limitations due to the reliance on stranding data and emphasized the need for improved data accuracy and further analysis to refine the understanding of manatee habitats.

Action items included enhancing the visualization of data distribution and clarifying the relationship between dissolved oxygen levels and manatee presence in future discussions.

Area 6 — Sucurijú, state of Amapá (Northern Brazil), to Suriname - estuaries and coast.

The presentation focused on the habitat analysis considering 395 manatee presence data points. To identify which variables to include in the modelling, Carol Meirelles identified habitat, dietary preferences, and environmental factors affecting manatee presence, specifically emphasizing the significance of surface current and nitrate concentrations.

A probability of presence map revealed higher manatee presence in calm waters, particularly in

French Guiana, where areas showed a 67% probability near rivers; however, more data is needed for effective modeling in Amapá Coast and Suriname.

Workshop participants discussed the similarities in habitats across Guyana, French Guiana, and Suriname and considered contacting a local expert for additional data. Discussions addressed considerations regarding the challenges of data acquisition and the potential impact of environmental factors like mud flats on manatee habitats.

Future action items include projecting presence probabilities to Guyana, contacting local researchers, and refining the model's learning area for better predictions.

Area 7 — Venezuela and Colombia coast - estuaries and coast

Discussion focused on the modeling results and distribution of manatees, highlighting the potential importance of seagrass presence in predicting manatee locations, particularly in comparison to areas like French Guiana that has no seagrass.

Workshop participants evaluated the records map that integrated both historical and current data, revealing varied chances of manatee sightings across different regions.

Habitat suitability was analyzed using only current manatee data, showing that depth has a significant impact on suitable manatee habitats, with a noted patchiness in deeper areas.

Furthermore, the discussion emphasized the identification of Evolutionary Significant Units (ESUs) among Caribbean manatees, supported by genetic and morphological evidence from regions including the Amazon estuary and French Guiana, underscoring the need for further sampling in the hybrid zone.

Action items included comparing the probability maps, assessing depth's effects on habitat suitability, and collecting additional samples for genetic research.

Area 8 — Rivers and swamps of French Guiana, Suriname, Venezuela, and Colombia

Key topics included the assessment of a heat map highlighting critical utilization areas, the need for seasonal modeling due to fluctuations in river depth and water clarity, and the challenges presented by the lack of comprehensive seasonal data.

The discussion emphasized the importance of validated sonar data for accurate mapping and analysis while noting recent data collection efforts, including collaborations with alliance members and updates from Venezuela.

Action items were assigned to participants, such as examining data scales and continuing data collection and interviews.

Workgroup Activity 1: Reflections on the Regional Model Predictions

Participants were instructed to evaluate the manatee habitat maps and heatmaps that were presented. They were also asked to identify and categorize threats, and prepare presentations using a PowerPoint template.

Action items included evaluating map accuracy, categorizing threats to manatees, selecting group reporters, and reviewing the emailed maps for detailed analysis.

Areas 1, 2 & 3

Iran Normande reported that the Workgroup experts from these three areas evaluated habitat suitability across all three areas and noted discrepancies between model predictions and their field observations, especially in the Ubatuba and Timonha river regions.

For Area 2, significant manatee habitats were identified, notably the stretch from Fortim to

Icapuí, while the presence of freshwater springs and seagrasses emerged as critical for manatee survival. Historical data showed a concerning gap in manatee distribution, attributed to hunting and habitat changes.

The workgroup also proposed enhancements to the habitat suitability model, including the incorporation of algae and proxies like coral reefs, to better inform future conservation efforts.

Finally, priority areas for manatee protection were established, along with an assessment of various environmental threats, with action items assigned for data collection and further exploration of these threats to bolster conservation strategies in Northeast Brazil.

Areas 4 & 5

Gabriel de Melo Santos addressed the habitat suitability and conservation strategies for manatees around the Amazon River mouth and the coast of Maranhão to Pará.

Workgroup participants expressed concerns about the existing suitability area map, advocating for the inclusion of additional areas due to ongoing calf strandings and the impacts of bycatch, poaching, and natural phenomena on vulnerable populations.

They emphasized the need to use water mass and floodplain variables in the modeling approach, with new records warranting the inclusion of the west coast of Marajo Island.

Further discussions highlighted the challenges in identifying specific priority areas despite the high percentage of protected regions, prompted by limited sighting data and recent incidents of poaching.

Participants agreed on the necessity for improved modeling accuracy and additional criteria for prioritizing conservation efforts, as well as the importance of feedback on modeling results for crafting effective management strategies.

Action items included sending data for enhanced modeling.

Area 6

Benoit de Thoisy discussed the habitat suitability model results for the region from Amapá to Suriname. His group noted significant differences in habitat suitability between Amapá and French Guiana, with identified drivers including current dynamics and surrounding environments.

Concerns were raised regarding suitable habitats extending into the sea in French Guiana and indicated unsuitable conditions along the Amapá coast.

The workgroup also addressed various threats, such as incidental capture and fishing, linked to infrastructure development in French Guiana and projected construction in Suriname.

Four priority conservation areas were proposed, accompanied by the need for improved data models and potential international collaboration to address cross-border conservation efforts.

Action items included rerunning the habitat model with updated data and organizing discussions to refine the analysis and better understand manatee resource needs in the region.

Areas 7 & 8

Katerin Arévalo-Gonzalez discussed the availability of suitable habitats for manatees along the coasts of Venezuela and Colombia, with critical areas pinpointed such as the Orinoco River delta and the Maracaibo Lake system.

Attention was drawn to the significant indirect and direct threats facing these marine mammals, including oil exploration, illegal mining, hunting, and the emerging risk of diseases like avian flu.

The presentation emphasized the need for enhanced environmental data to improve habitat modeling and address specific challenges related to freshwater ecosystems.

Additionally, the invasive hippopotamus population in the Magdalena Basin was highlighted as a major conservation challenge, necessitating urgent government action for control.

Several action items were proposed, including collecting new data for Maracaibo Lake, reviewing historical records for the Sinu River mouth, implementing regular health assessments for manatees, and initiating a letter to advocate for a hippo control plan.

Workgroup Activity 2: Alliance for Manatees Next Steps

Three workgroups were formed to think creatively about future projects, conservation actions, and potential partnerships. Each group was given dedicated time to discuss and present their findings.

Key topics suggested for group discussions included captures and tagging, conservation actions, population assessment, research on captive animals, and hybrid zone. Workshop participants were encouraged to establish 6-10 priority projects focused on manatee conservation, advocating for research-driven conservation strategies and effective knowledge sharing among alliance members.

Action items included forming the groups, compiling a list of priority projects, and developing a knowledge-sharing plan, with group leaders responsible for summarizing their proposals within a specified timeframe.

Workgroup 1

Iran Normande reported that his workgroup explored advancing manatee research through collaborative efforts among institutions. Key discussions included identifying research priorities related to drone and vehicle deployment for manatee capture.

The formation of a *Manatee Capture Task Force* was proposed to address information gaps in priority areas, as well as to develop a telemetry database similar to Florida's biannual capturing initiative. The group emphasized the need for fundraising, the selection of key personnel, and the combination of institutional expertise in conducting captures.

Additionally, plans to create a comprehensive database of biological samples and establish protocols for population estimations were outlined, alongside ideas for organizing workshops on rehabilitation practices to further bolster manatee conservation efforts.

Action items included identifying capture areas, fundraising, personnel selection, and organizing future field trips and workshops.

Workgroups 2 & 3

These two workgroups focused on defining priorities and actions for the Alliance, particularly regarding manatee conservation across Venezuela, Colombia, Guyana, and Suriname.

Key discussions included identifying wish list projects for support, standardizing protocols for conservation efforts, and empowering local communities.

The groups emphasized the need to hold a workshop with government stakeholders to establish protective area criteria and improve collaboration through knowledge sharing.

An action plan was proposed, highlighting the importance of quick results to sustain motivation while committing to produce a final report and peer-reviewed literature to enhance credibility.

Action items include preparing a press release, synthesizing proposed actions, conducting regional extinction risk assessments, and preparing a video for the Society for Marine Mammals conference.

Possible Alliance Activities

- **Coordinate collecting population data.** Need to establish standardized protocols (e.g., site scans, sonars, acoustics, aerial surveys). Obtaining data on population trends and health should be a top priority.
- **Establish a manatee capture task force.** Need to develop capture protocols, and train personnel to capture and transport manatees, to collect blood, urine, feces, genetics, contaminants—and to tag and release individuals. Should combine expertise from different institutions.
- **Organize a rehabilitation workshop.** To share best practices, and provide political and technical support for local initiatives.
- **Hold a workshop to determine criteria for protective areas.** Should address preparedness for oil spills and bycatch reduction. Also address minimum guidelines for manatees related to large-scale projects.
- **Establish a working group to address hybridization.** Need to clarify genetics and taxonomy for Red List assessment.
- **Co-publish papers that share data and expertise between Alliance members.**
- **Produce education and awareness materials that can be used to support public education.**
- **Produce an Alliance Action Plan.** Should position the Alliance as a group of experts that can provide guidance. Need to consider the geographic scope and overlap with the Greater Caribbean Manatee Alliance.

Workshop Reflections

The Workshop Reflection and Sharing Session, held as at the end of the workshop on manatee conservation, provided participants with an opportunity to reflect on their experiences and share insights. The workshop was widely appreciated for its focus on the geographic diversity of manatee habitats and the unique characteristics of these animals, including surprising aspects like their dietary habits and adaptability.

Participants from diverse professional backgrounds praised the workshop for fostering international collaboration and emphasizing the value of shared knowledge. The dedication of Brazilian researchers, particularly their innovative methodologies and resourcefulness, was highlighted. Emotional connections between participants, and a collective commitment to manatee conservation were evident, inspiring participants to pursue collaborative initiatives.

The key action items that emerged included disseminating workshop insights, publishing unpublished data and findings, and supporting the establishment of this alliance for South American manatee conservation.

Overall, the workshop was lauded for its organization, inclusivity, and capacity to inspire future efforts to advance manatee conservation initiatives collaboratively.

Conclusions

What Actions to Take

The discussion groups had evenly balanced expertise on manatees — and came to similar conclusions regarding key uncertainties that affect habitat suitability modeling, manatee distribution patterns, and the influence of environmental variables such as freshwater availability and human impacts.

Some of the recommendations to reduce uncertainties included gathering more data and investigating additional variables to better understand manatee habitat suitability.

Careful thought needs to be given to determine the top research priorities to protect and conserve manatees in South America in light of limited financial resources, the broad scope of

identified research gaps, and the timeline sought to make decisions. Addressing knowledge gaps needed to refine habitat models and guiding conservation action planning is of particular importance.

Future Refinement and Planning

This workshop was a first step in bringing together manatee experts from South America to collaboratively validate habitat maps and share region-specific knowledge essential for manatee conservation.

Going forward will require focused research to address the key uncertainties that prevent the development of effective conservation strategies, including understanding hybrid zones, identifying critical habitats, and mitigating regional threats such as poaching and habitat degradation.

Acknowledgements

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Alliance for Manatees Workshop participants discussing habitat maps during workgroup activities (Photo: Andrew W. Trites/MMRU).

Appendix A: Participants

Name	Affiliation
Trites, Andrew	University of British Columbia, Canada
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Normande, Iran C.	Universidade Federal de Alagoas, Brazil
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Oliveira, Larissa R.	Associação de Pesquisa e Preservação de Ecossistemas Aquáticos and UNISINOS, Brazil
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Von Fersen, Lorenzo	Zoo Nuremberg and YAQU PACHA e.V., Germany
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Sousa-Lima, Renata S.	Laboratory of Bioacustics, Federal University of Rio Grande do Norte, Brazil
Carvalho, Vitor L.	Associação de Pesquisa e Preservação de Ecossistemas Aquáticos, Brazil
Alves, Maria Danise O.	Secretaria de Meio Ambiente, Sustentabilidade e de Fernando de Noronha de Pernambuco, Brazil
Vancsok, Catherine	Pairi Daiza Foundation, Belgium
Alfonso, Saioa R.	Pairi Daiza, Belgium
Chaves, Thais	Associação de Pesquisa e Preservação de Ecossistemas Aquáticos, Brazil
Briceño, Yurasi	Instituto Venezolano de Investigaciones Científicas, Venezuela
Sánchez-Criollo, Leonardo	Instituto Venezolano de Investigaciones Científicas, Venezuela

Figure 2. Participants of the I Alliance for Manatees Workshop, held in the state of Ceara, Brazil, October 14th-17th, 2024. From left to right, standing: Benoit De Thoisy, Lorenzo von Fersen, Katherine Choi-Lima, Letícia Gonçalves, Thaís Chaves, Vitor Carvalho, Renata Sousa-Lima, Maria Danise Alves, Catherine Vancsok, Nataly Castelblanco-Martínez, João Borges, Saioa Alfonso, Katerin Arévalo-Gonzales, Adda Manzanilla-Fuentes, Iran Normande. From left to right, sited: Larissa de Oliveira, Andrew Trites, Danielle Lima, Carol Meirelles, Monique Pool, Gabriel dos Santos, Jaime Jimenez.

Appendix B: Agenda

Detailed Agenda

Day 1 - Monday October 14th		
2:00 PM	Visit to the Aquasis' Marine Mammal Rehabilitation Centre	All

Day 2 - Tuesday October 15th		
1:30 PM	Welcome and Introductions	Andrew Trites & Carol Meirelles (MMRU/UBC)
1:50 PM	About the Alliance for Manatees Project	Carol Meirelles (MMRU/UBC)
2:00 PM	How are going to work	Andrew Trites (MMRU/UBC)
2:10 PM	About Aquasis and PMM	Vitor Carvalho & Katherine Choi (Aquasis)
2:30 PM	EAZA Breeding Program	Lorenzo von Fersen (Nuremberg Zoo & Yaqu Pacha e.V
2:50 PM	Pairi Daiza Foundation	Catherine Vancsok (Pairi Daiza Foundation)
3:10 PM	Distribution and threats in Northeastern Brazil	Iran Normande (UFAL)
3:30 PM	Coffee Break	
3:45 PM	Distribution and threats in Northern Brazil	Gabriel Santos (Bioma)
4:05 PM	Distribution and threats in French Guiana	Benoit De Thoisy (Kwata)
4:25 PM	Distribution and threats in Suriname	Monique Pool (Green Heritage Fund Suriname)
4:45 PM	Distribution and threats in Venezuela	Adda Manzanilla (UNELLEZ)
5:05 PM	Distribution and threats in Colombia	Katerin Arévalo-González (FINS)
5:25 PM	Day 1 Wrap up	Carol Meirelles (MMRU/UBC)
5:35 PM	End of Day 2	

Day 3 - Wednesday October 16th		
8:30 AM	Talk: Situation of manatees in Venezuela	Leonardo Sanchez (CIT)
8:45 AM	Results Area 1	Carol Meirelles (MMRU/UBC)
9:10 AM	Results Area 2	Carol Meirelles (MMRU/UBC)
9:35 AM	Results Area 3	Carol Meirelles (MMRU/UBC)
10:00 AM	Results Area 4	Carol Meirelles (MMRU/UBC)
10:25 AM	Break	
10:35 AM	Results Area 5	Carol Meirelles (MMRU/UBC)
11:00 AM	Results Area 6	Carol Meirelles (MMRU/UBC)
11:25 AM	Results Area 7	Carol Meirelles (MMRU/UBC)
11:50 AM	Lunch Break	Carol Meirelles (MMRU/UBC)
1:10 PM	Results Area 8	Carol Meirelles (MMRU/UBC)
1:35 PM	Workgroups methods intro	Andrew Trites (MMRU/UBC))

1:50 PM	Workgroups	All
2:50 PM	Workgroup presentation and discussion - Areas 1, 2, and 3	João Borges, Iran Normande, Vitor Luz, Katherine Choi, Renata Sousa-Lima, Maria Danise, Larissa, Leticia, Thais
3:50 PM	Coffee Break	
4:05 PM	Workgroup presentation and discussion - Areas 4 and 5	Gabriel Santos, Danielle Lima, João Borges
4:45 PM	Talk: Mermaids in tanks: the pivotal role of *ex-situ* conservation for sirenians' recovery	Nataly Castelblanco-Martínez
5:05	Day 2 Wrap up	Carol Meirelles (MMRU/UBC)
5:15 PM	End of Day 3	

Day 4 - Thursday October 17th		
8:00 AM	Visit to the Aquasis' manatee acclimatization facility	Aquasis
12:00 PM	Lunch break	All
1:30 PM	Workgroup presentation and discussion - Area 6	Benoit, Monique, Nataly, Danielle
2:00 PM	Workgroup presentation and discussion - Areas 7 and 8	Nataly, Adda, Katerin, Jaime, Benoit, Monique
2:40 PM	Next steps for the Alliance for Manatees	Workgroups for proposals
3:40 PM	Coffee break	
4:00 PM	Sharing your thoughts session	Andrew Trites & Carol Meirelles
5:00 PM	End of the workshop	

Appendix C: Manatee Conservation Initiatives

Aquasis

Dr. Katherine Choi-Lima provided an overview of the Association for Research and Preservation of Aquatic Ecosystems, known as Aquasis, an NGO established in 1994 in Ceará, Brazil. The organization is dedicated to the protection of threatened species and vital habitats, focusing on biodiversity conservation. Aquasis employs various strategies to identify and safeguard endangered species, ensuring the recovery of their essential habitats for feeding, resting, and reproduction. This approach not only benefits the species but also enhances the quality of life for local communities.

Aquasis works with several flagship species, including the Araripe Manakin and the West Indian Manatee, which are critical to their conservation efforts. Additionally, the organization recognizes other umbrella species that play a significant role in the ecosystem. Their initiatives are supported by a range of projects, such as the Araripe Oasis Project and the Marine Mammals Program, all aimed at fostering sustainable development and environmental stewardship.

The European Association of Zoo & Aquaria (EAZA) Manatee Breeding Program

Dr. Lorenzo von Fersen discussed the European Association of Zoos and Aquaria (EAZA) Ex Situ Program (EEP) for manatees, specifically outlining strategies and actions taken to conserve manatee populations within managed care. Key topics included:

1. **Biodiversity Crisis and Conservation Needs:** Emphasis on action plans for *in situ* species protection, highlighting habitat conservation, population monitoring, and addressing threats.
2. **One Plan Approach:** This integrates *in situ* (natural habitat) and *ex situ* (controlled environments like zoos) efforts for species conservation, aiming to support overall population health and genetic diversity.
3. **EEP Population Details:** Overview of manatee population demographics within the EEP, including reproductive data, breeding ages, and the number of institutions involved in maintaining these populations.
4. **Conservation Research:** Discussion of bioacoustic research aimed at tracking and identifying manatees, potentially aiding wild population assessments. This includes analysis of vocal repertoires to distinguish individual manatees.
5. **Education and Awareness:** EEP zoos reach about 9 million visitors, using manatees as an "umbrella species" to raise awareness about conservation.
6. **Fundraising and Conservation Projects:** Financial support directed towards research and conservation initiatives in regions like Brazil and Venezuela.
7. **Insurance Population:** Managing genetic diversity and reducing inbreeding within *ex situ* populations to ensure a sustainable manatee population.

Pairi Daiza Foundation x Alliance for Manatees

Dr. Catherine Vancsok provided an overview of the foundation's mission and its contributions to conservation. Pairi Daiza, located in Wallonia, Belgium, spans 75 hectares and hosted 2.279 million visitors in 2023. It's recognized as one of Europe’s top zoos, housing over 7,500 animals across 800 species, with immersive exhibits that focus on wildlife, flora, and cultural experiences.

The foundation’s core values emphasize a harmonious relationship between humanity and nature, focusing on protection, restoration, scientific research, and raising awareness. They have various conservation projects, such as the reintroduction program for the critically endangered Yellow-bellied toad in partnership

with local organizations, and an upcoming sanctuary for diverse wildlife.

The Pairi Daiza Foundation supports manatee conservation as part of its broader mission to protect and restore endangered species, contribute to scientific research, and foster a deeper respect for the natural world. Their commitment to manatees aligns with the foundation's emphasis on protecting unique and vulnerable species through both *ex situ* (captive) and *in situ* (wild habitat) efforts. By supporting manatee conservation, Pairi Daiza aims to help preserve critical habitats and populations for these gentle marine mammals, which face threats from habitat loss, pollution, and boat strikes.

Supporting the Alliance for Manatees also allows Pairi Daiza to collaborate on international conservation strategies. This initiative aligns with their conservation goals of fostering biodiversity, supporting scientific knowledge, and raising awareness about the importance of preserving ecosystems that sustain threatened species like the manatee.

Translocation of manatees from Caucaia to Icapui

Katherine Choi-Lima showed a video about the rehabilitation and translocation process, detailing the journey of a manatee called ‘Estevão’ from Caucaia to the Icapuí acclimatization enclosure, where he will remain for at least a year before release. Participants viewed a video about the translocation process and discussed logistics regarding the visit to this facility on the next day, which involved a boat ride to the structure approximately 200 meters from the beach, requiring proper attire and safety measures. Safety protocols highlighted the necessity for life jackets and closed shoes, the potential for getting wet, and recommendations for seasickness medication, as well as guidelines regarding interaction with the manatees.

Mermaids in tanks: the pivotal role of ex-situ conservation for sirenians' recovery

Dr. Nataly Castelblanco-Martínez briefed participants on various aspects of manatee conservation, starting with a proposal for the standardized vernacular name "Greater Caribbean manatee" for *Trichechus manatus manatus*, which has been adopted by the IUCN but is not mandatory. She also covered the *Ex Situ* Manatee Conservation Project, highlighting global efforts to review captive manatees' conditions and legislative frameworks in collaboration with IUCN specialists.

Preliminary results revealed that there are 514 Sirenia in captivity across 25 countries, with Brazil housing the highest number. The ongoing data analysis focuses on age and sex structure, and rehabilitation practices, with discussions on establishing a live publication and employing relational databases for updates.

Action items included sharing further details about the live publication and sending relevant research materials to group members

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