



FINAL REPORT

MERMAIDS OF THE AMAZON - Using the Amazonian manatee as a “flagship species” for conservation in the Lower Rio Negro Region, Brazilian Amazon

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ABSTRACT

This project focused on the conservation of the lower Rio Negro region, Amazonas State, Brazil, by researching wild populations of Amazonian manatees (*Trichechus inunguis*) and engaging the local population in the species' and region's conservation. The Amazonian manatee is endemic to the Amazonas and Orinoco river basins and is threatened with extinction. The objectives of the project included:

- Integrating scientific information about the manatee with the traditional knowledge of the local communities;
- Designing a non-invasive methodology using side-scan sonar to obtain Amazonian manatee population information;
- Determining and monitoring habitats and landscape use by the Amazonian manatee,
- Verifying threats to the species in order to enhance knowledge of the species;
- Developing environmental awareness and outreach programs with local communities.

Expanded scientific knowledge of Amazonian manatee biology, ecology and habitat use is critical to planning for conservation of the species. Increasing public awareness about the importance of manatee and habitat conservation through environmental education and information dissemination is of utmost importance. We intend to employ the manatee as a flagship species to strengthen the protection and management of habitats and other wildlife species in the region.

BACKGROUND STATEMENT

Manatees (*Trichechus* sp.) are gentle, elusive, aquatic mammals from the Trichechidae Family. These herbivores live in tropical and sub-tropical aquatic ecosystems (Whitehead, 1977). The Amazonian manatee (*Trichechus inunguis*) is found in the Amazon River and its tributaries. The Amazonian manatee is the largest mammal in South American fresh waters, reaching up to three meters and 450kg (Ayres & Best, 1979). The species is endemic to the Amazon River basin, occurring in river springs in Colombia, Ecuador, and Peru, and eastward through the Rio Amazonas estuary in Brazil (Best, 1984; Rosas, 1994).

The Amazonian manatee may serve as an important fertilizer source through the release of nutrients in its urine and feces (Best, 1984, Junk & da Silva, 1997). These nutrients are used as food by phytoplankton, the base of the aquatic food web, which ultimately maintains the fish stocks in the rivers and provides the most important source of food to humans in the region. In addition, manatees help control overgrowth of aquatic plants through foraging (Best, 1984, Junk & da Silva, 1997). Manatees are described as sentinel species of ecosystem health. Pollution and urban development can negatively affect water quality and vegetation, and therefore, impact the manatee population (Blonde et al., 2004).

Despite the species' important ecological role, manatee populations have been excessively exploited over time. Amazonian manatees have been hunted since the Pre-Colombian age by native habitants; however, after European colonization, the species became over-exploited. From 1935 to 1954, between 4,000 and 7,000 animals were killed each year for extraction of leather, fat and meat (Domning, 1982).

The Amazonian manatee is listed as "vulnerable" on the IUCN Red List (IUCN, 2011) and is included on the Brazilian Federal Agency for the Conservation of Nature and Natural Resources – IBAMA's list of threatened species(MMA, 2003). It is also listed on Appendix I of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), which includes all species threatened to extinction through the wildlife trade (CITES, 2009).

Creation and enforcement of laws protecting the species has improved its conservation, although Amazonian manatees are still being hunted for the

subsistence of local communities and illegal trading purposes (Rosas & Pimentel, 2001). The slow reproductive cycle of the species worsens this exploitation scenario, as females have a long gestational period (12 to 14 months) and give birth to just one calf every three years (Best, 1983, Best, 1984, Junk & da Silva, 1997).

The Amazonian manatee is a highly endangered species, and very little is known about its biology and ecology, especially in the Rio Negro region of Brazil. The majority of scientific information available for this species comes from populations in the Rio Solimões system and from individuals kept in captivity. The Principal Investigator proposed to increase scientific knowledge about the Amazonian manatee and to encourage the participation and engagement of local people and stakeholders in the conservation of the species and its habitat.

The Amazonian manatee conservation project was carried out at Anavilhanas National Park, located in the lower Rio Negro region, in the Amazonas State, Brazil. This region is composed of a mosaic of conservation units in the Central Amazonian Corridor, the largest continuous area under environmental protection in the world. In this location the Amazon Forest shows high biological and socio-cultural diversity, with extremely delicate ecosystems, mainly because of its acidic and oligotrophic water. The climate is tropical rainforest or equatorial humid, with an average precipitation of at least 60mm for all twelve months and average temperatures of 18°C or higher. Tropical rainforest climates have no pronounced summer or winter; it is hot and wet throughout the year. In the lower Rio Negro region the average temperature through the year is 26°C. The wet season in the region is between October and July, wherein March and April presents the rainfall peak, with an average rate of approximately 290mm. The level of river water increases between May and July, reaching its peak in June. August has the lowest precipitation rate, around 60mm. The river's water level decreases between September and January, and the month of November has the lowest water level.

The main economic activities of the people in the region are sustainable hunting, fishing and harvesting of forest products, small-scale agriculture, and producing handicrafts. Local communities in the region depend upon the forest's natural resources for harvesting, using their traditional knowledge to maintain the forest and resources in the long-term. However, commercial logging and poaching are increasing and the population is losing its traditional and sustainable way of life. These activities are distancing residents from their traditional culture and nature conservation. This, in

turn, harms both the conservation of the region's flora and fauna and the population's well-being.

The proposed project occurred in the Novo Airão municipality (3,500.18 km²; latitude: 2°33'35", longitude: 60°52'39") within the lower Rio Negro region. This region is recognized as being of high importance to mammal conservation and of very high importance to aquatic biota conservation. The Central Amazon is designated as a Natural World Heritage Site by UNESCO and is one of the 553 Biosphere Reserves. Despite the importance of the region, land degradation is increasing, mainly due to illegal and unsustainable natural resources harvesting (commercial poaching and logging), increased development policies that ignore ecological systems and traditional knowledge, and the expansion of Manaus - the biggest city in the Amazon - located nearby the study site. In the near future, the Investigators plan to gradually expand their efforts to all protected areas in the lower Rio Negro- eleven conservation units, with a total area of almost 7,000,000ha.

OBJECTIVES

The goals of this project were to enhance scientific knowledge of the Amazonian manatee, and to engage the local people with conservation of this species and the natural resources of Brazil's lower Rio Negro region.

Specific objectives included:

- a. Integrating scientific information and the local community's traditional knowledge of the Amazonian manatee;
- b. Designing an approach using side-scan sonar to detect the occurrence of Amazonian manatees in the wild and obtain information to estimate population sizes;
- c. Identifying, describing and mapping the main areas used by Amazonian manatees in Anavilhanas National Park, and verifying seasonal landscape use by the animals, considering the hydrologic characteristics of the region;
- d. Understanding and mapping the threats to manatee populations in the region;
- e. Engaging local communities and promoting understanding of the long-term economic benefits of protecting natural areas.

PROJECT ACTIVITIES

Amazonian manatee monitoring

The investigators inventoried habitat use by Amazonian manatees in Anavilhanas National Park, using a small boat to search for evidence of the presence of individual manatees. Records such as feces, evidences of feeding, and sightings were annotated and the location of each was identified with a GPS unit. Environmental data (water temperature, water depth, weather characteristics, human presence etc.) were collected at each location. Monthly monitoring was used to verify differences in habitat and landscape use due to the river's water level variations throughout the year. The Amazonian rivers' large differences in water levels between the wet and dry season influence food availability for the local fauna, including manatees. The Investigators developed maps of areas critical for conservation of the species using GIS (Geographic Information System) tools.

The investigators also applied a technique using side-scan sonar for the first time to detect and record Amazonian manatees. This methodology has never been applied to study the Amazonian manatee in Brazil and estimate the abundance of the population in the wild. The side-scan sonar methodology has been used to detect West Indian manatees (*Trichechus manatus*) in Mexico and Florida (Gonzalez-Socoloske et al., 2009). Due to the elusive behavior of the cryptic Amazonian manatee, little research has been conducted on this species' wild populations. Application of this innovative technology could increase the scientific information available on this Amazonian manatee population and perhaps be reproduced in other Amazon regions. Development of this methodology is occurring in partnership with Dr. Miriam Marmontel from the Mamirauá Institute for Sustainable Development (IDSM). The investigators began developing application of the method in July 2011: a side-scan sonar was attached to a small boat, and the investigators monitored the side-scan sonar images until manatees and other large aquatic animals, such as river dolphins, were recognized. Following the calibration, the investigators conducted population surveys along linear transects aiming to estimate population sizes by DISTANCE sampling, and verify habitat use by the species.

The investigators also organized a participatory workshop with members of local communities, to identify the areas of highest use by the Amazonian manatee and the

sites of potential threats to the species. This workshop was held not only to map the region and threats, but also to combine important traditional and scientific knowledge. This provided an opportunity to inform the local communities about the research activities, in hopes of interesting them in the project and engaging them in conservation efforts for the region.

Identifying threats to conservation

To identify the main threats to the Amazonian manatee population in the region, the investigators prepared and administered questionnaires in Novo Airão, surveying people's knowledge of the species and its habits, hunting pressure, factors that may negatively impact manatees, and other important issues. The standard procedure for selecting households in Novo Airão was surveying one household per block, the third household after the corner, on alternating street sides. The streets were randomly selected.

The investigators recorded additional threats observed during the monitoring, such as evidence of hunting, forest harvest, and predatory fisheries. This information provided important knowledge of the impacts and the real hunting pressures that this population faces. The investigators also are contacting the relevant authorities to collect reports on manatee poaching in the region.

Raising public awareness

Since 2002 the IPÊ - Instituto de Pesquisas Ecológicas has implemented outreach programs which have been one of the most important tools for raising public awareness about environmental conservation in the region. To increase awareness, the Investigators intend to share the information gathered by the project, exchange knowledge and experiences among researchers and local inhabitants, and work to herald the species as a reason for regional pride of environmental conservation. Increasing public awareness is seen as one of the most important approaches for achieving local community support for conservation actions.

Areas on which the outreach program and information development will focus include the importance of the Amazonian manatee and conservation of the lower Rio Negro region, the main challenges and potential benefits to conservation, and actions that can be taken to improve protection of the species and area. Educational activities include lectures and workshops with the communities in the region to increase resident involvement with the species' conservation, empower their traditional knowledge, and facilitate exchange of information with the project staff. The investigators are using fun activities with children and teenagers, such as games, theater, and drawing. The State Agency of Environment and Sustainability (SDS), the Municipal Agency of Environmental and Sustainable Development (SEMADES), and the Brazilian Agency for Biodiversity Conservation (ICMBio) also are contributing to the outreach program.

PRELIMINARY RESULTS

Amazonian manatee monitoring

From January 2011 to September 2012 monthly incursions were carried out at Anavilhanas National Park to record feces, chewed vegetation and sightings of Amazonian manatees.

Forty-three records of chewed vegetation were annotated – comprising 15 food items and 58 occurrences of them. The food items recorded were “canarana-lisa” (Figure 01), “feijãoarana” (Figure 02), “cipó-icica” (Figure 03), “arrozarana”, “carárana” (Figure 04), “mururu” or “aguapé” (Figure 05), not-identified I, “cipó-icica II” (Figure 06), “maracujázinho” (Figure 07), “chuva-de-bolinha” (Figure 08), “borboletinha” (Figure 09), “batatarana-de-flor-branca” (Figure 10), “feijãoarana-açu” (Figure 11), *Ipomea* sp. and “jurubeba”.



Figure 01 – “Canarana-lisa”



Figure 02 – “Feijãoarana”



Figure 03 – “Cipó-Icica”



Figure 04 – “Carárana”



Figure 05 – “Mureru” or “Aguapé”



Figure 06 – “Cipó-ílica II”



Figure 07 – “Maracujázinho”



Figure 08 – “Chuva-de-bolinha”



Figure 09 – “Borboletinha”



Figure 10 – “Batatarana-da-flor-branca”



Figure 11 – “Feijãoarana-açu”

During the sampling period "feijãoarana" were the most frequent food item recorded (46.8%), followed by "canarana-lisa" (14,9%), cipó-icica (8,5%), "borboletinha" (6,4%), "cipó-icica II" and "batatarana-da-flor-branca" (4,3% each) and "arrozarana", "mururu", not-identified I", "cararana", "maracujázinho", "chuva-de-bolinha" and "feijãoarana-açu" (2,1% each).

Additionally, three sightings of Amazonian manatees were recorded during the project period. In the first sighting, on June 6th 2011 at "Siriri Grande" Lake (S 02°45'38.3, W 60°42'39.4"), between 6:49am and 8:51am at least three animals were sighted 20 times. On December 07th 2011 the only record was at 8:58am in the "Buiucu" Bay (S 02°52'23.1", W 60°23'18.9"), when two individuals emerged to breathe at the same time. The third sighting record was in July 03rd 2012 at 6:43 am, when two individuals were sighted in the "Siriri Grande" Lake (S 02°45'38.3, W 60°42'39.4"). Figure 12 shows where the Amazonian manatees were sighted in June 2011 and July 2012. Figure 13 shows the environment of the sighting in December 2011.



Figure 12 – Environment where three individual Amazonian manatees were sighted in June 2011 and July 2012 at Anavilhanas National Park



Figure 13 – Environment where two individual Amazonian manatees were sighted in December 2011 at Anavilhanas National Park

Figure 14 shows the location of Amazonian manatee feeding and sighting records at Anavilhanas National Park.

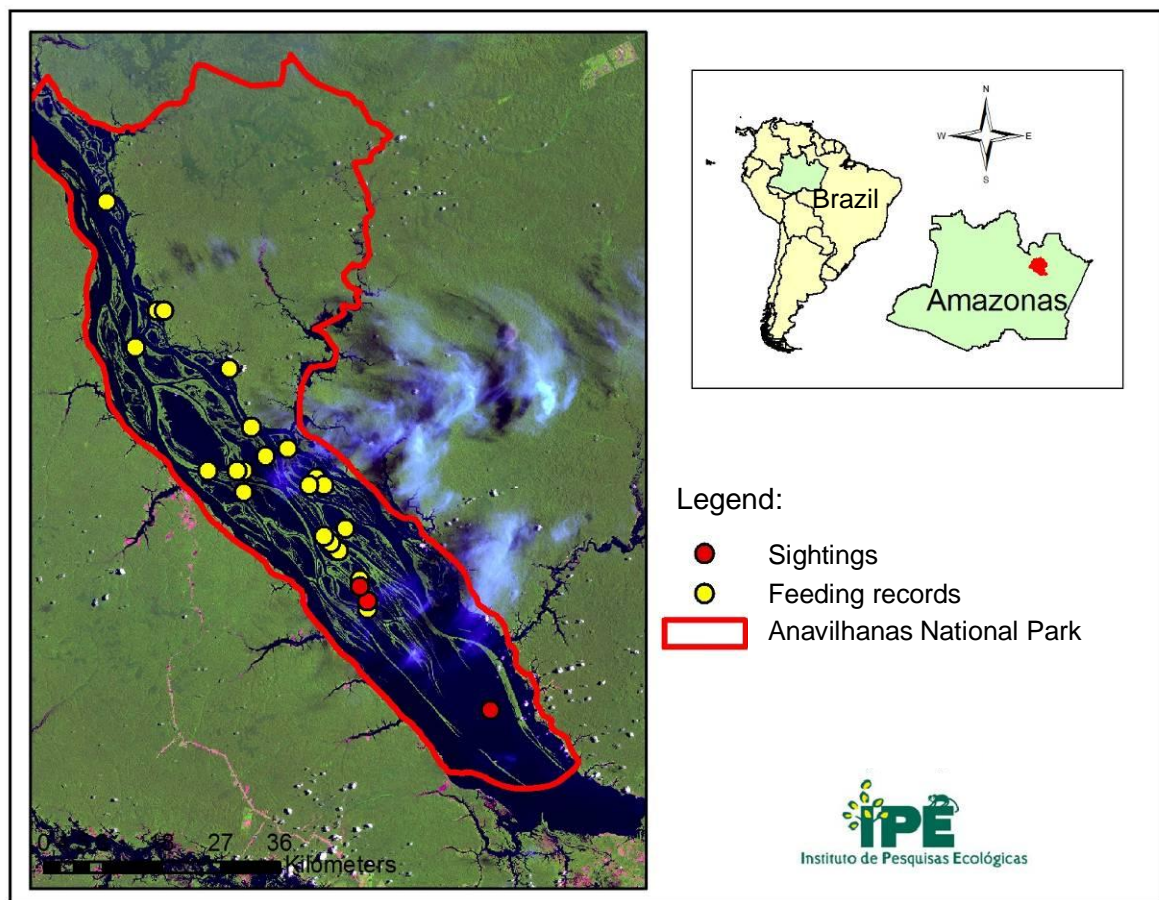


Figure 14 – Map of Amazonian manatees sightings and feeding records at Anavilhanas National Park

Threats identification

Along with the Amazonian manatee monitoring at Anavilhanas National Park some potential threats to the species were also noted. Twelve potential threats were observed between January 2011 and September 2012: including evidence of three incidences of illegal logging, one of trawl netting, six of gillnetting and two complaints of poaching of manatees at “Siriri Grande” Lake (Figure 15). Figure 16 shows the areas where Amazonian manatees were recorded and the potential threats were observed at Anavilhanas National Park. Furthermore, more than 120 interviews with the population in Novo Airão were carried out focusing on wild manatee conservation and research. The questionnaires results are still being evaluated.

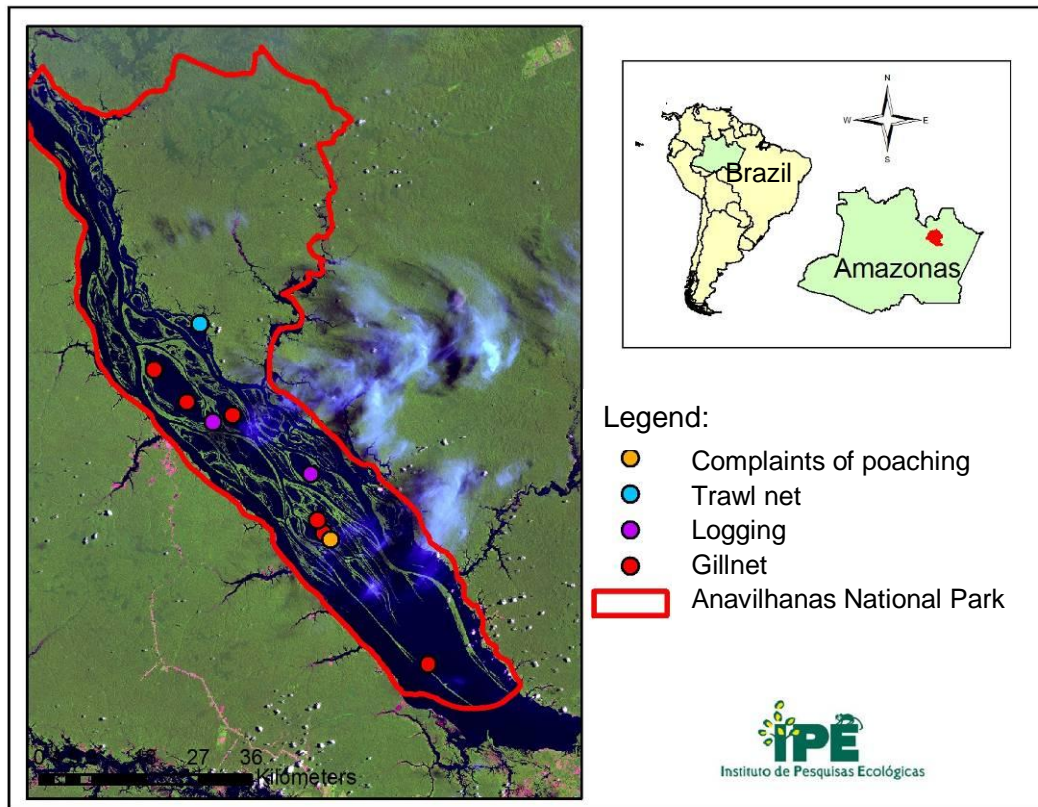


Figure 15 – Areas of potential threats to the Amazonian manatee conservation at Anavilhanas National Park

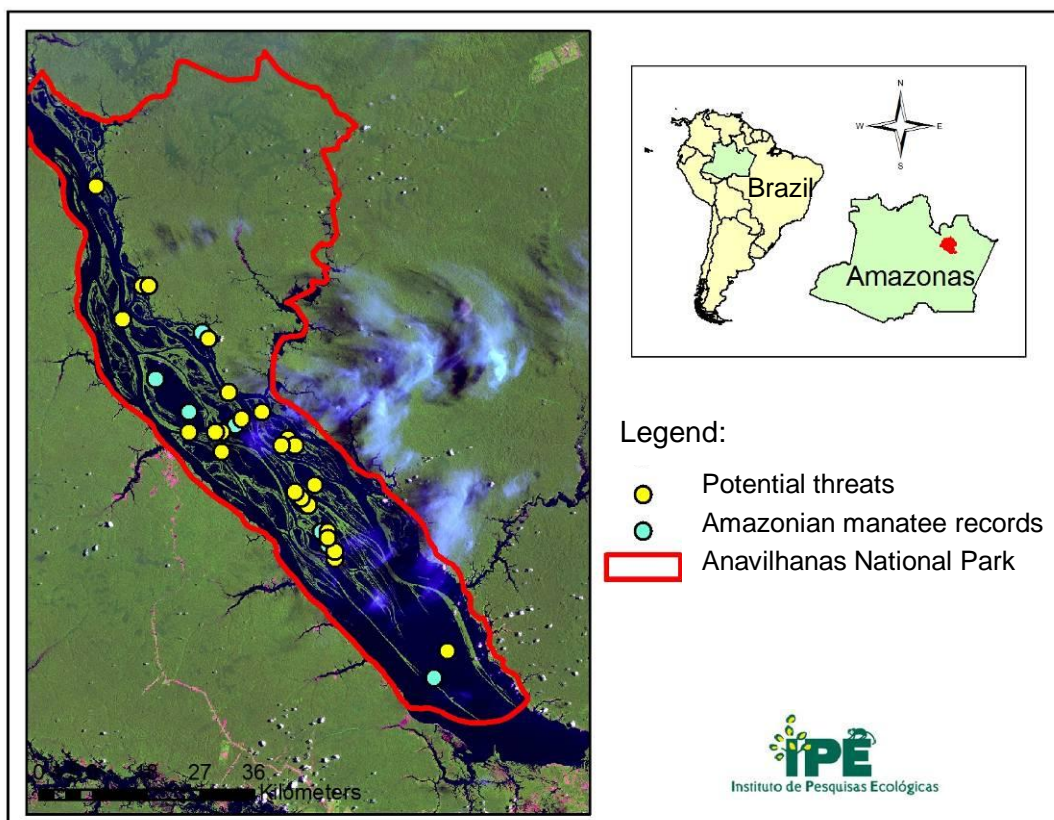


Figure 16 – Map of potential threats and records of Amazonian manatees at Anavilhanas National Park

Participatory Workshop on Amazonian Manatee Conservation

In April 2012 we organized a participatory workshop in the city of Novo Airão. Goals of the workshop included identification of the main threats to manatees in the region, to mapping of the areas used by the species and the potential threats, and recognition of the actions that participants can take to help conserve this species.

After the presentation of the project objectivities, activities and preliminary results, the participants were divided in two groups to identify the present and potential threats to the species in the region (Figure 17). Ten threats were identified: poaching for sustainable use, bushmeat trade, accidental kill, illegal fishing, deforestation, logging, forest burning, boat transit, mining and dams.



Figure 17 – One of the groups identifying the threats to the Amazonian manatee in the lower Rio Negro region.

Then, the participants mapped the areas used by the species and the places where the threats are present (Figure 18). Figure 19 shows the map resulting from the workshop. In the office, the Project researchers prepared another map, comparing the species occurrence and threats identified at the workshop with the species and threats observed during field activities (Figure 20).



Figure 18 – Participants mapping the Amazonian manatee occurrence and threats in the Anavilhanas National Park

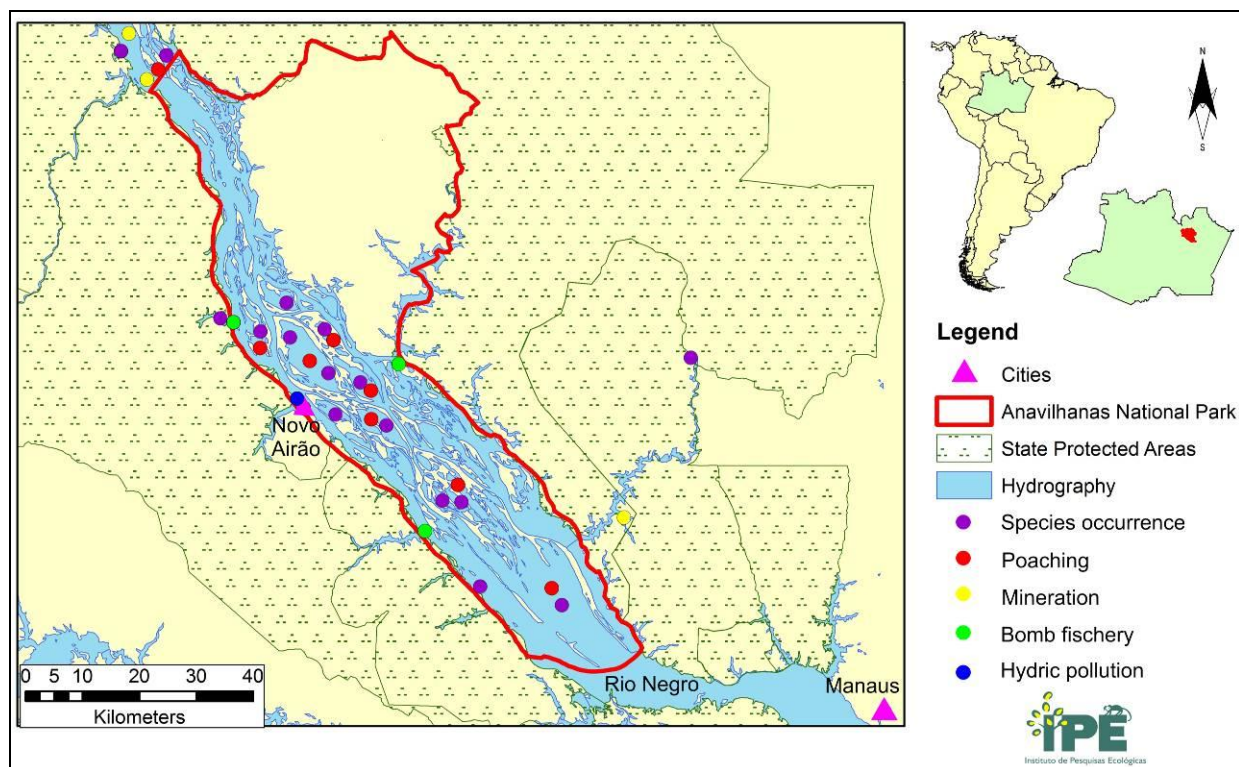


Figure 19 – Map of Amazonian manatee occurrence and threats in the Anavilhanas National Park identified at the workshop.

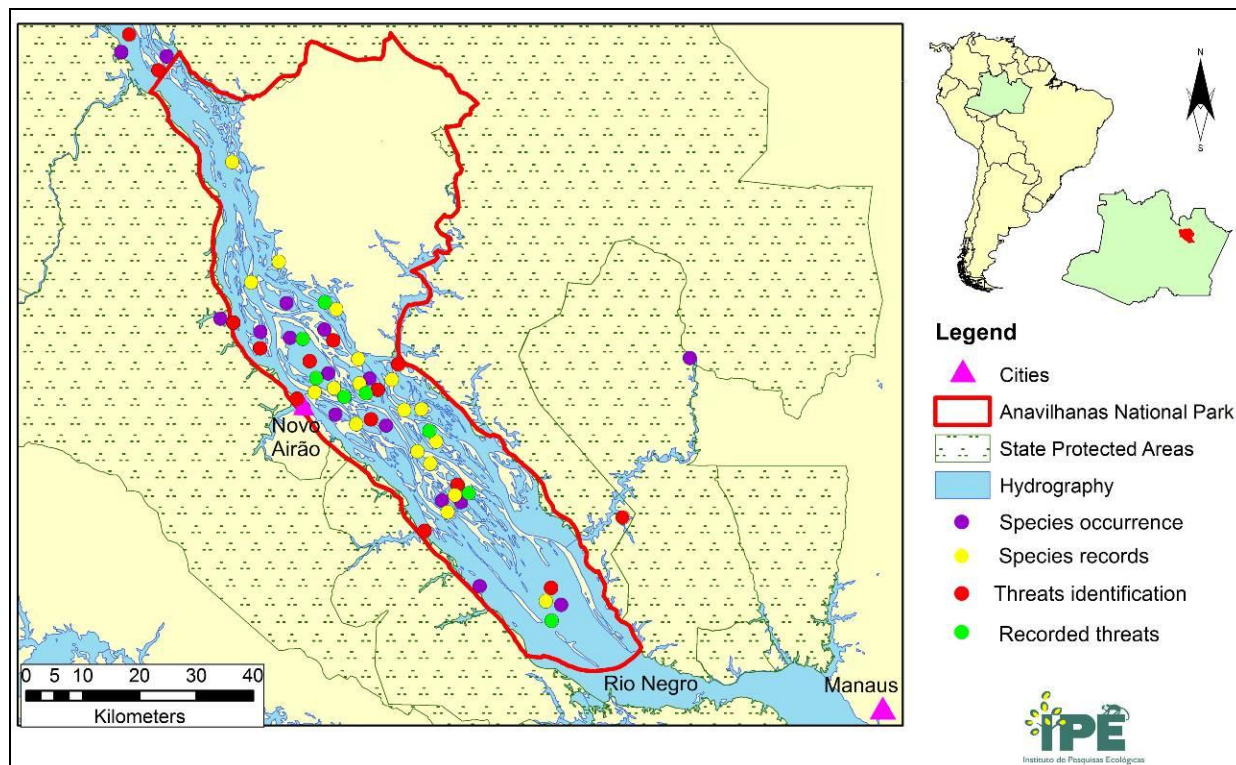


Figure 20 – Map comparing the species occurrence and threats identified at the workshop with the species and threats observed during field activities

Finally, the participants of the workshop identified actions that will promote species conservation. The most frequent activity, present in all previously identified threats, was to increase public awareness. Raising knowledge among the population about the importance of conserving this species and what they can do to help was an activity that all participants agreed to carry out.

Side-scan sonar methodology development

In July, August and September 2011 tests with a side-scan sonar attached to the side of a small boat were carried out at Amanã Sustainable Development Reserve. The tests were used to fine tune equipment configurations and to calibrate images generated by the side-scan sonar.

During the activities, tests were conducted using different range of detection distances and boat speeds to establish the best configurations to be able recognize large aquatic animals in the sides-scan sonar images (Figure 21). However, during these tests, no Amazonian manatees were recorded and the preliminary equipment configuration was

established using images of river dolphins: *Inia geoffrensis* (Figure 22) and *Sotalia fluviatilis*.



Figure 21 – Tests with the side-scan sonar to record Amazonian manatees in the wild

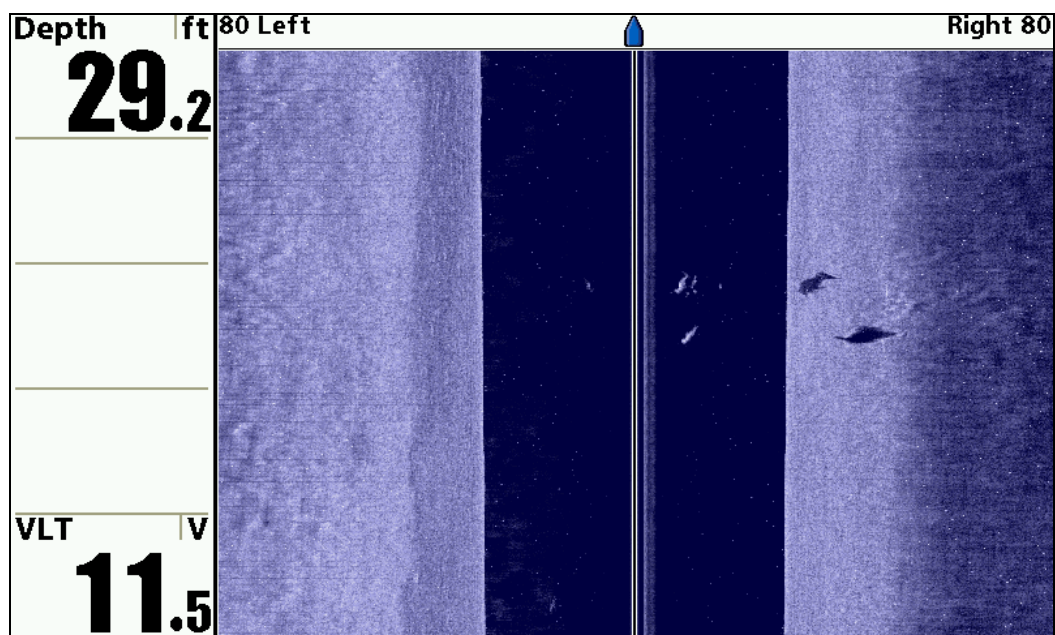


Figure 22 – River dolphin (*Inia geoffrensis*) image generated by the side-scan sonar

From February to July 2012, the side scan sonar was tested in Anavilhanas National Park, during the flooded season (Fig. 23). In these months we sampled 240.54 km during 12h 49min of tests. Unfortunately, once more we did not record any Amazonian manatees.



Figure 23 – Tests with the side-scan sonar in Anavilhanas National Park

In August and September 2012 we tested the side scan sonar at Amanã Sustainable Development Reserve using a wooden boat and an electric engine – aiming to reduce the noise during the tests. However, no manatees were recorded. Consequently, the project team are still working on the development of the side-scan sonar technique to record Amazonian manatees.

Raising public awareness

In 2011 four outreach activities were organized in the Anavilhanas National Park region: Environmental Week, in July 2011 – that included lectures to the students and the whole population of the region; a workshop about recycling with teachers from the city in August 2011 – with the goal that they will include this issue in their science and biology classes (Figure 24); the Clean Up Day in September 2011 – a task-force to clean the Novo Airão river beaches (Figure 25); and the Manatee Mini EcoFestival of Novo Airão in October 2011. Around 1500 citizens of Novo Airão participated in these public awareness activities. The Manatee Mini EcoFestival of Novo Airão included lectures about several environmental concerns of the region (Figure 26), enjoyable activities with students, such as theater, dance and music (Figure 27) and the Environmental Drawing and Poetry Contest. The Environmental Drawing and Poetry Contest were held with students from the region in October 2011: around 45 drawings

(Figure 28) and 60 poems were entered in the contest and more than 200 people voted. The prizes for the winners were a day-trip to the Science Forest in the INPA (National Institute for Amazonian Research) and to Anavilhanas National Park.



Figure 24 – Workshop on Recycling for Teachers of Novo Airão



Figure 25 – Task-force to clean the river beaches of Novo Airão on the Clean-Up Day 2011



Figure 26 – Cristina Tófoli during a lecture in the Manatee Mini EcoFestival 2011



Figure 27 – Enjoyable activities with students during the Manatee Mini EcoFestival 2011



Figure 28 – Winning drawing of the Environmental Drawing and Poetry Contest 2011

In June 2012 Environmental Week was held, comprising more than 15 activities (including lectures, environmental games, green cinema, environmental and sport contests) and engaging around 500 participants (Figures 29 and 30). In September 2012 the Clean Up Day was organized to clean the Novo Airão river beaches (Figure 31).



Figure 29 – Green movie to the population of Novo Airão during the Environmental Week 2012



Figure 30 – Environmental contest with students during the Environmental Week 2012

Furthermore, since 2010 we have presented 18 lectures about the Amazonian manatee and conservation of the lower Rio Negro region, including results from this project.

The public awareness activities are being carried out in partnership with several environmental institutions from Novo Airão, this initiative is called Ajuri de Novo Airão – ajuri is an indigenous word that means task force. The institutions engaged with the Ajuri de Novo Airão include the Municipal and the State Environmental and Sustainable

Development Agency, the Brazilian Agency for Biodiversity Conservation (ICMBio), NGOs and local associations.



Figure 30 – Task-force to clean the river beaches of Novo Airão in 2012

FINAL CONSIDERATIONS

Side-scan sonar methodology development

Results from the preliminary tests with the side-scan sonar revealed that due to the large river depths in the wet season (flooded period), there is a higher potential to apply the methodology during the dry season. During the drought the animals were confined in the deepest areas, such as lakes and deep parts of the rivers, therefore increasing the probability of recording the species. Although it would be a step forward to detect a manatee in the wild using the side-scan sonar to estimate population size we need to sample all year round, not just in the dry season, to avoid biases and the possibility of over-estimating the number of manatees in the region.

Additionally, the noise of the engine and the aluminum boat may be scaring the animals out of the sonar's detection range impacting the protocol development and potential application of this methodology. To address this potential problem a wooden boat with an electric engine are being used in the next phase of testing. Therefore, more tests will be carried out with the side-scan sonar aiming the development of the methodology to access information on wild Amazonian manatees.

Amazonian manatee monitoring and threats identification

Considering the results obtained during this project, we observe that the manatees most frequently used habitats at Anavilhanas National Park were lakes, environments with calm waters and with aquatic plants available.

Observing the map of potential threats and records of Amazonian manatees at Anavilhanas National Park, we noticed the presence of the species and of potential threats overlap in six areas. This information suggests these as priority areas to Amazonian manatee conservation in the Park.

However, it is necessary to continue the research activities and monitoring to define preferred habitats of the Amazonian manatees and the critical areas to species conservation at Anavilhanas National Park.

Participatory Workshop on Amazonian Manatee Conservation

The 1st Participatory Workshop on Amazonian Manatee conservation carried out in the region was very important, both to engage the population on species conservation and to connect them to the project activities, thus they can be the main actors to conserve the Amazonian manatee. More participatory workshops will be carried out next year in the region, focusing in the rural population, aiming to reduce the species poaching and to enhance the habitants to the species conservation.

Finally, it is interesting to observe that most of the records obtained from the project field activities (species and threats records) are located in the same places that the Novo Airão population identified during the participatory workshop, emphasizing their bond to nature and the accuracy of traditional knowledge.

Considering this result and the lack of public awareness activities in the riverine communities, in the future the project will focus more on participatory activities (workshop and public awareness) with the population that lives near the Anavilhanas National Park than on research activities.

Raising public awareness

The outreach activities carried out during the period engaged more than 2000 participants of the Anavilhanas National Park region. The majority of the participants were students of the city of Novo Airão, surrounded by the Park and other conservation units.

The public awareness activities promoted the involvement of the participants with regional environmental issues, with the Amazonian manatee specifically, and with conservation of the Anavilhanas region. The activities also allowed us to share project activities and results with the local population.

Furthermore, the outreach program disseminated internationally the research activities carried out with the project and the meaning of the conservation of the Anavilhanas region and the Amazonian manatee. The main issues regarding the conservation of this species and the project activities were presented at SeaWorld Orlando, University of

Florida, Fifth Sirenian Symposium and the 19th Biennial Conference on the Biology of Marine Mammals.

Taking into account that outreach activities should be carried out over the long-term, aiming for a sincere engagement of the population with conservation, we plan to continue the public awareness program.

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