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INTERPRETATION OF THE U.S. FISH AND WILDLIFE WEST INDIAN MANATEE FIVE-YEAR REVIEW

In April 2007, the US Fish and Wildlife Service (FWS) completed a five-year status review for the West Indian Manatee including both subspecies: the Florida Manatee, *Trichechus manatus latirostris*, and the Antillean Manatee, *T. m. manatus*. This was an internal staff assessment incorporating the latest information from current recovery plans, peer-reviewed scientific publications, unpublished reports, field observations, and information and personal communications from agencies, biologists and experts. The review is a requirement by the Endangered Species Act (ESA) and uses five criteria for evaluation: a) the present or threatened destruction, modification, or curtailment of its habitat or range; b) over-utilization for commercial, recreational, scientific, or educational purposes; c) disease or predation; d) the inadequacy of existing regulatory mechanisms; or e) other natural or man-made factors affecting its continued existence. Notice of the five-year review was made public in April 2005 through the Federal Register (Volume 70, Number 71).

At the forefront of the Service's evaluation was the incorporation of a threats analysis developed by the US Geological Survey called the Core Biological Model (CBM). The model can be manipulated to incorporate changing levels of threat, specifically watercraft, availability of warm water, deaths due to locks/dams, entanglement and red tide. The model also addresses environmental, demographic and catastrophic stochasticity. Multiple scenarios were run through the model to estimate the possible effects of changing threats. The quantitative analysis calculated probabilities of quasi-extinction (a minimum population level where recovery is unlikely) at three minimum population levels (100, 250, and 500 adult manatees) and three timeframes (50, 100, and 150 years). The specifics of the manatee five-year evaluation and threats analysis can be found at: <http://www.fws.gov/northflorida/Manatee/manatees.htm>.

According to FWS, the five-year evaluation is NOT a formal decision or a specific proposal that the manatee's status should be changed. However, a change from endangered to threatened is their

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INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

Commission de la sauvegarde des especes-Species Survival Commission



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recommendation, which is based on review of existing and most current information. There is no recommendation or requirement to reduce or modify any existing manatee protections. The review does, in fact, point out areas where there are deficiencies and recommends additional protection. The document also states that the formal proposal for reclassification will occur in the future and will be based on a variety of factors and priorities. The future proposal will likely occur when additional important information is available, particularly demographic data from southwestern Florida and more insights into the availability of warm water habitat. The review indicates that the downlisting to threatened could be skipped and a proposal may be made to remove the species completely from the endangered and threatened list if the updated information is positive. Alternatively, if the picture is gloomy, then manatees would remain as endangered and no formal recommendation would be made for a change in status. The review, as noted in the document itself, is recognition that the manatee population is doing better, but there still exists a number of important factors affecting their future which currently does not allow for formal action to be taken to change the listing status for manatees in Florida or Puerto Rico.

Under the ESA, the definition of an *endangered* species is one that is in danger of extinction throughout all or a significant portion of its range. A *threatened* species is one which is likely to become an endangered species within the *foreseeable* future throughout all or a significant portion of its range.

The science and the scientists behind the CBM are excellent and the best data and information have gone into the modeling. The CBM and projections of future manatee populations with threats remaining equal, i.e. status quo, show a steady decline that becomes accelerated at about 50 years, as a consequence of disappearance of warm water, with about an 8.5% chance of quasi-extinction (less than 250 animals on either coast) at around 100 years and 14% chance fifty years later. In the document there is no clear definition for *foreseeable* future given.

FWS has stated that to qualify for endangered status, manatees must be in imminent danger of extinction, without a timeframe given. Based on the FWS analysis, manatees are not on the brink of extinction and best fit the ESA definition of threatened rather than endangered. The CBM and threat analysis identified that the reduction of watercraft related mortality and limiting the loss of warm water would be the two key factors that would have the greatest positive impact for the recovery of manatees in Florida. They recommended 11 recovery actions for the Florida sub-species and 13 for the Antillean manatee. It was also determined that the current regulations, particularly Florida's 2007 manatee management plan and the Florida Manatee Sanctuary Act provide an adequate framework for recovery and future downlisting.

There certainly is much to celebrate with regards to the manatee's status in Florida. In three of the four regions of Florida, where there is adequate data, manatee populations show positive growth. Wildlife managers should feel good that conservation actions have provided adequate protection for populations to grow. The CBM and current estimated growth rates do seem to indicate that manatees in Florida are not on the verge of extinction. The threats, however, are far from under control and in some instances, e.g. warm-water issues, beyond the immediate authority of either FWS or the Florida Fish & Wildlife Conservation Commission (FWC) to directly manage. The review addresses these threats by evaluating whether regulations are in place and assumes they will be effective in reducing risk in the future. The Service is clear that regulatory mechanisms will be developed, monitored and improved as more information is available.

Southwestern Florida is currently data deficient and represents about 40% of the state's manatee population. The southwest also has some of the highest levels of watercraft related mortality in the state, warm water concerns, and must deal with the effects of red tide. New information from that region could possibly drive the population trend line down. However, FWS remains hopeful that any new information will prove positive and have the opposite effect.

I believe FWS and FWC are intent on finding solutions to the recovery issues. The agencies have on-going discussions with various state and federal organizations to develop and coordinate conservation actions. However, I remain somewhat dubious of their ability to effectively address and control the outcome of growing and future threats. This is not criticism of the FWS, per se, but rather concern for the reality of trying to manage agencies outside the direct oversight and authority of FWS or FWC.

The state's population continues to grow and our regulatory and water resources are increasingly strained. The challenges of addressing watercraft usage, reduction of natural warm-water flow, managing red tide with its complexities, dealing with external authorities, conflicting interests, variables of natural systems, and political will and popular support—particularly if the public and political perception is that manatees are no longer endangered—are immense. Already there are emerging implications for federal manatee funding from FWS. FWC funds for their manatee program through popular sales of specialty license plates have been steadily dropping. Are these funding issues related to changed perceptions about manatees in Florida? And if so, does it bode well for the future, particularly when management tries to tackle, with limited funding, some of the very complex issues such as the future of artificial and natural warm water? If in the public's view manatees are no longer endangered, are they less apt to buy a manatee specialty plate and law-makers less likely to support appropriating funds for manatee recovery actions? These are not legal or policy questions and well beyond the scope of the review, but they are very real concerns in terms of the ability of agencies to act on the recovery of manatees.

Factor D of the plan acknowledges the need to monitor effectiveness of regulations. It is very important that we not accept the existence of regulations as concrete evidence that recovery criteria are being met. This would be analogous to accepting that it is safe to cross a busy road when speed limits are posted - personally I will look both ways to see if drivers are actually slowing down. Achievement of the intent behind regulations should be the benchmark for success, not the regulations themselves. Establishing minimum flows for springs is an excellent goal, but not adequate for manatee protection. Rather, maintaining those minimum flows is the appropriate metric.

Manatee populations are doing better in over half the state, however, we are uncertain about what is going on in an area that is estimated to represent 40% or more of the statewide population. Threats remain and are becoming increasingly complex and difficult to address as the human population continues to grow in Florida and there is more and more demand for resources. Are manatees out of the woods? No. Are they on the "brink" of extinction? Probably not. Are they threatened with extinction in Florida in the foreseeable future? This depends on your definition, but a 14% probability in 150 years (assuming threats don't increase) appears high. Can the responsible agencies resolve recovery issues outside their direct authority in the near term? Probably not.

The position of FWS not to take further action on their recommendation of downlisting manatees from endangered to threatened is prudent. They are correct in asserting that there should be no change until, at a minimum, better population information from southwestern Florida can be incorporated into models. The current review uses a wealth of new biological data about manatees. Any future review and downlisting consideration should similarly incorporate and strongly consider a thorough analysis of how conservation actions and protective measures have and will effectively minimize watercraft deaths and maintain adequate warm water into the foreseeable future. –**James "Buddy" Powell** (powell@wildlifetrust.org)

CHANGES FOR *SIRENEWS*?

For over twenty years *Sirenews* has been provided free of charge to an international group of researchers, managers, educators and other interested parties. The initial need for a printed newsletter that could be accessed

by people anywhere in the world was essential. The U.S. Marine Mammal Commission has been the main source of funding for this newsletter, and in recent years the only source of funding, for which we are grateful. With the expansion of internet access to essentially all corners of the world, and with the limited amount of funding available for such endeavors, we are considering limiting the distribution of the printed newsletter for the most part to libraries and those who cannot receive an electronic version. Before we make this significant change we would like feedback from our readership. Please email me at taylor@wildlifetrust.org with any thoughts about the future of *Sirenews*. Please remember that if you are advocating for the continuation of a printed newsletter, we would appreciate suggestions and commitments for funding. - CRT

NEW REPORTS

USGS Core Biological Model. The U.S. Geological Survey (USGS) released a report describing a core biological model (CBM) that can be used to forecast the population growth of the Florida subspecies of the West Indian manatee over time in four regions: the Upper St. Johns River, and the Northwest, Southwest, and Atlantic coasts. The model was developed in cooperation with scientists at the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute, and is meant to serve as a flexible tool for assessments that support state and federal decision-making. The model includes recent understanding of manatee population dynamics and estimates of life-history parameters, as well as assumptions about the future state of the environment, said Dr. Michael Runge, the lead author on the report and a scientist at the USGS Patuxent Wildlife Research Center in Laurel, Md. The model can also include annual variation in manatee survival and reproduction rates, effects of predicted changes in warm-water capacity, and catastrophes such as red tide. The report can be downloaded from the following link: <http://www.pwrc.usgs.gov/resshow/manatee/>

USFWS West Indian Manatee Five-Year Review (see pg.1). The U.S. Fish and Wildlife Service's Five-Year Review is available online at <http://www.fws.gov/northflorida> or may be requested by e-mail at manatee@fws.gov; by fax at 904/232-2404; by mail at U.S. Fish and Wildlife Service, Attn: Manatee Five-Year Review, 6620 Southpoint Drive, Suite 310, Jacksonville, FL 32216-0958; or by telephone at 904/232-2580.

Florida Manatee Management Plan. The second draft of the Florida Fish and Wildlife Conservation Commission's (FWC) Manatee Management Plan is now available. Approximately 900 comments were received on the first draft. The second draft has been modified in a number of ways, including: emphasis and clarification that the FWC is not managing for a population decline; re-worded conservation goal, revised conservation objectives, and modified measurable biological goals; many areas were expanded in order to provide increased clarity based on public input; the legal framework was moved into the main document from the appendices; and all proposed tasks were combined into one table at the end of Chapter 11. The public comment period on this document will be May 7 – June 14th, 2007. The document can be accessed at http://myfwc.com/manatee/MMP_draft2_4-12-07.pdf.

UPDATE ON IUCN RED LIST STATUS OF SIRENIANS

As reported in an earlier issue of *Sirenews*, in August 2005 the Sirenian Specialist Group convened a full-day symposium/workshop with the primary goal of developing formal justifications and recommendations regarding the threatened status of the world's sirenian species and subspecies for the *IUCN Red List of Threatened Species*. Based on the information and assessments presented at the symposium/workshop and additional data collection and analysis in the ensuing months, the Sirenian Specialist Group has recommended

to IUCN the following Red List classifications for the sirenians: dugong *Dugon dugong* – Vulnerable (Red List criteria A2bcd); Amazonian manatee *Trichechus inunguis* – Vulnerable (A3cd); West Indian manatee *T. manatus* – Vulnerable (C1); West African manatee *T. senegalensis* – Vulnerable (A3cd; C1); Florida manatee *T. manatus latirostris* – Endangered (C1); and Antillean manatee *T. manatus manatus* – Endangered (C1). In addition to the listings themselves, the Sirenia Specialist Group has compiled and processed the supporting documentation necessary to underpin these assessments using the SSC Species Information Service Data Entry Module. This information will be available online via the IUCN Red List website, both for reference purposes and further analysis by the Specialist Group, IUCN and other interested parties.

As an immediate response to the recommendations of the Specialist Group, two Sirenian taxa were added to the 2006 IUCN Red List: the dugong (Vulnerable) and the West African manatee (Vulnerable). The assessments for *T. inunguis* and *T. manatus* (plus subspecies) were held back as members of the IUCN's Standards and Petitions Working Group requested clarification of some aspects of the assessments that were submitted.

With the great assistance of Dr. Chip Deutsch, Dr. Caryn Self-Sullivan (who recently and successfully defended her dissertation), and Dr. Tony Mignucci, the assessments for *T. manatus*, *T. manatus latirostris*, and *T. manatus manatus* were re-written and are likely to be satisfactory to IUCN. Therefore, we expect that these taxa will be added to the 2007 Red List at the originally recommended levels. Similarly, Dr. Miriam Marmontel provided great help in addressing the assessment for *T. inunguis*, and a re-written version has been submitted to the IUCN in hopes that the Amazonian manatee can also be added to the 2007 Red List with a classification of Vulnerable, as originally recommended.

To all who contributed of their time and expertise to develop or polish the assessments, we express our deepest thanks. It is extremely important to have the various sirenian taxa represented at the appropriate classification on the Red List and to have these assessments backed up by the full suite of supporting documentation. We encourage anyone who wishes to contribute new information, or make corrections to existing data, to please contact us so that we can ensure that the information on the Red List remains current and up-to-date.

The 2007 IUCN Red List will be available online (www.iucnredlist.org) on 26 June 2007. - **John E. Reynolds, III** (reynolds@mote.org) and **Michael Hoffmann** (m.hoffman@conservation.org)

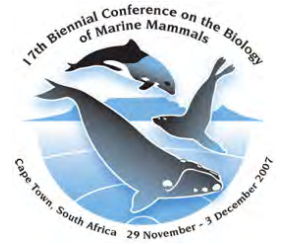
SIRENIAN SPECIALIST GROUP CO-CHAIR

I have been honored to serve as co-Chair of the Sirenian Specialist Group for several years, first with Buddy Powell and then with Benjamin Morales. In the past couple of years, in particular, it has been very satisfying to see the IUCN Red List assessments reach fruition, thanks to the efforts of a number of people.

I wish at this time to announce my resignation as co-Chair of the Group, effective 1 December 2007. My many obligations prevent me from providing the time and leadership that sirenians deserve. I hope that Benjamin will be willing to stay on as a co-Chair, and I suggest that Specialist Group members who attend the Cape Town workshop being organized by Helene Marsh, Buddy and Benjamin in association with the 17th Biennial Conference on the Biology of Marine Mammals consider at that venue someone with professional credibility, energy and time to replace me. Thanks for the honor of serving in this position for the past few years. –**John Reynolds** (reynolds@mote.org)

UPCOMING CONFERENCES AND WORKSHOPS

The Society for Marine Mammalogy will be holding the 17th Biennial Conference on the Biology of Marine Mammals from 29 November to 3 December, 2007, at the Cape Town International Convention Centre in Cape Town, South Africa. For more information on the conference and pre-conference workshops including international sirenians and African marine mammals, please go to www.smmconference2007.org. Abstract submissions are due by 31 May 2007, and early registration begins on 15 July 2007.



The Society for Conservation Biology will hold their 21st Annual Meeting from 1-5 July 2007 in Port Elizabeth, South Africa. The call for papers and posters is closed. For more information please go to www.nmmu.ac.za/scb/.



The American Society of Mammalogists will hold their 87th Annual Meeting from 6-10 June 2007 at the Museum of Southwestern Biology in Albuquerque, New Mexico, USA. For additional information please go to asm007.unm.edu/index.html.

REPORT FROM THE MESOAMERICAN MANATEE SYMPOSIUM

The First Symposium for the Biology and Conservation of the Antillean Manatee (*Trichechus manatus manatus*) in Mesoamerica was held in Antigua, Guatemala on November 1-2, 2006, during the XI Annual Congress of the Mesoamerican Society for Biology and Conservation. Organized by Daniel Gonzalez-Socoloske, Leon David Olivera-Gomez, and Ester Quintana-Rizzo and sponsored by Sirenian International, with additional support from Robert E. Ford of Loma Linda University, the primary purpose of this symposium was to update current knowledge regarding the status and distribution of Antillean manatees in Mesoamerica. Representatives from Mexico, Guatemala, Belize, Honduras, Nicaragua, Costa Rica, and Panama were invited to present on the current status and distribution of manatees within their country. A special invitation was extended to a manatee researcher from Venezuela to participate at the meeting.



The symposium provided an opportunity for scientists in Mesoamerica to present results of their current work and to begin collaboration on multi-national projects to investigate the regional manatee population using molecular, aerial survey, and other methods. It also provided a friendly venue where young scientists and students could interact with veterans of the sirenian world. Fourteen individuals presented at the symposium representing every Mesoamerican country and Venezuela. Twenty-eight abstracts were submitted (some are presented below) and 22 oral or poster presentations were delivered. Participants were presented with a certificate and a CD containing the symposium program, a list of participants with their contact information, and a bilingual (English and Spanish) manatee necropsy manual. Attendees to the symposium fluctuated from 30 to 50 depending on the day and the presentation.

Following the formal presentations, a round table discussion was held to enhance collaboration between countries, resulting in formation of a Mesoamerican Manatee Research Workgroup. Representatives were selected (see below) and charged with coordination of a region-wide effort towards the study and conservation of manatees. One of the first projects proposed was a fine scale molecular study on manatees in the Mesoamerican region, with a recommendation that Mote Marine Laboratory and the USGS Sirenian Project Laboratory be invited to collaborate on this project. The research group also provided some general recommendations for the new Regional Management Plan for the West Indian manatee that is been developed by the United Nations Environmental Program.

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Participants and attendees walked away from this symposium with the latest information on the status and distribution of manatees in Mesoamerica. New technologies were presented, such as a non-invasive DNA extraction technique using a metal scraper and the use of sonar to detect manatees. The round table discussion resulted in a research workgroup, enabling better coordination of research and conservation efforts in Mesoamerica. Collaborations between countries will prevent redundancies in developing materials and techniques. One example is the conservation work done in the Mosquito region of Nicaragua where a scientist has produced coloring books designed to help children understand why manatees are in danger and how to protect them. Books were written in the local Mosquito language enabling these same materials to be used in the Mosquito region of Honduras. The workgroup plans to continue meeting at least once a year during the Mesoamerican congresses. -**Daniel Gonzalez-Socoloske** (dgonzalez01x@llu.edu)

-Sirenian International is working with the Earthwatch Institute (EW) to secure funding for a similar symposium to be held in conjunction with an African Fellows EW Team to the new Manatee Project in Volta Lake, Ghana in November. African manatee and dugong scientists working at the grassroots level in their native countries of Africa are invited to contact Caryn Self-Sullivan (caryn@sirenian.org) for further details as they become available.

REPORT FROM A WORKSHOP ON THE CONSERVATION OF THE WEST AFRICAN MANATEE

From 18 to 20 December 2006, a workshop was held in Dakar, Senegal, for the development of a conservation strategy for the West African Manatee (*Trichechus senegalensis*), which was recently registered as vulnerable on the IUCN Red List of threatened species. The first meeting of its kind in West Africa, the workshop was organized by the Wetlands International Africa Office in partnership with the Abidjan Convention Secretariat in Nairobi, Kenya. The meeting comes under the framework of activities of the West African Manatee Conservation Project initiated by the Regional Coastal and Marine Conservation Programme for West Africa (PRCM).

The objective of the meeting was to provide the foundations for a conservation action plan for the species. It also hosted the third Focal Points Forum of the Abidjan Convention, a key project. It united more than 60 experts from 15 countries in Africa and Europe. The meeting provided the opportunity for presentation and evaluation of the studies and basic surveys carried out on the ground in various PRCM countries, and the examination of the reports from signatory countries to the Abidjan Convention. Additional information on the status and protection of the manatee was also presented. During the three days, participants looked at several topics such as research studies, gaps in research, existing literature on the manatee throughout its range, and population sizes. The meeting facilitated the identification of conservation opportunities at local, national and regional levels, as well as the role of the various players.

It was shown during the discussions that the West African manatee is a “forgotten” mammal, considered by some as unimportant and without local value. Little research exists on the species although surveys were carried out in some areas of West Africa (Ivory Coast, Togo and the countries of the PRCM). This is mainly due to the lack of financial and logistical means and a lack of scientific expertise. The species is highly threatened due to hunting, destruction of its habitat, trade (meat), and the ignorance of local populations about its various heritage, ecological and scientific values.

Due to these many constraints, recommendations for strategic actions were formulated in the areas of wetlands policy and legislation improvement, ensuring a better scientific understanding of the species, applying research results to set up effective management and conservation systems for the West African manatee, developing pilot actions to safeguard the species and its habitat, training experts, and informing the public. The Wetlands International Regional Office for Africa was given the responsibility of facilitating the conservation strategy document for the West African manatee. - **Mame Dagou Diop** (Project Officer, Conservation of the West African Manatee (*Trichechus senegalensis*), Project WI-PRCM, Dakar, Senegal, dagouwet@orange.sn)

WEST AFRICAN MANATEE GENETIC ANALYSIS: A REQUEST FOR SAMPLES

Very little is known about the population genetic structure of manatees in West Africa. As a part of two manatee research projects starting in Gabon and Angola, we are hoping to collaborate with researchers in an effort to analyze genetic samples throughout the range of the West African manatee. Fine-scale analyses will provide increased and much-needed baseline data for this species and can also assess the impact of by-catch/directed take. These analyses will facilitate the examination of individual identity, comparison of animals sampled from different lagoon and river systems, a regional evaluation of population structure for samples obtained throughout the range of West African manatees (hopefully from other sample contributors) and assigning population relatedness of West African manatees in comparison to other manatee species and populations. Such studies have recently been conducted involving detailed analyses of West Indian and Amazonian manatees (Garcia-Rodriguez *et al.* 1998; Cantanhede *et al.* 2005; Vianna *et al.* 2006). As noted above, we are seeking manatee samples from other West African countries and collaborators who would be

interested in assisting with this larger initiative. We consider this collaboration essential to the success of the project. Samples will be analyzed by the Cetacean Conservation and Research Program (CCRP - a joint program of the American Museum of Natural History and the Wildlife Conservation Society) and in collaboration with researchers at the University of Florida. Molecular techniques and existing polymorphic primers for manatees and dugongs have been developed by the University of Florida and the Florida FWC. If you have manatee tissue samples and would like to contribute, please contact Lucy Keith and Tim Collins. Storage and transportation vials and preservatives will be provided. -**Lucy Keith**¹, **Tim Collins**², **Howard Rosenbaum**², and **Bob Bonde**³ (¹Wildlife Trust, 1601 Third Street South, Suite F, St. Petersburg, FL 33701, keith@wildlifetrust.org; ²Wildlife Conservation Society, Marine Program, Bronx Zoo, 2300 Southern Blvd., Bronx, NY 10460-1099, tcollins@wcs.org, hrosenbaum@wcs.org; ³USGS, Florida Integrated Science Center, Sirenia Project, 2201 NW 40th Terrace, Gainesville, FL 32605, rbonde@usgs.gov)

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LOCAL NEWS

CUBA

First report of a Florida manatee documented on the North Coast of Cuba. On January 18, 2007, Anmari Alvarez-Alemán (Marine Research Center, Havana University) received a report that the previous evening a manatee cow/calf pair had entered the cooling channel of the Camilo Cienfuegos power plant in Santa Cruz del Norte, Cuba. On a site visit, photographs of these manatees were taken, and three series of healed, white scars were noted on the cow. No other manatees were present. The pair stayed in the channel for three days and then apparently left as sea conditions calmed. On February 3, they were observed in the cooling channel again, but remained for only three hours.

In late February 2007 James Powell (Wildlife Trust) visited Cuba and Alvarez-Alemán shared the images of the manatees. Since he suspected that a scarred manatee using a Cuban power plant might have a known history in Florida, the images were sent to Cathy Beck (USGS Sirenia Project) for comparison to known Florida manatees documented in the Manatee Individual Photo-identification System (MIPS). The MIPS is a computerized database of manatee sightings and images that includes approximately 2,000 individual manatees, some documented for as long as 40 years.

Comparison of the images resulted in an unequivocal match to a manatee first photographed by Powell in Crystal River, on Florida's northwest coast, in December 1979 (MIPS ID CR131). CR131 has an extensive sighting history in Florida (47 sightings) from December 1979 until January 2005 when she was last

photographed by R.K. Bonde (USGS Sirenia Project), again in Crystal River. All her Florida sightings are along the northwest coast, extending from the Homosassa River, just south of Crystal River, to the Wakulla River in Florida's panhandle. Speculation abounds about how and why she ended up in Cuba, and where her calf was conceived. We plan to further investigate the possibilities! -**Anmari Alvarez-Alemán¹, James A. Powell², and Cathy A. Beck³** (¹Marine Research Center, Havana University, Cuba; ²Wildlife Trust, St. Petersburg, Florida, USA; ³Cathy A. Beck, U.S. Geological Survey, Florida Integrated Science Center, Sirenia Project, Florida, USA)

ECUADOR

Manatees in Añangucocha, Yasuni NP, Ecuador? -We are involved in a conservation and ecotourism project called Napo Wildlife Center (www.ecoecuador.org), located at Añangucocha Lake, within Yasuni National Park, in Amazonian Ecuador. The project is in direct partnership with the local Quichua community, which has carefully protected the wildlife resource for over a decade now. This is roughly the 4th largest non-seasonal lake in Amazonian Ecuador and is well over one kilometer in diameter. There have been very few sightings of manatees, but there are also vast areas of floating vegetation that the manatees could be under. We would like to have some idea of how many manatees are in the lake and their conservation status, and would like to determine if we could regularly show them to eco-tourists (without harming them).

We would like to request the following information: 1) Does anyone have data on Amazonian Manatees in Añangucocha? 2) What are their preferred foods (with the intent of making sure the habitat is preferable)? 3) Is there any other kind of habitat management that manatees could benefit from? 4) Are there any techniques for increasing the predictability of sightings, or for documenting their presence? 5) Is anyone looking for a place to reintroduce Amazonian Manatees? 6) Is anyone interested in doing research on Manatees in Añangucocha? Thank you for any information you can provide. -**Chris Canaday** (omaere@gmail.com), **Jiovanny Rivadeneira** (jiovannyrivadeneira@yahoo.com) and **Ethan Borg** (ethanborg@yahoo.com)

GABON

West African Manatee (*Trichechus senegalensis*) 2006 Survey Activities in Gabon. -West African manatees face numerous threats throughout their range, and the lack of basic knowledge on their distribution, behavior and ecology is considered a great hindrance to their conservation. There are no recent estimates of abundance and the impact of hunting and habitat destruction are poorly documented, but the trade in manatee bushmeat is well known in Gabon and elsewhere in West Africa (Powell 1996, Reeves 1988, WCS-Gabon unpublished data). We have begun a multi-year, collaborative project comprising field research, interviews, and market survey components to assess manatee status and distribution in Gabon. This project is also designed to provide local biologists and resource managers suitable training in manatee research techniques, and opportunities to put lessons into practice. The resulting data and analyses will provide much needed information on status and will provide a basis for further conservation action for this species.

Our objectives for the first surveys were to collect baseline manatee use data for selected lagoon and river systems, to conduct interview surveys at these sites, to begin training local biologists in manatee research and conservation techniques, to review existing information and to assess threats to identified populations. During seven weeks in September and October 2006, we were able to survey manatee habitat throughout Gabon, including national parks in the north, central and southern regions of the country, inland freshwater systems and coastal estuarine environments, protected areas and areas where hunting still occurs unchecked. L. Keith was able to talk to a wide range of people about manatees, from current and former hunters, fishermen and bushmeat vendors to park managers, scientists, NGOs and private citizens, all of whom had valuable perspectives. The numbers of manatees observed at several sites during these preliminary surveys is

encouraging, particularly at Loango National Park where we conducted 19 surveys over two weeks that resulted in 12 sightings, including a mating herd. We were also able to collect genetic and skeletal samples from 4 carcasses at Loango National Park and to begin training park staff there in manatee field research techniques.

In 2007 and beyond, we plan to continue and expand our research, including surveys of additional lagoon and river systems, GPS tagging of manatees at selected sites to look at fine-scale habitat use and behavior of these very elusive animals, increased market and interview surveys to ascertain biological, cultural and economic issues, further in-depth training for local biologists, and continued collection and initial analysis of genetic and other biological samples from manatee bushmeat, carcasses and any live manatees captured for tagging. -**Lucy Keith¹ and Tim Collins²** (¹Wildlife Trust, 1601 Third Street South, Suite F, St. Petersburg, FL 33701, keith@wildlifetrust.org; ²Wildlife Conservation Society, Marine Program, Bronx Zoo, 2300 Southern Blvd., Bronx, NY 10460-1099, tcollins@wcs.org)

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GHANA

Recent West African Manatee Research in Afram Volta Lake, Ghana. -In 1964, the world's largest manmade lake, the Volta Lake, was created as a result of the installation of a dam on the Volta River for hydroelectricity. The flooded lands above the dam include the lowlands surrounding one of the Volta's tributaries, the Afram River. Cut off by the Akosombo Dam from the main Volta River, which feeds into the Atlantic Ocean, the resulting submerged forest offers potential habitat for manatees. Reports were made of an isolated West African manatee population surviving in this region.

During sixteen days in April and June 2004, a preliminary survey was completed on the Afram Arm of the Volta Lake (in the Eastern Region of Ghana) to establish West African manatee prevalence in that locality of the Volta Lake. The area used by manatees was defined and mapped using GPS coordinates, and the conservation status of the manatee was established. Methods included: 1) Formal and informal interviews of key informants such as manatee hunters and fishermen, 2) Photographic records of manatee remains, hunting and trapping artifacts, and manatee damaged fishing nets, 3) Direct opportunistic observation of manatee and manatee feeding evidence, and 4) Abundance of preferred manatee food items.

Results confirmed the presence of a manatee population. Overall, the unique flooded forest habitat has created an ecosystem that supports the co-existence of manatees and humans, with partially submerged stumps characteristically scattered throughout the watercourse. This distinctive situation restricts the use and speed of motorized boats, defines the fishing methods that will be successful, and provides a slow-moving water course and safe haven for manatees. They are well known to the fishing people living along the Afram Arm of the Volta, known as 'laale' or 'enor' in Ewe and 'laluuko' in Ada. Fishermen come in contact with them regularly through their fishing practices, which include swimming under water in the setting and removal of fishing nets, and the use of non-motorized, dugout canoes.

However, anthropogenic activity in the locality appears intensive, with several main concerns for the long term survival of the species:

- 1) Hunting pressure – planned hunting appears to be minimal, but remains a potential threat to the survival of manatee in the area.

2) Fishing practices – certain fishing practices appear to be in conflict with manatee feeding and travel behavior, and may have adverse effects on the long-term survival of manatees in the area such as:

a) the removal of floating vegetation for certain methods of fish harvesting, thereby altering the aquatic habitat; b) the competition for access to aquatic vegetation from fishermen using live vegetation as habitat for certain fish harvesting methods resulting in reduced access to feeding resources; and c) the use of purse seine nets for harvesting the fingerling ‘*one-man thousand*’ fish species, thereby resulting in the accidental trapping and by-catch of manatee.

Legal protection has been established for manatees in Ghana, and the Wildlife Division of the Forestry Commission prohibits trade and hunting of manatees. However, the enforcement of wildlife laws protecting the manatee is frustrated by a lack of resources, manpower, and limited awareness of existing regulations. In 2004, the NCRC survey team documented historic evidence that a small number of individuals have hunted manatees in the Afram catchments. The team concluded that manatee hunting did not appear to be a major livelihood strategy, and may be brought under control by working with the individuals concerned. Furthermore, through education and environmental awareness, it would be possible to support local people to make adjustments in their fishing and farming practices to reduce conflict with the species.

Further study was completed in April 2006, when international manatee scientist, Caryn Self-Sullivan, and the NCRC field research team undertook an 8-day field investigation of the same Volta Lake manatee population using the upper Afram Arm. This expedition furthered investigations from 2004 and aimed to investigate the viability of the manatee population and the feasibility of using the Earthwatch Research Model to help stem deleterious anthropogenic impacts on the population. A follow up survey was conducted over 7 days in June 2006 to share findings from the April field work with the local communities and to learn more about the level of interest in a potential conservation initiative for the West African manatee. Communities were unanimous in their support for an endeavor that could bring potential alternative economic opportunities to the depressed area.

Through this follow up field work, it was determined that the Volta Lake manatee population represents an opportunity to advance our breadth and depth of scientific knowledge related to insular populations of endangered species in general and West African manatees in particular. The research has the potential to significantly enhance the conservation status of the West African manatee in Ghana over the next 3 years through greater understanding of population status, distribution, behavioral ecology parameters, and anthropogenic impact. The project can increase awareness and reduce human/manatee conflict in the shoreline fishing communities; enhance local capacity and Ghanaian expertise with regards to this species; and improve economic and social conditions in the project communities. The West African manatee is a charismatic species that could be central to the development of eco-tourism efforts at the Volta Lake, offering economic benefits to the local inhabitants while simultaneously meeting conservation objectives. – **Donna Sheppard** (Sanctuaries Advisor, Nature Conservation Research Centre, P.O. Box KN 925, Accra, Ghana; djsheppa@yahoo.com)

MEXICO

First records of long-distance manatee movements between Mexico and Belize. -Belize and the Mexican state of Quintana Roo share one of the largest populations of manatees in the Caribbean (O’Shea and Salisbury, 1991; Morales-Vela et al., 2000). In 2004, Benjamin Morales-Vela and Janneth Padilla-Saldívar from the Mexican manatee research project from El Colegio de la Frontera Sur (ECOSUR), with technical assistance from James Reid and Susan Butler from the U.S. Geological Survey’s (USGS) Sirenia Project, initiated a study of manatee movements in Chetumal Bay (CHB), Mexico, using satellite-monitored GPS tags. This project received funds from the Mexican Federal Government (Project SEMARNAT-CONACYT-1128) and Dolphin Discovery Group. As this was the first time that satellite-monitored tags were used in manatee

studies in Mexico, the Mexican researchers spent time at the USGS Sirenia Project in Gainesville, FL, to learn how to use this new technology. To assist this project, two marine biologists from Chetumal, Rafael Estrada-Anaya and Gerardo Rodríguez-Martínez, were trained at ECOSUR to conduct manatee captures, radio-tracking, manatee monitoring, and tag maintenance.

From 2004 to 2006, four male and five female manatees were captured and tagged with Argos-linked GPS tags in northwestern CHB. Two of these, “Tizoc”, a 292 cm adult male, and “Rafael”, a 228 cm subadult male, made long distance movements between CHB and Belize.

“Tizoc” remained near his CHB capture area for one month after his tagging in March 2006. He then moved south 260 km along the mainland shore of Mexico and Belize, arriving in Southern Lagoon (SL), a wildlife sanctuary located on the central coast of Belize, after traveling for 12 days. After two months in SL, “Tizoc” began a rapid return to CHB, arriving at the same area where he was captured within six days. He then spent two and half months in CHB before returning to SL within nine days.

After tagging, “Rafael” remained on the west coast of CHB from March to May 2006 before rapidly moving south along the same coastal route as “Tizoc”. “Rafael” covered 285 km in eight days from CHB to South Stann Creek, close to Placencia Lagoon, Belize, where the tag broke free. Placencia Lagoon has one of the highest numbers of manatees in Belize (Morales-Vela et al., 2000).

A manatee tracking project in Belize, lead by James Powell and Nicole Auil with Wildlife Trust in collaboration with Robert Bonde from the USGS Sirenia Project, has been studying manatees in SL and the cays near Belize City since 1996 (Auil, 2006). When “Tizoc” and “Rafael” traveled to Belize in 2006, Wildlife Trust staff helped track “Tizoc” in SL and recovered the GPS tag of “Rafael”, which was found by a local fisherman near South Stann Creek in May 2006. “Tizoc” lost his tag near Belize City in February 2007. We appreciate the cooperation of Wildlife Trust and Belize authorities for their assistance in the recovery of these GPS tags.

The movement pattern from CHB to Belize for the two male manatees was very similar. They both made directed, continuous moves along the shoreline between discrete manatee habitats. The northwestern side of CHB in Mexico and SL in Belize are important manatee habitats for these countries. Our data are the first records of long distance manatee movements along the Mexico-Belize coast. They also show regional connectivity among areas of localized manatee occurrence with movements between distant sites, and site fidelity for some individuals to multiple sites.

International cooperation between Mexico and Belize will be essential to conserve this important western Caribbean manatee population. Since 1992, ECOSUR and the Coastal Zone Management Project of Belize, followed by the National Manatee Working Group of Belize in 1996, have collaborated with experts from Mexico and the U.S. to develop research and conservation priorities. This new information about regional manatee movements emphasizes the need for strengthening the collaboration between Mexico and Belize. - **Benjamin Morales-Vela¹, Janneth Padilla-Saldívar¹, Jim Reid² and Susan Butler²** (¹El Colegio de la Frontera Sur. Av. Centenario km 5.5. Chetumal, Q. R., México. C. P. 77900. Tel.: 983-8350440. E-mail: benjamin@ecosur-qroo.mx, janetaps@yahoo.com; ²U. S. Geological Survey. Florida Integrated Science Center. 2201 NW 40th Terrace. Gainesville, FL, USA 32605. Office: 352-264-3546. E-mail: jreid@usgs.gov, Susan_Butler@usgs.gov)

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New Observations of Manatees off the Northern Coast of Quintana Roo, Mexico. -A group of six large, presumably adult manatees was observed by the first author during aerial surveys for whale sharks off the northern coast of Quintana Roo, in the Yucatán Peninsula (YP) on 16 August, 2006. A second group of five large manatees was observed in the same area on September 8. Both groups were sighted on the northern side of Laguna Chakmochuk (21° 25' 29" N, 86° 53' 51" W), about 32 km north of Cancun, Mexico. In both sightings the manatees appeared to be resting. It is likely that the two sightings involved the same group of animals because it is uncommon to see manatees in that area. Previous data from aerial surveys of manatees from 1992 to 1996, and again in 2000, show that manatee abundance is low along the northern and western coasts of YP (Morales y Olivera, 1997; Morales et al 2003).

Historical information suggests that prior to 1970 manatees were commonly observed in groups (including calves) in coastal regions of the northern YP associated with fresh water resources. Some of the possible causes for population decline after 1970 suggested by local fishermen include hunting and entanglement in fishing gear (Morales et al 2003). Currently, most of the coastal areas of the YP that have appropriate habitats for manatees are designated Natural Protected Areas which now minimizes such threats. It would prove useful to start a new set of aerial surveys along the coast of Quintana Roo to determine if these two groups of manatees observed north of Cancun are the result of recent manatee movements from the central and southern coasts of Quintana Roo where manatees are more abundant. With 19 years of committed manatee conservation activities in the latter areas, it is possible that the manatees are becoming re-established in areas that were natural habitats in the past. -**Oscar Reyes Mendoza¹ and Benjamin Morales-Vela²** (¹CINVESTAV Unidad Mérida Km. 6 Antigua carretera a Progreso Apdo. Postal 73, 97310, Mérida, Yuc., México; ²El Colegio de la Frontera Sur. Av. Centenario km 5.5. Chetumal, Q. R., México. C. P. 77900; E-mail: bioskar@yahoo.com.mx; benjamin@ecosur-qroo.mx)

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SENEGAL

The Manatee & the Fishermen of the Senegal River: Survey Report. -The following is the abstract from a report contributed to the management plan for West African Manatee (*Trichechus senegalensis*) population conservation. For a summary of the report in English or the entire report in French please contact the authors.

Between the 1st and 25th of October 2006, a survey was conducted about manatees (*Trichechus senegalensis*) among the fishermen communities along the Senegal River, from the Djoudj's National Park to the Malian border. Four main subjects were investigated: 1) the status and distribution of West African manatees along the Senegal River; 2) the biology, ecology and ethology of the manatees; 3) the utilization of manatees by the human populations along the river; 4) the cultural importance of the manatees in the fishermen communities. Data were collected in 42 villages and analysed in a detailed report written in French. The report

gives recommendations in order to contribute to the management plan for West African manatee population conservation currently coordinated by Wetlands International. Recommendations fall under three main categories: 1) monitoring of Senegal River manatees population(s); 2) research in West African manatee biology, ecology and ethology; and 3) conservation, education, and ecotourism. This project was carried out in partnership by Noé Conservation, Wetlands International and the Department of Nature & Wildlife of Senegal. -**Antoine Cadi & Julien Marchais** (Association Noé Conservation, *Responsable "Conservation de la biodiversité"*, Email : acadi@noeconservation.org, julienmarchais@free.fr)

ABSTRACTS

The following abstracts are from oral and poster presentations at the First Symposium for the Biology and Conservation of the Antillean Manatee (*Trichechus manatus manatus*) in Mesoamerica (see pg. 6). These abstracts are English translations of abstracts that will appear this month in *Mesoamerica* v11.1. We would like to thank Haydee Dominguez Tejo (Centro de Investigaciones de Biología Marina de la Universidad Autónoma de Santo Domingo (UASD-CIBIMA), Dominican Republic) for the translations:

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN BELIZE

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It is reported that Belize has the biggest Antillean manatee population (*Trichechus manatus*) within its distribution range. Fifteen aerial surveys were conducted throughout the country between 1994 and 2002. Within these, the highest number of sightings for the coastal zone was of 338 manatees in 2002. The highest percentage of calves registered in one flight was 13%. Manatees can be found in rivers, coastal lagoons, coasts and keys, but there is a higher probability of finding them in coastal habitats (lagoons and rivers). The threats are of anthropogenic origin, the most important one is boat collision due to the increase in tourism activities. The hunting pressure, that reduced the populations, is rare nowadays and occurs mostly in the north and south frontiers. In Belize, the manatee population can be described as stable or declining. Currently there are three initiatives on long-term research: the Turneffe atoll, Drowned Cayes, and Southern and Northern Lagoons. There is strong fidelity for some individuals, but others are transient and seasonal movements are detected between the different habitats. There are different protective measures for manatees in Belize; it stands out that national legislation protects them from capture and direct damage. They are also protected through the designation of Wildlife Sanctuaries (WS)- Belize has three for manatees (Bahía de Corozal, Swallow Caye, and Southern Lagoon), that include 80,362 ha. Those sites have community participants and organized groups managing or proposing the management of the sanctuaries. A National Recovery Plan was completed in 1999 and a scheme summary was made of five years of high-priority management activities, the majority of which have been achieved. Due to limitations in abundance estimates, a conservative approach is of 1000 individuals.

CHARACTERIZATION OF RESTING HOLES AND THEIR DAILY AND NIGHTLY USE BY ANTILLEAN MANATEES (*TRICHECHUS MANATUS MANATUS*) IN THE DROWNED CAYES, BELIZE

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Manatees in the Drowned Cayes of Belize are thought to rest primarily in depressions in the seafloor called "resting holes". The objectives of this study were to characterize resting holes and to investigate diurnal and nocturnal use of these by manatees. Data were collected from June – September, 2005 and 2006.

Characterization of resting holes was accomplished by collecting measurements of depth, distance to shore, type of substrate, current through the water column above the resting hole, salinity, water temperature and type of benthic vegetation around each resting hole. Also, thirty-minute scans were conducted during the day and at night at four scan sites of known resting-holes. At the start of each day of scanning and after each individual site scan, sea and weather conditions were recorded including tidal state, sea surface temperature, and salinity. All manatee sightings and observed behaviors were recorded. Nocturnal scans were performed in the same manner as daytime scans, except that spotlights were used to compensate for the lack of ambient light.

We conducted 79 scans at the four scan sites during 2005. Fifty-four of these scans were conducted during the day and 25 at night. Of the 25 manatee sightings, 19 sightings were during the day and six at night. There were no significant differences in sea

surface temperature or sea surface salinity among the four resting hole locations. Analyses by logistic regression showed that none of the habitat variables significantly predicted presence/absence of manatees.

MANATEE NECROPSY EXAMINATION: AN IMPORTANT TOOL FOR MANATEE SCIENTISTS AND MANAGERS

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The gross and microscopic necropsy examination of manatees can provide critically important information about cause of death, morphologic changes associated with disease and anthropogenic factors. It can also be most beneficial in manatee population studies involving disease epizootics. Additionally, the manatee may also function as a good sentinel for oceans and human health by providing early warnings about current or potential negative trends and impacts in the aquatic environment. Disease characterization through necropsy examination would then permit manatee researchers to potentially manage these impacts on human and animal health.

Currently, there is no universal standard for the necropsy examination of a manatee. However, a systematic and standardized Florida manatee necropsy manual has recently been translated into Spanish and this manual will be distributed. Briefly, the amount of data collected depends on the stage of carcass decomposition. Generally, the more decomposed a carcass, the less information that can be obtained. However, even severely decomposed carcasses can provide important information. Basic minimum data on all cases should include investigator's name and address, the manatee's geographic location, date, sex, length, girth, weight (if possible), and body condition. If possible, the necropsy examiner should take detailed notes on gross observations and photographs. The carcass should then be placed on its back and opened ventrally so all organ systems can be thoroughly examined *in situ*. If the carcass has minimum postmortem decomposition, tissue samples from each organ should be collected and properly preserved. Detailed descriptive notes should be taken to include abnormal findings including tissue color, size, shape, consistency, texture and smell. Practice proper, sanitary hygiene at all times throughout the examination. It is important to remember that a pathologist does not have to do a necropsy examination to provide accurate diagnostic information. However, it is important that necropsy data be collected in a thorough, and systematic manner.

FIELD SAMPLING FOR DNA EXTRACTION AND DEVELOPMENT OF MICROSATELLITE DNA MARKERS IN THE FLORIDA MANATEE, *TRICHECHUS MANATUS LATIROSTRIS*

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The Florida manatee is an integral part of Florida's coastal ecosystem, but the subspecies is classified as threatened or endangered under various laws. Even though numbers of manatees have increased in recent decades, the population faces numerous threats including red tide, cold stress and human impacts on their habitat and in waterways. Methods such as photo-identification, aerial survey counts, and modeling have provided most of the scientific information available to date regarding population size, survival, and reproductive rates. Behavioral studies have provided some information about social structure. Much remains unknown about the variability and stability of the Florida manatee population, as well as about reproductive strategies and success. Genetic tools can address many unanswered questions of interest to scientists and of value to managers. The limited number of DNA markers that exist for this species have low variation and are not able to provide adequate resolution for population genetic analysis. We describe here our use of a PCR-based method to develop additional microsatellite DNA markers. These markers, in combination with existing ones, will be used in analyses to obtain estimates of the effective population size and of population variation. We also describe a minimally-invasive method to obtain manatee skin samples genetic analyses.* Using a serrated piece of metal on the end of a pole, we have been able to successfully obtain high-quality genomic DNA from skin scrapings of animals. In combination with several decades of photo-identification records from southwestern Florida, our genetic analysis will help to elucidate the structure of manatee social groups, including the identification of potential fathers. Our genetic efforts will increase understanding of this protected species and provide needed information to managers to facilitate wise conservation decisions for manatees. Our approaches could easily be applied to conservation genetics programs for manatees or other species in Mesoamerica.

* a manuscript describing this method has been accepted for publication

Carney, S.L., Bolen, E.E., Barton, S.L., Scolardi, K.M., Englund, C.C., Tringali, M.D., and

Reynolds, J.E. III. Accepted. A minimally invasive method of field sampling for genetic analyses of the Florida manatee, *Trichechus manatus latirostris*. *Marine Mammal Science*.

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN COSTA RICA

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In Central America, Costa Rica is one of the countries with more information on the conservation status of manatees. The Costa Rican Caribbean coast does not count with extensive apt areas for the development of the species. However, there are important extensions of freshwater wetlands surrounded by rainy forests in the northern half of the country (e.g. Tortugero plains), that are ecologically connected to the habitats of the southeast of Nicaragua, and a small coastal area provided with seagrasses near the Panama frontier. We could speak of a principal subpopulation of manatees that inhabits rivers and lagoons, genetically linked with Nicaragua and a smaller one that inhabits marine waters, linked to the Panamanian coastal wetlands (e.g. San San and Changuinola). The actual distribution of the species is similar to the one estimated for 1996 and for the mid XX century, although their abundance has increased in the last years. Costa Rica has a protected area system that includes 80% of the manatee distribution, so a good part of the habitat is well conserved, and also hunting has become a residual activity. However, during the last decade the rapid growth of the tourism activity has caused a marked increase in outboard motor boat traffic and an increase in manatee mortality due to this cause. The possible impact of agrochemicals used in agricultural plantations on the Caribbean coast has to be added. In these ten years Costa Rica has testified important manatee conservation actions, among them: population and ecological studies, design and negotiation of a national conservation plan, educative campaigns supported by different didactic materials, signaling of the Parque Nacional Tortugero to decrease boat accidents, and the start of a marking and radio tracking program.

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN NICARAGUA

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Nicaragua counts with one of the principal habitat extensions optimum for manatees in the Caribbean basin. This habitat is composed of big brackish lagoons surrounded by mangroves together with some big rivers in the northern half of the country, and of a group of rivers and small freshwater lagoons surrounded by rainy forests in the southern half. There is no precise data on the size of the manatee population, although the only nationwide study in 1999 pointed towards a population of several hundreds of animals. In general higher densities and group sizes are reported in the big lagoons to the north of the country. There also exists a higher hunting pressure in these lagoons, representing nowadays the principal threat to manatee conservation in Nicaragua. In a study conducted in 2001 and 2002 the cultural and economic importance of this activity was analyzed in Misquita communities that surround these lagoons, finding that two thirds of the inhabitants consumed manatee meat in some occasion and the majority of them considered manatee meat their preferred one. It is difficult to estimate the real impact of this activity on the survival of the species due to strong fluctuations in hunting activity, the absence of precise population estimates and unknown movements of individuals between possible subpopulations. The weak governmental presence and the marginal economy make manatee conservation an incipient process in the northern half of the country. In contrast, in the southeast of Nicaragua there are relatively well managed protected areas where hunting of the species has become an extremely rare activity and where important education and awareness actions have initiated in favor of the manatee framed within binational projects together with Costa Rica.

PRESENCE OF MANATEES (*TRICHECHUS MANATUS*) IN FOUR ZONES OF THE NORTH PART OF VERACRUZ, MEXICO (TAMIAHUA, TUXPAN, TECOLUTLA AND CASITAS-NAUTLA)

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Knowledge about the distribution and abundance of manatees in the north coast of Veracruz, Mexico, is imprecise, because studies conducted in this respect by national as well as foreign researchers have been few. The goal of this work is to establish if there are still viable populations of *Trichechus manatus* in the north part of the state of Veracruz (Tamiahua, Tuxpan, Tecolutla and Casitas-Nautla). There were 502 interviews to fishermen and surveys were conducted on a boat with an outboard engine of 65 horse power (Hp), 25 feet long and a prow of 1 m and on occasions canoes with oars were used. Of the people interviewed 74% (n=371) have not seen manatee populations in the zones of Tamiahua, Tuxpan, Tecolutla and Casitas-Nautla, the remaining 26% (n= 131) indicated that in the zones of Tecolutla and Casitas-Nautla individuals were seen between 1985 and 1986 and they were observed again in 1995 and 1996. In the study area 14 surveys were conducted (1197.24 Km.), especially in the places where people had seen manatees but no individual was observed. Physical phenomena like cyclones, floods and storms significantly affect the aquatic medium where manatees lived, having as a result the probable disappearance of *T. manatus* in these zones.

SCIENTIFIC MONITORING FOR THE CONSERVATION OF MANATEE AND ITS HABITAT IN GUATEMALA

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The manatee (*Trichechus manatus manatus*) is a species of high ecological value, especially because it can serve as an indicator species of biological equilibrium. It consumes up to 40 kg of plants per day and returns back approximately 40% as pure nutrients to the water, contributing biological elements for the stability and productivity of wetlands; it is also an excellent nutrient recycler, so it positively influences the fertilization and productivity of the aquatic medium, contributing to the proliferation of plant and animal populations. Currently the biological integrity of the Bocas de Polochic wetland, located in the southwest zone of the Lago de Izabal, is being affected by anthropogenic activities conducted at the basin level, causing habitat loss for the manatee. This study contributes to consolidating the biological monitoring done not only in the Refuge, but also in the Izabal region. In addition to contributing information regarding distribution patterns, number of individuals in the area and threats to the species, based on a design of integration and association of physical and anthropogenic factors, among them water quality, *Hydrilla verticillata* cover, fishing activity, wetland use, environmental education, inter institutional links and local knowledge, it integrates aerial and aquatic surveys. The generated information will be used to determine potential sites for manatees in the region, which will allow identification of points that by their characteristics are ideal habitat for manatee feeding or reproduction, determining priority conservation sites, in which management actions will be prioritized, promoting habitat conservation and indirectly manatee conservation in the long term. The Bocas de Polochic Wildlife Refuge represents an important site for manatee survival, so its management is fundamental for the conservation of the species.

BAITING OF MANATEES (*TRICHECHUS MANATUS*) AS AN EXPERIENCE FOR THE CAPTURE OF THE SPECIES IN THE PARQUE NACIONAL TORTUGUERO, LIMÓN, COSTA RICA

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The most relevant manatee populations are found in the area covered by the Parque Nacional Tortuguero. The principal problem this species confronts in the zone is boat collision. Several conservation actions have been implemented in the zone for the protection of the manatee and its habitat. Within these conservation measures there have been two capturing attempts to place a radio collar on at least one manatee, principally because of the information needs reflected in the research conducted so far on manatees in Costa Rica. To date there has been no success with manatee captures so the next step to follow, by recommendation from scientists experts in manatee capture and research, would be to do manatee baiting attempts to develop new capturing attempts. For this reason, between the months of March 2005 and July 2006, the present research was conducted with the principal question to determine which is the food item preferred by the species that will function as bait before a new manatee capture attempt by a trap-confinement is made. The approach is based on the experience from other parts of the world where this sirenian has been successfully captured. The basic methodology used to conduct this study were the "restaurant experiments" in which the food items that the animal consumes are put in place and the animal chooses which of them to consume. For this research aquatic plants from the zone as well as human harvested foods were placed (for example: lettuce, carrots, apples, mangoes). The manatee did not consume the food items harvested by humans, on the contrary it was kept baited with one of the aquatic plant species it consumes in the zone for more than nine months.

FIRST SYMPOSIUM ON BIOLOGY AND CONSERVATION OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN MESOAMERICA

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Although this area encompasses much of the range of the sub-species, the exact distribution and number of Antillean manatees in Mesoamerica is unknown. The purpose of this symposium is to strengthen relations between the scientists that work with manatees in this region. A total of 25 presentations will be made orally and in the form of posters representing the work of more than 40 scientists coming from 10 countries. The Mesoamerican region, defined as the biological region from the south of Mexico to Panama, will be evaluated by country in terms of knowledge on manatees. Each presentation will present the historical distribution, the most actual distribution, the actual threats, and the relative abundance if there is enough data. In addition to these key presentations, presentations of regional studies will be made. There will also be presentations about techniques used as tools to study manatees in the field and in the laboratory. These include: DNA collection techniques and the identification of DNA satellite markers, manatee necropsy techniques, use of side-scan sonar to detect and study manatees in turbid waters, the use of non-lethal boat scars to evaluate protected areas, and the effect of contaminants on manatee health. Finally the symposium will have a round table section

where future studies will be planned on subjects like: genetic distribution of manatees in Mesoamerica and coordination of aerial surveys for manatees in Mesoamerica.

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN HONDURAS

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Data on the manatee in Honduras is scarce and sporadic. Although the manatee is protected in Honduras since the year 1959, scientific literature only counts with two manuscripts about the species in Honduras. Historical publications report that manatee population was fairly big. In 1979-80 the entire coast of Honduras was flown in search of manatees, reporting only 11 manatees during a flight including the entire coast. It was very carefully estimated that there were only 100 to 200 manatees left in the country. There were also several places reported as important for manatees: the rivers to the east of Trujillo, the Cuero and Salado rivers, and the Caratasca lagoon, specifically the Tansin lagoon (Rathbun et al. 1983). In 2000 and 2005 the coast from the Motagua River (frontier with Guatemala) to the west of Tela was flown over. In the two flights 4 manatees were reported (Auil 2005; Quintana-Rizzo 2005). In 2006 a series of 6 flights were made over the north coast (from the rivers to the east of Trujillo until a little to the west of Tela). The average number of manatees seen per flight was of only 3. The regions of higher concentration were similar to the ones reported in previous years including: the Cuero and Salado rivers, and the Aguan and Chapagua rivers to the east of Trujillo (González-Socoloske et al. 2006). The number of manatee sightings per hour of flight in the 2006 flights was significantly lower than the reported in the year 1979-80 ($t(10) = 5.03, p < 0.001$). In 1995 the Caratasca lagoon in La Mosquitia was flown over but no sighting was reported. Manatees are still very threatened in Honduras by habitat loss, subsistence hunting, and by the use of gill nets.

GASTROINTESTINAL HELMINTHS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN THE STATE OF TABASCO, MÉXICO

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The Antillean manatee is an aquatic mammal that is currently in danger of extinction. In Mexico, previous studies have focused principally on the distribution and abundance, while work on their biology is limited. About the parasite fauna of manatees distributed from the south of Mexico until north of Brazil little is known. The species of endoparasites registered at the moment include a nematode (*Heterocheilus tunicatus*), and three trematodes (*Chirchis fabaceus*, *C. groschafti* and *Cochleotrema cochleotrema*). The present study was done with faecal samples from 10 manatees, collected from seven localities in the state of Tabasco, in the period from April 2005 to July 2006. The faeces examination techniques of flotation and sedimentation were applied. Preliminary results are the presence of three gastrointestinal parasite species, the nematode (*Heterocheilus tunicatus*) and the trematodes (*Chirchis fabaceus* and *Moniligerum blairi*). Registering a new distribution area for the trematode *Moniligerum blairi*, only found in Florida manatees (Beck et al., 1988), and contributing new locality registers for the other species.

STATUS OF THE MANATEE POPULATION IN THE BAY OF TABLAZO, MARACAIBO LAKE STATE OF ZULIA, VENEZUELA

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Work was done in the islands and caños of the Almirante Padilla municipality, to the north of the Maracaibo Lake, state of Zulia Venezuela, since August 2003 until November 2004. With the objective of confirming the presence of manatees in the zone, knowing the distribution and abundance of the species, describing the habitat and determining the food offer. We navigated 364.52 km with a total effort of 48 hours of navigation. The routes were divided into a long transect of 40.36 km crossed over five times and a short transect of 4.52 km, crossed over 36 times during the study. Manatee presence was confirmed directly (four sightings) and indirectly by detection of vocalizations using a hydrophone and bottom images with a sonar and the observations of the co-researchers (23 detections). The habitat was described and some algae associations were identified: *Polisiphonia*, *Centroceras*, *Siphonocladus*, *Chladophora*, *Ectocarpus*, *Briopsis*, *Diatomeas*, *Microcoleus*, *Chaetomorpha*, *Gracilaria*, *Enteromorfa* among others, as possible food offer for the species in the zone. It was concluded in accordance with other authors (Rathbun et al., 1990; Provanha and Hall, 1991; Lefebvre et al. 2000, Morales-Vela et al., 2000; Olivera 2004) that the species prefers habitats close to freshwater sources, with depths between 1.5 m and 4.5 m, with the presence of slopes and abundant aquatic vegetation, so it coincides with the described habitat.

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN THE YUCATAN PENINSULA, MEXICO

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The actual abundance of manatees in the west and north coast of the Yucatan Peninsula (YP) is very low, based on three aerial surveys conducted in 2000 and on interviews to locals who pointed out that more than 35 years ago it was common to observe manatees. In the east coast of the YP the abundance increases from north to south, with manatee presence along the entire coast and concentrating in three regions: creeks and natural wells (cenotes) located between Playa del Carmen and Tulum, in the two bays of the Sian Ka'an Biosphere Reserve and in the Chetumal Bay. In this coast to the Caribbean a population of 200 to 250 manatees is estimated, based on aerial surveys conducted in different seasons and years. Two recent causes are primarily suggested for the decreasing populations in the north and west coast of the YP: the hunt for meat consumption and the high presence of nets in rivers and other lagoon systems causing accidental deaths. A few solitary manatees are still being observed in the north and west coast but they are not resident. In the east coast, coastal habitat loss due to tourism activity and environmental degradation due to contamination are the principal risks for the species in the Mexican Caribbean. Accidental death by nets or boat collision is low. There is a strong development pressure over important reserves for the manatee.

STATUS OF THE MANATEE (*TRICHECHUS MANATUS*) IN WETLANDS TO THE SOUTH OF THE GULF OF MEXICO

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The wetland systems to the south of the Gulf of Mexico are extensive zones rich in hydrophilic vegetation, conditions which favour manatee distribution, leading to suggest it as the area with the highest abundance of these sirenians in Mexico. A conservative estimate would be of 500 to 1500 individuals in the region. Manatees are principally distributed throughout the basins of the Usumacinta and Grijalva rivers, where they are found year-round. In a general way the area can be divided between the swamp zone where the river floods form very extensive wetland areas, allowing a bigger dispersion of manatees, and the rest of the area to the south where there are lagoon systems that are smaller and more separated among them, that form midsize wetlands favouring the permanence of local populations. The occupation of different places varies between the dry and rainy seasons. Local people identify the manatee and know their past use. Nowadays there is little hunting principally due to current legislation. The threats are multiple: transformation of space for extensive cattle ranches, agriculture and wood exploitation; extraction of hydrocarbons; isolated populations due to diminished affluents, works on hydraulic infrastructure, highways and flood control and to changes in the hydrological dynamics because of drainage constructions; boat collisions and lack of local infrastructure for the rehabilitation of manatees. On the other hand, a great extension of the low flooded zones of the region falls under the protection of the Pantanos de Centla Biosphere Reserve. Since mid 2004, research was reinitiated for the monitoring and conservation of manatees in the region and work is being done regarding rescue and attention to strandings with the environmental authorities and with the parks that maintain captive manatees.

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN GUATEMALA

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The manatee is considered a species threatened by extinction in Guatemala. This is because the species is hunted illegally for meat consumption and because other threats like habitat loss and contamination affect the species. Manatee studies in Guatemala started by the end of the eighties, but they have not been continuous. The majority of them have involved aerial surveys, although some studies have focused on behaviour of the species, threats, and habitat characteristics. A total of 11 aerial surveys have been financed by different institutes to examine the species distribution throughout the Atlantic coast of Guatemala. In the nineties, results of four surveys were used to estimate that manatee population was of 53 ± 44 individuals (95% confidence interval). Currently, there is no new population estimate but a relative abundance is estimated of approximately 0.33 manatees/km². Two areas have been defined as important for the species due to continuous manatee sightings: Lago de Izabal and the Bahía de la Graciosa. The two areas have similar characteristics like shallow waters, seagrasses, and little human impact. Of these two areas, the Lago de Izabal has been identified as an important area for calves and is also the place where the highest number of manatees has been observed in each aerial survey. The habitat quality of Lago de Izabal seems to be very good. However, the lake receives wastewater with agricultural and

industrial chemical contaminants. The effect of these contaminants has not been studied, but could affect the health and status of the manatee population that uses Guatemalan waters in the long-term.

STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN PANAMA

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The population of *Trichechus manatus manatus* in Panama is circumscribed to the San San Pondsak Wildlife Refuge (including the Sixaola River and the Changuinola Lagoons), the Juglí-Damani Lagoons—both in the Caribbean province of Bocas del Toro and a small population located in the Panama Canal, product of a translocation project in the 1960's. Occasional sightings are also reported in the Caribbean coast along the Veraguas and Colón provinces. During 1980-1990 the population was estimated in 42-72 individuals, with a high proportion of calves 15.7%, the majority located in San San Pondsak. Manatees have been reported in the Panama Canal since the 60's, speculating that they could have crossed into the Pacific. For decades the principal threat to the survival of manatees was hunting. Currently the principal threats come from more aggressive activities, like the continued water discharge with agrochemical residues coming from the banana plantation canals, the conversion of woods and wetlands into farmland and commercial plantations and marine-coastal habitat transformation to establish resorts and other tourism facilities. Nowadays the communities of San San Pondsak and the Comarca Gnohe Bugle are more conscious about manatee conservation. In fact the community organization AAMVECONA, with financing from CEPF/CI, is developing the project *Raising Awareness to Conserve Manatee Habitats through Environmental Monitoring in Local Communities*. In October 2004, CONAVI started a manatee conservation program; 49 sightings have been registered in San San Pondsak, including the Sixaola River, the San San and Negro rivers, the Changuinola Lagoons and Playa Soropta, with a calf proportion of 18.3%. There are plans to continue the count in the Damani-Juglí Lagoons, in the lower basin of rivers that present characteristics as manatee habitat and in the Panama Canal.

CULTURAL USE AND MANAGEMENT OF THE WEST INDIAN MANATEE (*TRICHECHUS MANATUS*), IN THE ALVARADO LAGOON SYSTEM, VERACRUZ, MEXICO

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The West Indian manatee (*Trichechus manatus*) has been classified by the IUCN as in danger of extinction. In Mexico, some of its populations are insignificant and a few isolated individuals survive throughout the Gulf of Mexico. Little is known about the status of this species in Alvarado, Veracruz. This study presents the existing local information on this species and its relation to human use and habitat management within the Lagoon System of Alvarado. From July 2002 to May 2004, I conducted interviews with local coastal fishermen from Alvarado, Arbolillo, Punta Tía Pancha, Costa de San Juan, Costa de la Palma, and Paso Platanar, all where manatees are known to inhabit coastal and estuarine areas. Most of the questionnaire was aimed to understand the current use of manatees, as well as what and how much knowledge they had about the species. From these interviews, information regarding the habits and biology were assessed, including reproduction, habitat requirements, and home range seasonality, feeding, and hunting. Analysis of the questionnaire showed that manatees have been heavily utilized in the past (since 1940's), mostly as a food source, which contributed to the reduction of the population and its home range. During the summer of 2002, two females were rescued near Costa de San Juan and Punta Tía Pancha. The rescue of these animals changed the point of view within the fishing community; they first saw the manatee as a food source, and now many of them conceive the manatee as a species that needs protection from human predation and habitat change. Throughout the investigation, the need to educate and inform the public about the presence and state of conservation of the manatee became evident. It is important to consider the role of these communities in the wellbeing and survival of this species in Mexico's Alvarado region.

CONSIDERATIONS ABOUT THE STATUS OF THE ANTILLEAN MANATEE (*TRICHECHUS MANATUS MANATUS*) IN CUBA

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The Antillean manatee is considered a vulnerable species since 1982 by the International Union for the Conservation of Nature. In Cuba the first studies started in 1986. Since 2002 the Empresa Nacional para la Protección de la Flora y la Fauna of the Ministry of Agriculture in Cuba and the Centro de Investigaciones Marinas of the Universidad de La Habana initiated a work program to know the conservation status, distribution and principal threats of the Antillean manatee in Cuba. As study points 29 marine protected areas administered by the Empresa de Flora y Fauna and other nearby zones were selected. Based on the analysis of

habitat maps, interviews to fishermen and visits to coastal sites, it has been determined that manatees are practically present around the entire coast in Cuba. As results from this initial stage we identify: 1) A zone where manatee presence is registered regularly and there is criteria about their distribution and possible habitat use (Villa Clara province); 2) Zones where the existence of manatees is known through fishermen reports gathered by interviews and surveys (eight zones to the north and five to the south); 3) Zones where the existence of manatees is inferred by map analysis and unconfirmed reports (two in the north and seven in the south). The coast of Cuba is extensive and includes habitats apt for manatees in the north as well as in the south. Maps have been elaborated with the real and probable manatee distribution in Cuba, as principal threats habitat destruction and fishing net captures have been identified and by surveys, interviews and reports from activists a preliminary manatee habitat zonation has been done in the province of Villa Clara.

NON-LETHAL BOAT SCARS ON MANATEES IN BELIZE AS A TOOL FOR EVALUATION OF A MARINE PROTECTED AREA

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To evaluate the effectiveness of a Marine Protected Area (MPA) as a conservation strategy for an endangered species, it is important to know to what extent the population is using the MPA. In the Wider Caribbean Region, the use of MPAs is driven by the SPAW Protocol of the Cartagena Convention. Belize has been a leader in implementing goals set forth in the SPAW Protocol, including establishment of MPAs targeted towards the Antillean manatee, *Trichechus manatus manatus*. However, evaluation of the effectiveness of this conservation strategy for protecting endangered manatees in Belize is lacking. As part of a long-term study (1999-2006), I used underwater video techniques to capture images of manatees encountered in the Drowned Cayes area near Belize City. Non-lethal boat scars were detected on 103 of the 233 manatee images captured on video. Due to this relatively high number of individually identifiable animals in the area, a database of known manatees is being developed and analyzed to determine the parameters of the manatee population using Swallow Caye Wildlife Sanctuary (SCWS) and the Drowned Cayes. SCWS is a MPA established in the Drowned Cayes area in 2002, and the only MPA in the vicinity of Belize City where manatee mortality due to boat collisions is high. If manatees previously hit by boats have learned to seek shelter within SCWS, I would expect the proportion of scarred animals to be higher within the boundaries of the MPA. To date, the probability of capturing a scarred manatee within the boundaries of SCWS (probability = 0.44, n=43 events, 19 scarred) is equal ($G^2=0.00$) to the probability of capturing a scarred manatee outside SCWS (probability=0.44, n=190 events, 84 scarred). Continuation of this study is necessary to determine the parameters of the manatee population using SCWS and to evaluate the effectiveness of this MPA.

CONSERVATION OF THE MANATEE (*TRICHECHUS MANATUS*) AS FOCAL OBJECT OF THE PARQUE NACIONAL TORTUGUERO MANAGEMENT, COSTA RICA

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The Parque Nacional Tortuguero is located in the north Caribbean coast of Costa Rica and is one of its most important protected areas, since representative samples of the principal vegetation associations in the Costa Rican Caribbean are found there and also because of the presence of a great quantity of species that are in danger of extinction like the jaguar (*Panthera onca*), the tapir (*Tapirus bairdi*), the manatee (*Trichechus manatus*) and the green turtle (*Chelonia mydas*), among others. In the last years the park has seen a considerable increase in visitors due to different factors, which has brought positive as well as negative effects. The manatee (*Trichechus manatus*) is one of the species affected by tourism activity, since the principal problem it faces is collision with the motors that transport visitors, which causes death in many cases. In the year 2002, the Área de Conservación Tortuguero initiated the elaboration of a Park management Plan, since there was a need to organize the management of the protected area and allow the fulfilment of its creation objectives. This plan was framed within the norm emitted by the Sistema Nacional de Áreas de Conservación (2000) to elaborate management plans and was carried out in three stages, two of them diagnostic and a stage of management strategies proposals. For the diagnostic, among other tools the site conservation planning model was used, and the manatee was defined as a focal object of the protected area management. The greater manatee populations in Costa Rica are found in the north Caribbean coast of the country, so the execution of the plan recommendations are already being put to practice to guarantee the conservation of the species.

CAPTIVE MAINTENANCE PROGRAM FOR MANATEES OF THE VERACRUZ AQUARIUM, MEXICO

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Since the year 1998 the Veracruz Aquarium has been given the task of maintaining manatees (*Trichechus manatus manatus*) in captivity in its facilities, product of rescues by fishermen, the competent authorities and our institute, for which a maintenance program was established that consists of three protocols: 1. Feeding, 2. Health and 3. Management. Obtaining the first records at a national level of weight gain, growth, diets and haematic constants. To date 6 new born orphan manatees have been rehabilitated (three females and three males), a new born female and a juvenile due to loss of a pectoral fin. On average a weight gain of 10 kilograms per month has been registered during the first months of rehabilitations, and a trimester growth of 20 centimetres (total length) on average. All these calves were fed with a special lacteous formula during a year and a half, also a health assessment that includes taking samples (blood, faeces and urine) for clinical analysis was performed. As a result of this program to date the first birth of a calf in captivity at the national level was achieved on December 2004 and the second one in the aquarium on the 18th of June 2006 representing the third one in Mexico.

THREATS OF ORGANIC CONTAMINANTS TO MARINE MAMMALS OF MESOAMERICA AND A SUGGESTED APPROACH FOR ASSESSING LEVELS AND EFFECTS IN ANTILLEAN MANATEES (*TRICHECHUS MANATUS MANATUS*)

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Scientists and conservationists in Mesoamerica are concerned about levels of several types of persistent organic contaminants, including pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and herbicides in the environment. Despite these concerns, local levels of contamination have often been poorly assessed, and levels in and effects on local wildlife, including marine mammals, are largely unknown. The latter are especially vulnerable because of their long lifespans and the tendency of many organic contaminants to accumulate in blubber and other lipid reserves. Tissues of marine mammals elsewhere in the world have been shown to contain remarkably high levels of organic contaminants, especially organochlorines (pesticides and PCBs). Although cause and effect relationships between contaminant body burdens and pathology or survival have been difficult to establish, scientists feel that it is likely that reproduction and survival of some marine mammal populations have been and are being affected by persistent contaminants. The Antillean manatee is broadly distributed in coastal and riverine waters of the Caribbean; body burdens of contaminants in manatees may reflect regional or local contamination that could also affect humans and other species. Recent work in Mexico has documented PCBs in blood of manatees. We expect to find high levels of certain contaminants in coastal environments, fear that marine mammals, including manatees, may be biological sinks for these chemicals, and believe that marine mammals may serve as good sentinels of environmental health. Monitoring programs should focus on index sites where contamination is a particular concern; at such locations, we recommend an investigative program of marine mammals in the field, to rigorously correlate known and relevant indices of toxicological effects with definitive chemical analyses. This monitoring approach should use tissues of deceased animals and biopsies of living animals, as available. Assessments of contaminant levels in manatees should be accompanied by similar evaluations of sediments.

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