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NEWS FROM THE SECRETARIAT TO THE UNEP/CMS DUGONG MOU

First South Asia Sub-regional Dugong Workshop in India

India hosted the *First South Asia Sub-regional Workshop of the UNEP/CMS Memorandum of Understanding on the Conservation and Management of Dugongs and their Habitats throughout their Range in South Asia*, in Tuticorin, Tamil Nadu, on 6-7 June 2011. Technical and policy participants from the range states – India, Pakistan, Sri Lanka and Bangladesh – shared information and undertook training to help develop their capacity to conduct standardized methodology used in dugong surveys. The workshop was hosted by the Ministry of Environment and Forests and Wildlife Institute of India (Government of India) and organized in cooperation with Marine Research Foundation (Malaysia).

The meetings' overall objective was to support and enhance regional cooperation to implement the Conservation and Management Plan in the South Asia region, and to encourage non-signatory dugong range states to sign the Dugong MOU. The workshop introduced the Standardized Survey Questionnaire developed by the Dugong MOU Secretariat – a low cost, low technology methodology designed to identify key dugong habitat, population numbers and trends, and impacts including direct harvest, habitat degradation and fisheries by-catch. The range states gave strong support for the workshop recommendations, including developing a practical and resource-efficient strategy to collaborate in and implement regional dugong conservation and management initiatives; enhancing communication among participating countries and organizations; and identifying the financial and technological resources to support implementation of these recommendations.

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

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

Commission de la sauvegarde des especes - Species Survival Commission



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Delegates at the Tuticorn Meeting of the Dugong MOU.

Dugong Conservation Gathers Momentum in South East Asia

A sub-regional dugong workshop was also held in Lawas, Sarawak, Malaysia on 27-29 July 2011. *UNEP/CMS South East Asia Sub-Regional Meeting on Dugongs and Workshop on Developing Standardised Analysis Protocols for Dugong Questionnaire Survey Project Data for South East Asia Region* gathered some 50 participants from 11 countries. The workshop was jointly organized by Sarawak Forestry Corporation, UNEP/CMS Office - Abu Dhabi, Jabatan Perikanan Malaysia, Universiti Malaysia Sabah and Marine Research Foundation.

The meeting introduced a global dugong genetic project initiated by James Cook University (Australia) and supported by the Dugong MOU Secretariat. It aims at building a network across the entire dugong range, interested in collaborating in a study of dugong genetics. The network would include participants that can help provide already collected or new samples for genetic analysis. The genetic analyses can be done in Australia or in any of the range states where appropriate facilities and expertise exist. This approach will provide valuable information to provide an estimate of the genetic diversity remaining in different parts of the range, estimates of gene flow and population size.

In addition, at the meeting the Dugong MOU Secretariat presented pilot projects trialing novel sustainable financing schemes, recently started in Mozambique and Papua New Guinea. Dugong country reports provided information on the implementation of the Dugong MOU and Conservation and Management Plan at a national level. Delegates also discussed the development of an enhanced communications strategy, potential for trans-boundary conservation actions, and the development of standardized data analysis protocols. The development of a Global Environment Facility project concept for dugong and habitat conservation received strong support from the meeting participants.



Delegates at the Lawas meeting of the Dugong MOU.

Thailand Becomes 20th Signatory to the Dugong MOU

A significant step for the South East Asia region was Thailand becoming the 20th signatory of the UNEP/CMS Dugong MOU on 30 June 2011. Thailand has the largest documented area of seagrass which supports one of the biggest concentrations of dugongs in the region. Thailand has long been recognized for its contribution to dugong conservation through its development of educational material, training, awareness-raising, research, and monitoring efforts. In collaboration with the Governments of Australia and the United Arab Emirates, Thailand co-led the process of developing and concluding the Dugong MOU that came into effect on 31 October 2007. With Thailand's signature, three of the twelve range states in South East Asia have now signed the Dugong MOU, but effective dugong conservation will require the concerted action and regional collaboration of all the range states.

Progressing Dugong Conservation in SWIO

Range states in the South West Indian Ocean (SWIO) sub-region have initiated a number of activities under the UNEP/CMS Dugong MOU, aimed at improving conservation outcomes for dugongs. On 28 October 2011 the Dugong MOU Secretariat will organize a special session at the 7th WIOMSA Scientific Symposium in Mombasa, Kenya. The objective of the session *Progressing Dugong Conservation in the South West Indian Ocean Sub-Region* is to share information about current dugong conservation, management and research activities in the SWIO region. The session also aims to share the experiences, challenges and aspirations of those undertaking activities within the framework of the UNEP/CMS Dugong MOU, in order to inspire others, particularly community groups, NGOs and potential donors to join us and contribute to these efforts.

The session will present various case studies from around the region based on the implementation of dugong surveys in 2010 and 2011. It will also present developments on the current

projects trialing socio-economic incentives, and discuss funding and/or collaboration between range states, as well as lessons learned in terms of survey implementation. This special session on dugong conservation is open to all those participating in the WIOMSA Symposium.

See activities of the UNEP/CMS Dugong MOU Secretariat and available meeting/workshop reports on http://www.cms.int/species/dugong/dugong_noticeboard.htm

NEW BOOK ANNOUNCEMENT

Ecology and Conservation of the Sirenia: Dugongs and Manatees

Helene Marsh, Thomas J. O'Shea, John E. Reynolds

- **Hardback and Paperback:** 540 pages (Hardback US\$124; paperback US\$65, order from Amazon)
- **e-book** format in 2012
- **Publisher:** Cambridge University Press, Conservation Biology Series (release date November 30, 2011)
- **Language:** English
- **ISBN-10:** 0521716438
- **ISBN-13:** 978-0521716437

This book is a scholarly synthesis that provides detailed information and perspectives on the ecology and conservation of sirenians and acknowledges gaps in our understanding. In reviewing the literature for the book, we were struck by the amount of new information about the Sirenia that has been published in a wide variety of outlets over the past decade. By synthesising and distilling this information we hope to help readers more effectively access the diverse primary literature.

Chapter 1 introduces the extant Sirenia and describes how dugongs and manatees are increasingly being used as 'flagship species' to represent larger environmental causes. Indeed, the dugong is at the heart of an international political, economic, military, cultural and environmental conflict. These animals have added fuel to the controversy over the presence of a US military base on Japanese soil, in Okinawa.

Chapter 2 describes the demise of the largest sirenian species ever; one of the largest creatures ever to inhabit our planet. The tragic loss of Steller's sea cow at the hands of Russian explorers and hunters only 27 years after its discovery by Europeans exemplifies the triumph of human greed over Nature.

Chapter 3 provides the evolutionary history of the Order Sirenia. That history is peppered with unusual beasts and considerable diversity. Many sirenian species co-existed throughout tropical and sub-tropical waters, but today that diversity is limited.

Optimal efforts to conserve species and their habitats will take advantage of all that is known about a species' needs and capabilities. Chapters 4-6 provide a thorough review and synthesis of the scientific information about sirenian feeding and foraging; habitat use and behaviour; life history and population dynamics. The cross-species comparisons provide new insights into which features of Sirenia are flexible, to provide the science base for designing effective conservation and management programs.

Chapters 7 and 8 get to the heart of our concerns for the future of the sirenians. Chapter 7 provides an assessment of the threats to sirenian populations from environmental factors such as climate change and harmful algal blooms, and human-related factors such as habitat destruction, directed hunting and incidental fishing take. Chapter 8 examines how we understand the 'status' of a species or population and addresses hard-to-study factors that would ideally be included in a status assessment, but which are often difficult or impossible to integrate because of lack of funds or logistic difficulties. We

then provide details of the conservation status of sirenian populations around the world. Some populations are actually doing quite well, whereas others have been lost or greatly reduced and are likely to disappear in a matter of years.

Chapter 9 is titled 'Conservation Opportunities' because we believe that new approaches, new tools and new perceptions about science, values and partnerships will equip motivated people with what they need to make a difference. In part, the change has occurred because people and governments are increasingly acknowledging that traditional ways of doing science and conservation do not always work; this admission can be liberating as it encourages people to seek novel ways of working together.

There is much to be done to ensure that sirenians and their ecosystems are conserved. We trust that this book conveys both humility and urgency and provides a foundation for future successes.

-Helene Marsh, Tom O'Shea, & John Reynolds

FIFTH INTERNATIONAL SIRENIAN SYMPOSIUM 2011

27 November 2011 at the 19th Biennial Conference on the Biology of Marine Mammals, Tampa, FL

The Fifth International Sirenian Symposium is being held on Sunday, November 27, 2011 from 08:30AM-5:00 PM in Room 23 at the Tampa Convention Center. The aim of the symposium is to foster communication between sirenian researchers, managers, and policy makers from around the globe. Over the last couple of years we have made marked progress regarding sirenian conservation, management and research. At this symposium we hope you will be able to share your expertise and experiences. Priority will be given to presentations focusing on international efforts outside the U.S. to promote collaboration and information exchange with foreign programs. Registration for the workshop has closed. Organizers: **Nicole Adimey** (Nicole_Adimey@fws.gov) and **Bob Bonde** (rbonde@usgs.gov)

LOCAL NEWS

AUSTRALIA

Dugong in Crisis in Queensland Cyclone Yasi was one of the deadliest cyclones to hit Australia with its payload of destruction visiting untold damage on the marine environment. Following on from the disastrous floods in late December and early January, the dual impacts of the tempest are washing up on a daily basis along Queensland's urban coastline which stretches from Cooktown to the New South Wales border. Some scientists estimate a 700% increase in dugong stranding with more than 150 dead dugongs now registered under the State's stranding network. Green turtles are also suffering a very high mortality with almost 1000 dead turtles counted so far. Fishermen are reporting emaciated, sick, lethargic dugongs and turtles with no end to death by starvation in sight.

With growing evidence of the cyclone's destruction of intertidal seagrass beds and seed banks, the future is looking decidedly grim for the dugongs along the urban stretch. Prior to the cyclone, dugong expert Professor Helene Marsh had designated the animals in this area as critically endangered. Now, a combination of cumulative impacts is spelling out the possibility of localized extinctions.

Although some scientists have been privy to aerial surveys of the intertidal seagrass beds carried out by the state's Department of Employment and Economic Development (DEEDI), the Queensland government continues to withhold the results publicly. According to these scientists, virtually all the intertidal seagrass beds from Cooktown to the New South Wales border have been wiped out. Queensland Environment Minister Vicki Darling said in a recent newspaper interview "surveys taken

after the floods showed seagrass cover, which is critical to the diet of green turtles and dugong, were the lowest ever recorded.”

Dr. Peter Doherty, a senior researcher with the Federal Government’s Australian Institute for Marine Science (AIMS) in Townsville, has been researching the state of deep seagrass beds in the area most affected by Yasi and the news is not good. With the help of an AUV loaned by the University of Sydney, the damage to the seafloor and deep beds is enormous. The only sign of life was a few small sea cucumbers.

Further down the Queensland coast, massive dredging in Gladstone Harbour will see up to 55 million cubic metres of dredge spoil dumped on seagrass beds, ensuring major risks to the dugong population, the only dugong feeding place in the region.

Curtis Island, which sits on the edge of the Great Barrier Reef Marine Park, is the site of planned LNG terminals and wharves. A pipeline, currently under construction, will see a 50-70m high mound of soil visible above the waterline. In the last few weeks, a ban has been put in place on commercial fishing because of the growing evidence of contaminated fish.

The Queensland government’s response to the seagrass bed crisis is curious. In September, Minister Darling said the state would “call for tenders from researchers and scientists to express interest in rehabilitating and improving the resilience of seagrass beds in Port Curtis, off Gladstone.” Conservation groups suspect the Minister doesn’t need expert advice to inform her that 55 million cubic metres of dredge soil dumped on seagrass beds is unlikely to improve their resilience.

Nor do seagrass experts know how the sheer extent of seagrass beds destroyed by the cyclone and floods can be rehabilitated. Domning (2001) wrote that "the long-established tenet that seagrass ecosystems are largely detritus based must be revised to recognize that the modern situation is anomalous and that the 'normal' pattern throughout most of tropical seagrass history has been that much (probably most) of the primary productivity has been channeled through the guts of herbivores, particularly sirenians." With a significant loss of dugongs and green turtles, an important self-sustaining symbiotic cycle may take years to recreate and regenerate. Seagrass scientists recommend urgent surveys be undertaken to establish the location of any viable seagrass beds, ensuring these areas are given immediate protection until such time as the ongoing crises are resolved. Whilst the state government has established dugong protected areas, without the relevant seagrass species, the likelihood of dugongs remaining in those places is a no-brainer.

A recent report by the Queensland State Environment Department found a commonly used farm chemical known as Diuron has been found in a Great Barrier Reef catchment area at 50 times higher than the safe level. Diuron is a broad-spectrum herbicide used for weed, grass, and brush control on highway shoulders. It stops photosynthesis, which in turn causes plants to stop growing. It also inhibits seed germination. Diuron easily moves into the roots of plants but has less movement through the leaves and stems. Diuron is poisonous to some marine plants and animals. Whether Diuron inhibits seed germination in the intertidal seagrass beds is a question many conservation groups are asking. Farm chemicals metolachlor and atrazine were also found at 11 sites, all of which flow into the waters of the Great Barrier Reef.

Finally, there’s a big question hanging over another major threat to dugong and green turtle survival. Indigenous hunting is a deeply controversial issue in Queensland. Dugong meat is part of the traditional and cultural rites of Aboriginals and Torres Strait Islanders. Over the last decade, a huge shift in the Torres Strait Islander population has occurred. Approximately 7,000 Islanders are living in their traditional homelands whilst more than 80,000 islanders now live on the east coast. The traditional and cultural needs of Aborigines and Islanders are protected by the Native Title Act, which overwhelms all wildlife conservation legislation including relevant international conventions.

Indigenous hunters have no legal requirement to report on the extent of any kill, details of age, sex, location, or method of slaughter. Nor are there prohibitions on killing cows and calves. According to research, Indigenous hunters prefer female dugongs.

An illegal trade in dugong and turtle meat is a source of alarm and concern. Last year, a member of the Queensland Opposition Party, (the LNP) Glen Elmes, Shadow Minister for Climate Change and Sustainability, raised the issue in Parliament. Dugong meat is reported being offered for sale in Cairns and Townsville pubs for \$150 AUD a kilo. Aboriginal leaders have also raised concern over the illegal trade. In a submission by NSW Young Lawyers Association to the Federal Government's Marine and Coastal Committee Taskforce on Dugong and Marine Turtle Populations, an elder from one of the Torres Strait islands asserted that many people hunt dugong commercially, supplying the big Torres Strait Islander communities in Cairns, Townsville and other southern cities.

On September 6th, in an ABC news report, wildlife documentary filmmaker, Ben Cropp, reported that some Indigenous communities have resorted to selling the meat for cash. "It is so common - the sale of turtle and dugong meat - and that has escalated the killing, probably doubled, tripled, the killing," he said. "That is what has got to be stopped and the only way to stop that is to simply make a law that dugong and turtle meat cannot be taken out of the community. We know that dugong and turtle meat is sold now - you have only got to go to the airport and see the people come through with eskies. If you stop them they are going to say, 'sure, I brought some dugong meat down for my family' but it's rubbish - they are selling it."

In the same report, James Epong from the Mandubarra group in Far North Queensland says poachers are killing turtle and dugong meat for sale locally and overseas. Mr. Epong says the illegal sale of turtle and dugong meat is no secret, with people selling it in local pubs and it being sent overseas. He says one man allegedly made \$80,000 last year. "There is an overseas market - you can buy a 20 to 30 kilogram pack of dugong," he said. "There is a black market where they are transporting the turtle and dugong meat overseas. Up Cairns way, some lad made \$80,000 for one year of poaching. Now the breeding season starts, these poachers they come along with their boats and shooting them or spearing them and just taking them."

Queensland police have taken no action in spite of formal complaints and reports being lodged. Federal Minister for the Environment, Tony Burke, has refused to call in the federal police to investigate the trade and any possible international trafficking. A growing body of scientific evidence believes indigenous hunting is unsustainable and threatens the survival of the species in certain areas.

Although some far-sighted Aboriginal communities, who hold native title over their sea country, have declared moratoriums on any dugong and green turtle slaughter, other communities continue killing. The Great Barrier Reef Marine Park has initiated Traditional Use Marine Resource Agreements (TUMRAS) with a small number of Aboriginal groups. Funding comes from the Reef Authority and there is no requirement for monitoring. Instead, the Authority encourages cooperative and culturally appropriate management, which can, in reality, be broad enough to cover a huge spectrum of "cultural" activities.

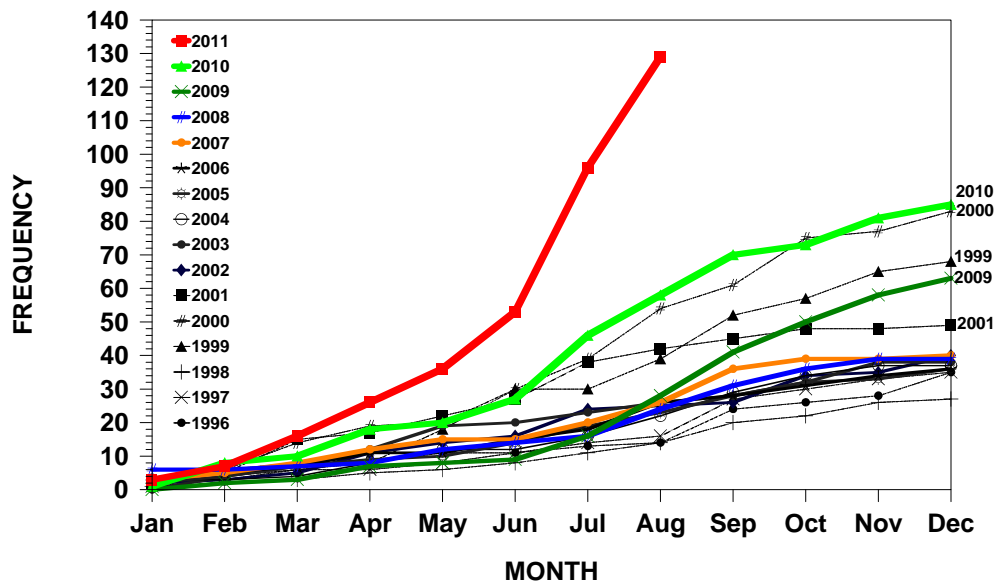
Cruelty reports documented by the Queensland RSPCA have been stomach churning. Appalling cruelty has been witnessed and reported. Most Aboriginal elders deplore the cruelty, which is neither cultural nor traditional. Under the current Queensland Prevention of Cruelty to Animals Act, Indigenous Australians and Torres Strait Islanders are exempt from the provisions of the legislation. This exemption is in stark contrast to the rest of Australia with every other state requiring Indigenous people to abide by the States' anti-cruelty laws.

The Federal Government recently announced a \$5 million grant to encourage the training of Indigenous rangers, but there's a lack of trainers, severely inhibiting an important contribution to the

protection of dugongs. Responsible Aboriginal communities are keen to protect their country and frustrated with the failure of both State and Federal governments to urgently address the need.

In July, UNESCO World Heritage Committee expressed “extreme concern” at the Queensland and Federal Government’s backing of planned multi-billion LNG processing plants at Curtis Island near Gladstone. Notes from the meeting indicate the organization criticized the federal government’s failure to inform it, in line with World Heritage Guidelines, that the projects would go ahead. The Committee called for a comprehensive strategic assessment of the reef, including a long-term plan for sustainable development. UNESCO requested an international monitoring mission be allowed to visit the reef to scrutinize conservation efforts. Queensland and Federal governments have agreed to host a monitoring team from IUCN in November.

Basic information on population estimates and stock assessments are not available. The last estimates were undertaken in 2006. No stock assessment has been undertaken in Torres Strait. With no current population estimates, stock assessments, estimates of the Indigenous kill and the extent of seagrass bed loss, the dugongs along Queensland’s urban stretch are in dire straits. Conservation groups are pinning their hopes on the UNESCO/IUCN monitoring team’s visit and a warm, sunny summer season to encourage seagrass growth. Another La Nina is predicted although Australian authorities believe it will be a weak one. However, at least four cyclones are predicted to cross the Far North Queensland coast, wreaking more havoc on denuded seagrass beds. An urgent assessment of the population and its primary prey are needed. - **Sue Arnold** (Australians for Animals Int. Byron Bay, NSW, Australia, suearnold@linknet.com.au)



Monthly cumulative dugong strandings by year for Queensland, up to 1 September 2011 (Queensland Department of Environment and Resource Management data).

ECUADOR

The Status of Amazonian Manatees (Trichechus inunguis) and Their Habitats in Eastern Ecuador.

The Amazonian Manatee (*Trichechus inunguis*) is currently listed as “vulnerable” on the International Union for Conservation of Nature (IUCN) Redlist and “endangered” under the US Endangered Species Act. *Trichechus inunguis* inhabits the black-water lagoons and tributaries of the remote Amazon River Basin in Ecuador, Peru, Brazil, and Colombia and is the only freshwater sirenian. An investigation was conducted in several expeditions to eastern Ecuador and the border near Peru exploring Yasuni National Park, Gueppi Wildlife Reserve, and Cuyabeno Wildlife Reserve in March, May, and July 2011. The last survey of the species in eastern Ecuador was done in 1983 and 1984 (Timm et al 1986). They found that the manatee population was threatened by subsistence and commercial hunting and fishing but that some efforts had been taken to reduce this anthropogenic mortality. The purpose of our investigation was to determine the current population status of the Amazonian manatee and if hunting and habitat destruction by petroleum exploration and extraction are substantial threats to the survival of the species. Recently, the extraction of oil from the Amazon basin has increased due to economic development and the habitat of the Amazonian manatee may have been affected by petroleum spills and other pollution.

Our techniques for data collection included interviews with local residents, side scanning sonar surveys of the Amazon River tributaries, and collection of water samples for analysis. Interviews were conducted with many residents of the small encampments along the river who had a lot of experience sighting the manatees and hunting them. The side scanning sonar survey used a transom-mounted Humminbird 797c2 for detecting the animals in the highly turbid water. In addition, water samples were collected at specific sites where manatees were possibly detected on the sonar and near sites where runoff of human waste, oil extraction, and boat traffic were likely to be the cause of pollution. Global positioning system coordinates were recorded for all manatee sightings and water sampling sites. The samples were analyzed by Environmental Protection Agency (EPA) methods for polyaromatic hydrocarbons (PAHs), volatile organic compounds, toxic metals, and petroleum compounds. Several samples had natural levels of petroleum based hydrocarbons, but no other pollutants were found.

The interviews showed that the hunting of *Trichechus inunguis* is still occurring in some areas, but many people were interested in education about conservation of the species. The water analysis revealed little evidence of pollution in the area with toxic crude oil, PAHs, heavy metals, and volatile organic compounds. However, this doesn't rule out the possibility that pollution is occurring in other areas. There are still thousands of km² of Amazon River, tributaries, and lagoons to investigate. After confirming the manatee sightings collected on our sonar, the data from the three expeditions and from the previous survey in 1983 will be used to construct a patch occupancy model. After preliminary data analysis, we conclude that the most notable threat to the sustainability of the *Trichechus inunguis* population in eastern Ecuador is hunting. -**Caitlin Elizabeth Brice** (Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL, 33004, USA), **Victor Utreras & Galo Zapata Rios** (Wildlife Conservation Society, Antonio Flores Jijón E 17-96 y Sotomayor , Quito, Ecuador), **Chris Canaday** (Omaere Botanical Garden, Puyo, Ecuador) & **Edward O. Keith** (Nova Southeastern University Oceanographic Center, 8000 North Ocean Drive, Dania Beach, FL, 33004, USA).

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FLORIDA

Florida Manatee Cold-related Unusual Mortality Event, January – April 2010. Record cold weather in Florida early in January 2010 followed by below-average temperatures in February and March led to a record number of manatee deaths. The magnitude of the 2010 manatee die-off is unprecedented in the history of manatee research and conservation in Florida because of the geographic range, severity, and duration of the event. The longer term impacts to the population are not currently known. Staff at the Florida Fish and Wildlife Conservation Commission (FWC) compiled an in-depth report of the 2010 manatee unusual mortality event (UME) which describes the comprehensive response and investigative actions taken to thoroughly identify and assess the cause and extent of the event, to minimize deaths, and eventually to understand impacts to the population. Resultant information from the UME investigation includes preliminary data associated with mortality, rescue records, aerial and ground survey observations, and environmental data. The report is available on the Fish and Wildlife Research Institute website: <http://myfwc.com/research/manatee/information/publications-links/publications/>

Throughout the UME, three divisions of the FWC—the Fish and Wildlife Research Institute, the Division of Law Enforcement, and the Division of Habitat and Species Conservation—with assistance from several of FWC’s conservation partners, made tremendous efforts to respond to a high level of mortality and to public reports of distressed live manatees. Aerial and ground monitoring were implemented to document the extent of the event and to augment standard rescue operations. Communication with Florida’s power industry was ongoing during the event in order to increase water temperature monitoring efforts near primary winter habitat for manatees. The statewide 2010 UME lasted 89 days from January 11 through April 9 based on an algorithm used to identify UMEs. A total of 480 carcasses was verified over this time; preliminary cause of death for the majority of these manatees was attributed to cold stress (n=252). In addition, many deaths were assigned to the undetermined category (n=197); however, the timing and location of these carcass recoveries suggest that a majority of the deaths from unknown causes were due to cold stress. Manatee mortality was particularly high in the central-east and southwestern regions of Florida. In total, 49 live manatee rescues were conducted, the majority related to cold stress. Although rescue operations occurred statewide, cold-related rescues most commonly occurred in the central-east region.

The unusual mortality event had two distinct phases based on the UME algorithm: an initial Acute Mortality Phase followed by a Chronic Mortality Phase. Disease and death associated with exposure to extreme low temperatures over a short period of time were more often reported in the Acute Mortality Phase. Manatee carcasses recovered during the Chronic Mortality Phase often showed “classic” cold stress signs, such as skin lesions, fat depletion, internal abscesses, gastrointestinal disorders, constipation and secondary infections. Overall, most carcasses (58%) with a known cause of death attributed to cold stress were calves. Most (89%) of the 55 adults whose deaths were attributed to cold stress occurred during the Acute Mortality Phase. Over the timeframe of the UME, 118 adult deaths from all causes were reported. Manatee population growth rate is most sensitive to adult survival and, therefore, the impacts of the 2010 UME will likely have a measureable impact on population vital rates.

The FWC will rely on data from monitoring programs conducted over the next few years to better understand the implications of the unprecedented number of cold-related deaths reported in 2010.

Updated survival estimates based on multi-agency photo-identification monitoring programs will be included in a mathematical model used to calculate the growth rate of the manatee population as well as the probability of extinction. However, it will be important to keep in mind that survival estimates calculated through current photo-identification monitoring data include adults only, and the UME resulted in the relatively large loss of immature animals. In addition, photo-identification techniques have proved to be very challenging in the far southwestern region, therefore limiting our knowledge of adult survival for a region that clearly demonstrated effects of the UME.

A multi-pronged response strategy in step with contingency plans facilitated the handling of large numbers of ill and dead manatees. Early activation of contingency actions was key in managing a broad-scale investigation that was both structurally and operationally complex. Contingency plans for catastrophic rescue and mortality events for the Florida manatee should be reviewed and updated to incorporate what was learned from this and previous events so that future responses will benefit from knowledge gained through experience.

PUERTO RICO

Progress with Aramaná and Guacara in Puerto Rico. Bayamon, Puerto Rico - There is good news from the Puerto Rico Manatee Conservation Center. The two manatees in rehabilitation at the Inter American University, 4-month-old Aramaná and 6-year-old Guacara, got high marks from the veterinarian and curator of the facility.

Aramaná was rescued on May 18, 2011 in Dorado, Puerto Rico, as an orphaned, injured manatee with a bacterial infection. "It came to us weighing 43 pounds and in very bad shape, but today he is in good health and weighing 73 pounds," said Dr. Antonio Mignucci, curator of the Center and research professor at the Bayamón Campus of the University. "We had to do a lot of work to stabilize him, combat a complicated bacterial infection and regain the health he enjoys today," added Dr. Antonio Rivera, veterinarian in charge of manatees.

On the other hand, Guacara, who arrived from Florida on December 9, 2010 with a pulmonary disability, has progressed greatly, and outside his buoyancy condition, he is in good health. "We were able to increase his weight during these six months with a special diet, and increased it from 687 pounds to 821 pounds," said Mignucci. "This is important because a higher body fat composition will help him improve his buoyancy and be more comfortable with his disability," said the professor.

Guacara was hit by a boat in the Wakulla River in northwest Florida in 2008 which damaged his diaphragm and right lung. This in turn causes Guacara not to float at all in the water column and therefore is not eligible to be released in the future. In Puerto Rico, he will serve as a surrogate parent to the calves that the Center rehabilitates. This in turn will make the calves better suited to interact with other manatees when they are returned to the sea.

Manatees are an endangered species due to hunting for their meat throughout the Caribbean, Central and South America. In Puerto Rico their major threats are collisions from speeding boats and the excessive development that affects the health of the coast and seagrass beds in which they feed. It is estimated that the manatee population in Puerto Rico is between 300 and 600 animals.

The Puerto Rico Manatee Conservation Center is a facility licensed by the Department of Natural and Environmental Resources and the US Fish and Wildlife Service (USFWS) to carry out the rehabilitation of this endangered species. "We are very proud of the progress shown by Guacara and Aramaná and of the collaborative work with the Center throughout these years," said Marelisa Rivera, director of the Ecological Services Caribbean Field Office of the USFWS.

Additional information about the Manatee Conservation Center at the University of Puerto Rico can be obtained by visiting their website, www.manatipr.org.



Guacara at his 821 pounds at the Manatee Conservation Center, Inter American University of Puerto Rico.



Inter American University biology graduate student and caretaker, Nelmarie Landrau, bottle feeds Aramaná at the Puerto Rico Manatee Conservation Center.



Inter American University biology student and caretaker, Marinelly Rodríguez, listens to the heart of manatee Guacara to take his heart rate during a veterinary exam at the Puerto Rico Manatee Conservation Center.

ABSTRACTS

Biological, physical environmental and anthropic aspects of manatee strandings in Ceará State, northeastern Brazil. Borges e Silva, R.¹ & Meirelles, A. C. O.²

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Praia de Iparana, Caucaia, Ceará, Brazil. The Antillean manatee, *Trichechus manatus manatus*, a herbivorous aquatic mammal that inhabits tropical shallow waters, is considered endangered throughout all of its range. In Ceará State, compared to other states in northeastern Brazil, a high stranding rate has been recorded in recent years, especially for dependent calves, which seem to have been precociously separated from the cows for reasons not yet fully clarified. The aim of this study is to analyze possible causes for the strandings, assessing the influence of physical environmental factors on each event. In addition to biological information on the specimen, data on moon phase, tidal range, rainfall and wind speed and direction were obtained. Between January 1987 and November 2010, 55 strandings were recorded in Ceará State, concentrated in summer (41.8%) and spring (27.3%). Calf strandings corresponded to 75.9% of the events, and a large part of them took place in February (24.4%) and March (24.4%), which might reflect a peak of births during these months. The diagnosis reveals that 96.1% of the stranding events were directly or indirectly related to anthropic activities, such as fishery and occupation of estuarine areas by shrimp farms, respectively. Even though the tidal range had no detectable effect on the events, the moon phase analysis pointed to the predominance of records in the new and first quarter moons. It is possible, therefore, that lower lightness and consequent lower visibility during the new moon phase contribute to calf stranding. Despite the fact that direct influence of rain and wind was not found, the possibility of indirect effect of these variables cannot be discarded. Moreover, morpho-ecological aspects may also act upon the differential frequency of strandings among beaches in Ceará. The East Zone, where 89.1% of the strandings took place, probably offers progressively less

favorable conditions to manatees that occur in this area compared to the west coast that held only 3.6% of the records. This difference is possibly due, among other factors, to the better preservation status of the west coast ecosystems, where the manatee population is more protected. The density previously estimated for the eastern population, considered to be low when compared to the period before the three centuries of hunting in Brazil, might be causing the loss of maternal ability and early reproductive recruitment of the females. Both these factors could be contributing to the strandings of live dependent calves. Since the greatest threats to the Antillean manatee in Ceará State are human-related in many aspects, it is necessary to develop conservation strategies that include, besides educational campaigns in the communities, the permanent effectuation of public policies concerning the protection of the coastal zone in the State.

Keywords: stranding causes, moon phase, tides, rainfall, wind, beach morphology, loss of maternal ability, early reproductive recruitment, habitat degradation.

The Trophic Role of the Endangered Caribbean Manatee *Trichechus manatus*; in an Estuary with low Abundance of Seagrass. Castelblanco-Martínez, D., Barba, E., Schmitter-Soto, J., Hernández-Arana, H., Morales-Vela, B., 2011. ESTUARIES AND COASTS, 1-18. DOI 10.1007/s12237-011-9420-8.

Chetumal Bay is a refuge for the manatee, *Trichechus manatus*, a large and strictly herbivorous aquatic mammal. The ecosystem is notoriously poor in subaquatic vegetation, the main components of manatees' diet. Due to the constant presence of manatees in the bay and their ability to consume large volumes of plant material, it is assumed that the species has a relevant trophic impact on the system. A mass-balance trophic model was designed to describe the flows of energy and matter in the bay, with the goal of assessing the role of manatees in the system. The system was aggregated in eight effective trophic levels. The biomass was intensely concentrated in the detritus, suggesting that the matter on the bottom sediment is the main regulator of the energy flow in the system. Primary producers are comprised of detritus, mangrove, benthic autotrophs, and phytoplankton. The apex predators were dolphins and large piscivorous fishes. Manatees occupied the trophic level 2.0. and were directly or indirectly impacted by autotrophs, mangrove, and detritus; but the competition between manatees and other groups was insignificant. In comparison to other ecosystems where manatees occur, Chetumal Bay (BCh) has the lowest relative biomass of seagrasses. Several ecological and behavioral mechanisms to compensate are useful to describe the flow of energy and matter in the ecosystems. However, there are still critical gaps in the knowledge of BCh and its manatee population. It is difficult to assess the uncertainty associated with the estimates obtained; therefore, results should be interpreted with caution. Improving this preliminary model with robust local information on the Chetumal Bay ecology and its manatee population is recommended.

Keywords: Manatee, Chetumal Bay, Trophic model, Grazing, Ecology, Ecopath with Ecosim

Evidence of two genetic clusters of manatees with low genetic diversity in Mexico and implications for their conservation. Coralie Nourisson, Benjamín Morales-Vela, Janneth Padilla-Saldívar, Kimberly Pause Tucker, AnnMarie Clark, Leon David Olivera-Gómez, Robert Bonde and Peter McGuire. DOI: 10.1007/s10709-011-9583-z

The Antillean manatee (*Trichechus manatus manatus*) occupies the tropical coastal waters of the Greater Antilles and Caribbean, extending from Mexico along Central and South America to Brazil. Historically, manatees were abundant in Mexico, but hunting during the pre-Columbian period, the Spanish

colonization and throughout the history of Mexico has resulted in the significantly reduced population occupying Mexico today. The genetic structure, using microsatellites, shows the presence of two populations in Mexico: the Gulf of Mexico (GMx) and Chetumal Bay (ChB) on the Caribbean coast, with a zone of admixture in between. Both populations show low genetic diversity (GMx: $N_A = 2.69$; $H_E = 0.41$ and ChB: $N_A = 3.0$; $H_E = 0.46$). The lower genetic diversity found in the GMx, the largest manatee population in Mexico, is probably due to a combination of a founder effect, as this is the northern range of the sub-species of *T. m. manatus*, and a bottleneck event. The greater genetic diversity observed along the Caribbean coast, which also has the smallest estimated number of individuals, is possibly due to manatees that come from the GMx and Belize. There is evidence to support limited or unidirectional gene flow between these two important areas. The analyses presented here also suggest minimal evidence of a handful of individual migrants possibly between Florida and Mexico. To address management issues we suggest considering two distinct genetic populations in Mexico, one along the Caribbean coast and one in the riverine systems connected to the GMx.

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