

Sirenews

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IN MEMORY OF DR. GALEN RATHBUN



Galen B. Rathbun (1944–2019)

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

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Galen Bert Rathbun, vertebrate behavioral ecologist with a long-term interest in marine mammalogy, died in Cambria, California, on April 13, 2019. In many ways Galen was a zoological Renaissance man with wide research activities across vertebrate taxa and multiple biomes, but here we remember him for his contributions to the study and conservation of marine mammals, especially dugongs, manatees, and sea otters. Galen was scientifically productive until he suddenly became ill from metastatic melanoma a few weeks after his return from an elephant shrew expedition to Djibouti in east Africa in early 2019.

Galen was interested in marine mammals, initially dugongs, from early on in his biological awakening. He was born and grew up in California, earning an Associate in Arts (A.A.) degree in Zoology at the College of San Mateo and then moving to Humboldt State University on the northern California coast, where he earned a Bachelor of Science (B.S.) degree in Zoology in 1966. After graduation, Galen served five years in the Peace Corps, first as a school teacher in western Kenya, and then as a museum education officer with the National Museums of Kenya in Nairobi.

At the museum in Nairobi he was instrumental in establishing the Wildlife Clubs of Kenya. This youth conservation organization continues to the present day and serves as a model for similar organizations throughout the developing world.

Following his service in the Peace Corps, Galen became interested in dugongs along the Indian Ocean Coast of Kenya and explored dugong research for a possible master's degree thesis at the University of Nairobi. However, when looking for dugongs along the Kenya coast near Malindi he encountered the mysterious golden-rumped elephant shrew. He moved his attention from dugongs and instead began field studies on the behavioral ecology of this odd and little-known mammal. His research produced excellent results and he was encouraged to expand his elephant shrew studies for a Ph.D. dissertation in Zoology under Professor Festo Mutere at the University of Nairobi, granted in 1976. Galen then returned to the United States for a postdoctoral fellowship with Devra Kleiman at the Department of Zoological Research, National Zoological Park, Smithsonian Institution, to explore details of the behavior and reproduction of several species of elephant shrews that could only be observed in captivity. Elephant shrews are now found in zoos throughout North America due in no small part to Galen's early affiliation at the National Zoo.

In 1978, one of us (RLB) wanted to hire Galen to be the Sirenia Project Leader for the Marine Mammal Section of the National Fish and Wildlife Laboratory, USFWS, in Gainesville, Florida. However, this proved to be difficult, as the government personnel office said Galen was not qualified for the position because he had no experience working with manatees. So RLB flew to the personnel office in Boston, argued the case for hiring Galen, and said he was not leaving the office until Galen was hired. After two or three days of RLB sitting in their office, the personnel office staff finally gave in and Galen was hired.

Florida manatees were listed as endangered under the Endangered Species Act of 1973, and fell squarely under the U.S. Marine Mammal Protection Act of 1972. However, up until 1978 federal

progress in both research and management for manatees had languished and was slow to get organized, even though the blueprints for much of what needed to be done were clear. Galen was the perfect person to get the effort organized and on a serious and productive trajectory. He put his heart and soul into working with a remarkable staff along multiple lines of research: guiding operation of the carcass recovery and necropsy efforts for documenting causes of manatee mortality, and reaching out to potential collaborators to study tissues and specimens salvaged from carcasses; improving organization of life history studies of individually recognized manatees through his own efforts in the field and the development of a rigorous photo-identification catalog for determining reproductive traits; expanding the rudimentary aerial survey efforts at assessing distribution and abundance of manatees in Florida and abroad; and welcoming biologists from other nations within the range of West Indian manatees to train with the Sirenia Project and to collaborate on status assessments in their home countries. While in Gainesville, Galen also held adjunct positions at the University of Florida and the Florida Museum of Natural History. In addition to work in Florida, Galen also conducted field work on sirenians in Australia, Belize, Haiti, Honduras, Mexico, Palau, and Puerto Rico, and led the development of the recovery plan for Puerto Rico's manatees.

Galen was gifted with an inventive mind. He developed new tagging methods for an array of small vertebrates from frogs to kangaroo rats. In Florida, he spent many hours working late into the evenings tinkering with materials to develop a workable harness and floating, tethered transmitter system that would enable radiotelemetry for sirenians in salt water. This soon advanced to the use of floating, satellite-based platform transmitter terminals (PTTs). Working in collaboration with Bruce Mate, Galen and Sirenia Project staff launched a tagged Florida manatee nicknamed Beauregard to begin what was then arguably the first successful (in terms of tracking duration and numbers of locations) satellite telemetry application in marine mammal research. The floating tethered transmitter assembly has subsequently been used on many hundreds of manatees and dugongs in Africa, Australia, and the Americas, and has been a key technique for determining habitat needs and defining conservation areas for sirenians.

During Galen's work in Florida, he acted intensively behind the scenes for manatee conservation efforts, spelling out and spurring on actions by federal and state wildlife managers in Florida, and coordinating with others to ensure that management goals were accomplished. The Crystal River National Wildlife Refuge, for example, is the product of a foundation laid with Galen's behind-the-scene efforts. His labors were both large and small. As an example of the latter, he often wrote letters to the editor of the local Crystal River newspaper supporting logical manatee conservation efforts, but using the pseudonym "Cy Rhinia" (Cy for Cyrus), ducking a prohibition on federal researchers taking such stands without approval from higher bureaucratic levels.

Galen moved back to his home state of California in 1985 to join the major effort planned to establish a new sea otter population through translocation of otters from the mainland coast of central California to San Nicolas Island off southern California. This was a big job, called for in the recovery plan for this threatened subspecies, to reduce the risk that the entire sea otter population would be affected by a major catastrophe such as an oil spill. It required capturing and tagging 139 sea otters, driving them to the Monterey Bay Aquarium, flying them to San Nicolas Island, and monitoring their movements and behavior as much as possible after release. Although many of the translocated otters left the island, some returning to the California mainland, a new population was successfully established, and is still growing. In 2019, 121 sea otters were counted during the annual survey.

After supervising the translocation of sea otters to San Nicolas Island, Galen worked mainly on the ecology and conservation needs of the less high-profile and sometimes “forgotten” aquatic fauna of coastal California (red-legged frogs, Pacific pond turtles, and two-striped garter snakes) as well as desert small mammals, such as the San Joaquin antelope ground squirrel. He also collaborated in a long-term study of the impacts of cattle grazing on a community of San Joaquin Desert small vertebrates, which demonstrated that controlled grazing can be an effective tool to reduce the negative effects of nonnative grasses on several endangered species.

Galen retired from federal service in 1999, but retained an Emeritus position with the U.S. Geological Survey, and in 2000 began his affiliation with the California Academy of Sciences as a Fellow and Research Associate in the Department of Ornithology and Mammalogy. He continued his field work on sengis (elephant shrews) and other African mammals (dassie-rats, golden moles, and black mongooses; see supplemental file with a list of over 150 career publications and reports). He founded the IUCN Afrotheria Specialist Group in 2001 and served as its chair until his passing. Galen made multiple research expeditions spanning the breadth of the African continent together with colleagues from the Cal Academy, elsewhere in the U.S., and abroad. Discovering new species and revealing details of the evolution and behavioral ecology of the Afrotheria (especially the monogamous species), he filled many knowledge gaps in the biology of this group during the very productive last 20 years of his life.

Galen was a clear thinker and a master of critical argument. He used language with precision. He was a formidable editor and was particular about the rules of English grammar. He served as an Associate Editor for *Marine Mammal Science* and on the review panel for the *African Journal of Ecology*. He also provided service to multiple scientific and conservation organizations through a variety of committee assignments, including a 3-year tenure from 2001 to 2003 on the Committee of Scientific Advisors to the U.S. Marine Mammal Commission.

By Thomas J. O'Shea¹, Robert L. Brownell Jr.², Helene Marsh, Emeritus Professor³, and Katherine Ralls⁴

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Editor's Note: Dr. Galen Rathbun dedicated much of his scientific career working with politicians, managers, researchers, and conservationists throughout the world. Galen laid the foundation for the **Sirenia Project** in Florida that matured into one of the most admired research programs in federal service. He was truly admired and respected by all those who came in contact with him. We will always cherish the pragmatic approaches he provided in conducting sound science and respect the direction he led for many of us in our dedicated careers.

Feature Article – Reprinted from UF Advancement

<https://www.uff.ufl.edu/gators/manatees-feared-gator-offers-hope/>

WHERE MANATEES ARE FEARED, A GATOR OFFERS HOPE

by David Finnerty



Lucy Keith-Diagne is slowly changing the way people in Africa think about the manatee by including them in research and rescue efforts.

**In Africa, the gentle sea cow is viewed as dangerous.
But a UF graduate is determined to dispel myths
and save the vanishing species.**

A wicked woman is rumored to lurk in Africa’s mud-darkened lagoons, mangroves and rivers. Fishermen are said to die at her hands. Villagers warn children not to swim in her waters — she’ll drown those who dare.

It’s not crocodiles or hippos that stir the fear.

It’s manatees.

In eastern Senegal, where Lucy Keith-Diagne is based, there’s a belief that if a manatee breathes on you it will kill you.

“There are a lot of myths and legends about them,” she says. “People are very afraid of them.”

That’s a big problem for conservationists like her.

“Occasionally, I’d meet someone from Brazil or Ghana working with manatees on a shoestring budget, and I thought that’s really what I want to do. That’s where manatees really need more attention.

— LUCY KEITH-DIAGNE —”

“The manatees aren’t thought of as cute, like in Florida,” Keith-Diagne (Ph.D. ’14) explains. “They aren’t thought of that way at all.”

Instead, protections are weak or not enforced. Poachers hunt them for meat. African manatees that are accidentally caught in fishing nets are almost never released. River dams isolate their populations.

Habitats are shrinking because of mangroves being cut for firewood, seasonal floodplains being converted to farmlands and urban growth on the coast. All of which puts the African manatee in jeopardy.

“They’re going to be eaten out of existence if that doesn’t stop,” Keith-Diagne warns.



Keith-Diagne interviews fishermen in Senegal to determine practical ways to protect Africa’s wildlife.

The trouble, in part, is the sea cow itself. Smaller than their Florida cousins, the African manatee is “secretive.” It swims in silence and is most active at dawn, dusk and night. Murky waters hide it from view — it’s hard for people to know when a manatee is just below the surface.

To save the manatee, Keith-Diagne and her husband, Tomas, created the African Aquatic Conservation Fund in 2014. Its focus is on research, preservation and educational outreach. Not just for the African manatee. Keith-Diagne’s small team also concentrates on turtles, marine mammals and other water creatures. It’s a tall order for such a large continent. The manatee’s range alone spreads across 21 countries. To manage, AACF relies on fellow scientists, volunteers and students, local communities and governments, charities and zoos.

The job, Keith-Diagne admits, can be daunting.

“Being in Africa is fantastic — the people, the culture. But it also has challenges,” she says. “It’s interesting, because I do love it ... but I also see all those challenges. It’s a tough place to work.”

A Young Girl’s Wish

Birds were her father’s thing. One of New England’s most respected ornithologists, Allan Keith taught his daughter to delight in wildlife. So it was no surprise when young Lucy announced her intentions to work with animals, too.

“My family would tell you that I learned about manatees in seventh grade and came home and told my parents that I wanted to save them,” Keith-Diagne says.

That idea, to her at the time, seemed to be a wish on a rainbow.

“I grew up in New Jersey, so Florida seemed very exotic at that point in my life,” she says. “A manatee seemed as exotic as a lion — it was far away and something I thought I’d probably never see: this big underwater floaty potato animal, and they were gentle and plant eaters.”

But she did make it to Florida. And, as promised, she did help save the state’s manatees as a biologist for six years with the Florida Fish and Wildlife Conservation Commission. Then, in 2006, she moved across the Atlantic Ocean to specialize in the far-less-studied African manatees. And there she’s remained.

“I really wanted to work with manatees that aren’t as well taken care of as the ones in Florida,” Keith-Diagne explains. “Occasionally, I’d meet someone from Brazil or Ghana working with manatees on a shoestring budget, and I thought that’s really what I want to do. That’s where manatees really need more attention.”



Villagers in Senegal help Keith-Diagne measure a rescued manatee.

So when a colleague studying whales in Gabon, on Africa’s west coast, invited Keith-Diagne to work with manatees there, she jumped at the chance.

“I never looked back,” she says. “I fell in love with Africa, fell in love with African manatees, and told myself I’d do anything to stay here.”

While it hasn’t been easy and can be frustrating — even heartbreaking — there are really good days. Like the time her team rescued and raised an orphaned manatee calf. It took three years before it was mature enough to be released back into the wild. Which meant three years of almost constant care; three years of dragging supplies to a remote lagoon in southern Gabon where the calf lived; three years of her team taking turns watching over the little manatee.

The wonder, Keith-Diagne says, is manatee babies usually don't survive without their mothers. When this one was found stranded on a beach, he was put in a bathtub in hopes of a miracle. A few days later, he was still alive. He was named, fittingly, Victor.

"I thought he'd never survive," Keith-Diagne says. "That was pretty great."

Other good days are wrapped in the moments when children first "meet" manatees during educational outreach events.

"I'll show them pictures of manatees in the water, and their faces light up," Keith-Diagne says. "Kids the world over love animals, and I love to try to inspire them to care so they become adults who love animals and want to protect them."

Gator Gal

She hadn't planned on being Gator.

Then again, Keith-Diagne hadn't really imagined that a career working with manatees was feasible either. Wolves in Minnesota, she used to think, were more likely — maybe she'd be a park ranger. But then opportunities to work with penguins in Antarctica and monk seals in Hawaii came along. And, finally, with manatees in Florida ... and later in Africa.

"I never thought I'd end up in Africa," she says. "I always knew I wanted to work with animals, but I never imagined this would be the direction it would go."



One of Keith-Diagne's successes was raising the orphaned calf Victor and releasing him back into the wild.

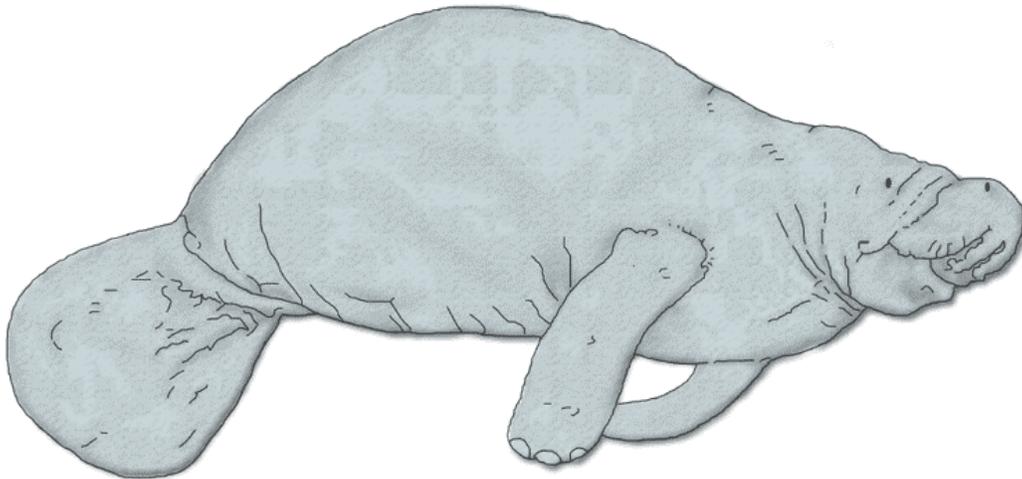
The University of Florida was an equal surprise. Keith-Diagne was three years into her work with the African manatee when Ruth Francis-Floyd, director of UF's Aquatic Animal Health program, and now-retired professor Charlie Courtney encouraged her to come to UF to earn a Ph.D. That was 2009; Keith-Diagne was 45.

A doctorate degree hadn't been on her radar. After all, it had been a long time since she'd received a bachelor's in biology at St. Lawrence University in New York in 1987 and a master's in marine biology from the Boston University Marine Program in 1999. But the chance to learn more about the African manatee's ecology and genetics was too tempting to pass up.

Nowadays, Keith-Diagne — who was named a UF College of Veterinary Medicine Distinguished Alumnus last spring — is the world's leading expert on the elusive African manatee. She's trained close to 100 African biologists and started a network for manatee fieldwork and conservation involving 19 countries on the continent.

But there's much more to do, she insists. Africa needs more scientists. There are no facilities for injured manatees, no rescue centers, and few wildlife genetics labs in West or Central Africa. There aren't enough opportunities for college interns, either. (Her hope is to someday host an internship program at the African Aquatic Conservation Fund that includes UF students.) And the list goes on.

"We need more conservationists out there," Keith-Diagne says. "We need people to study the planet and to try to fix the things we've screwed up." 



Sirenews – African manatee
(Free Web clipart)

LOCAL NEWS

EAST AFRICA

Status of dugongs off East Africa

Over the last five decades there has been a dramatic decline in the number of dugongs across the entire Western Indian Ocean. Travis (1967) observed herds of up to 500 individual dugongs in Somalia, whilst Marsh et al., (2002) reported that prior to 1961, 'large' isolated populations of dugongs were sighted at both Mombasa Marine Park and Natural Reserve and Malindi Marine National Park in Kenya, and that in 1967 a herd of approximately 500 individuals was reported off Kenya's south coast (Husar 1975). Muir et al. (2003) reported herds of 80 animals at Manda Bay, Kenya in 1996. However, Jarman (1966) suggested lower numbers had been recorded by this time. Muir et al. (2003) noted that dugongs were once common along Tanzania's 900 km coastline, while Dollman (1933) described the Zanzibar Archipelago of Tanzania as the dugong's East African stronghold. However, by 1968, Ray (1968) had identified Rufiji and Kilwa as the last remaining refuges for dugongs along the Tanzania coast. The Pemba-Zanzibar channel had also been recognized as an important dugong habitat in Tanzanian waters (Bryceson, 1981; Howell, 1988; Korrubel and Cockcroft, 1997; UNEP, 2001). Hughes (1969) noted that dugongs were relatively common on the Mozambique coast, from Maputo Bay, Chidenguele, Inhambane Bay, Bazaruto Bay, Angoche, Mozambique Island and Pemba Bay. Hughes (1969) also noted a hiatus in the distribution between Bazaruto and Angoche corresponding to low visibility waters corresponding to the "swamp coast" region of Mozambique (Tinley 1971; Rodrigues et al. 1999; Motta 2001). Further, anecdotal reports suggest that dugongs were once plentiful, with herd sizes of eight to ten individuals reported for Inhaca Island in the 1970s (Guissamulo & Cockcroft 1997).

Marked declines in dugong abundance were recorded across the region by a number of authors from 1990 onwards. Surveys of the entire Kenya coastline showed a sharp decline with 10 and 6 dugongs counted in 1994 and 1996 respectively (Cockcroft, 1995; Komora, 1996; Wamukoya et al., 1997; Marsh, 2002; Cockcroft et al., 1994). Similar declines were noted for Tanzania and the Masceline Islands (Cockcroft & Young, 1998; Muir et al., 2003; Kiszka et al., 2007).

From the 1960s, dugong populations in Mozambique, Maputo Bay, were already declining (Smithers and Lobão Telo, 1976). Guissamulo and Cockcroft (1997) sighted dugongs in the eastern quarter of Maputo Bay, although there were too few sightings to estimate their abundance or density and by 1998 Maputo Bay was believed to support only two or three individuals (Cockcroft & Young 1998). Based on boat and aerial surveys conducted from 1991, Cockcroft et al., (1994) suggested the waters of the Bazaruto Archipelago supported the last viable dugong population along the East African coast. The most comprehensive series of surveys of dugongs in the WIO were those carried out by Findlay et al. (2011) in the Bazaruto Archipelago region.

The result of the past three decades of research in the WIO led to a comprehensive research project on the numbers and distribution of dugongs along the East African coast (Cockcroft et al., 2018). Dugong 'hotspots' in Kenya, Tanzania and Mozambique were identified through historical knowledge, fisher

questionnaires and satellite telemetry. At dugong ‘hotspots’ questionnaires were taken and focal group surveys were undertaken, as well as aerial surveys, including unpublished aerial surveys between 2007 and 2018 (Table 1).

Table 1: Details of the aerial surveys carried out in Kenya, Tanzania and Mozambique (Cockcroft et al., 2018)

Country	Area	Year	No. of surveys	Total Effort (nm)	No. of sightings	No. of individuals
Mozambique	Vilanculos to Inhambane	2007	1	317	0	0
	Quirimbas archipelago	2007	2	599	0	0
	Maputo Bay to Ponta do Ouro	2009	2	381	1	1
		2018	1	362	1	2
	Bazaruto archipelago region	2017 - 2018	7	2,234	95	212
Tanzania	Mafia, Kilwa, Rufiji	2016 - 2017	3	1,296	0	0
Kenya	Kenyan coast	2016 - 2017	3	1,746	2	2
TOTAL			19	4,703	99	217

Dugongs of the Bazaruto Archipelago

The overall results for the above research indicate that dugongs are all but extirpated from the East African region, other than in the Bazaruto Archipelago. This dugong population, estimated at between 250 and 350 individuals, probably represents the last viable dugong population within the Western Indian Ocean. Population viability modelling suggests this population is viable, given zero mortality through anthropogenic causes, particularly incidental catch and oil and gas exploration (Cockcroft et al., 2010). A management plan and conservation strategy for dugongs in the Bazaruto Archipelago has been formulated and submitted to the relevant authority (Cockcroft et al., 2018). In addition, Cockcroft et al., (2018) are in the process of proposing that Mozambique’s dugongs be regarded as an IUCN special management unit and classed as highly endangered.

For information on our East African dugong research, please view:

<https://www.dugongs.org/>

Dugongs (*Dugong dugon*) of the Western Indian Ocean Region: – Identity, Distribution, Status, Threats and Management.

<https://www.wiomsa.org/ongoing-project/dugongs-dugong-dugon-of-the-western-indian-ocean-region-identity-distribution-status-threats-and-management/>

Developing an education and awareness campaign to conserve dugongs in the Bazaruto Archipelago and Mozambique (MZ3).

<http://www.dugongconservation.org/project/developing-education-awareness-campaign-conserve-dugongs-bazaruto-archipelago-mozambique-mz3/>

The distribution of dugongs in the coastal waters of Mozambique (MZ2).

<http://www.dugongconservation.org/project/distribution-dugongs-coastal-waters-mozambique-mz2/>

In March 2019 a number of scientists and conservationists proposed that the Bazaruto Archipelago and the coastal region south to Inhambane be declared an Important Marine Mammal Area (IMMA), specifically for dugongs. This proposal was accepted in September 2019. For further information, see below.

<https://www.marinemammalhabitat.org/activities/immas/>

<https://www.facebook.com/IUCNMMPATF/>

-Vic G. Cockcroft (Director, Centre for Dolphin Studies, Dugongs Western Indian Ocean, P.O. Box 1856, Plettenberg Bay, South Africa. 6600.; Email: vic@dugongs.org).

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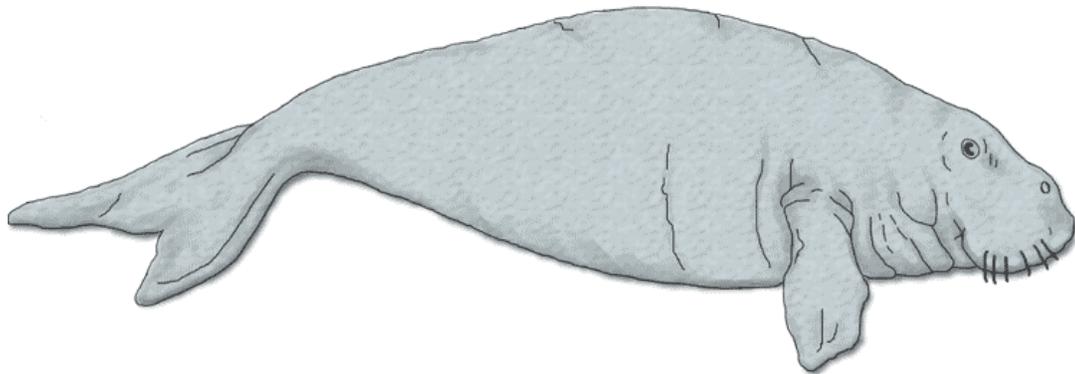
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Sirenews – Dugong
(Free Web clipart)

BRAZIL

The manatee festival at Ilha do Gato, Maranhão, Brazil: a preservation strategy for a remaining manatee population

The 13th Manatee Festival was held from September 6 to 8, 2019, at Ilha do Gato, located within the Baía do Tubarão Extractive Reserve, in the state of Maranhão, Brazil. The event was organized by the Chico Mendes Institute for Biodiversity Conservation (ICMBio) alongside the Ilha do Gato Residents Union and the Humberto de Campos City Hall, where the Extractive Reserve is located. Created in 2007 with the purpose of sensitizing residents to the preservation of the Antillean manatee (*Trichechus manatus manatus*) and its environment, the 2019 edition featured various cultural and recreational activities such as lectures, aquatic mammal model exhibitions, videos, a painting contest, dances, a collective waste disposal effort and a sand soccer tournament (Figures A to I). Ilha do Gato is a small village comprising about 60 families that subsist mainly on artisanal fishing, complemented by family farming and small animal husbandry (Alvite, 2008). This area presents the highest number of manatee specimens recorded in a natural environment off the coast of Maranhão (Alvite et al., 2006).



Efforts to preserve Antillean manatees have been carried out in the area since 1992, when popular conservation awareness began in the state of Maranhão. The Aquatic Mammals Center (CMA/ICMBio) was implemented in 2001, prioritizing educational campaigns and implementing physical observation points for manatees in the wild, in order to monitor the local marine manatee population around Ilha do Gato. The “Don't Kill the Manatee” campaign was launched in July 2007, when a collaboration between the CMA/MA, Aquatic Mammals Foundation, Alumar and the Alcoa Institute organized the 1st Manatee Preservation Festival at Ilha do Gato, also deploying the first manatee observation tower on-site, which became the responsibility of a community resident.

However, in March 2015, ICMBio Ordinance No. 16 ordered the closure of the CMA in Maranhão, ceasing monitoring activities at both Ilha do Gato and two other areas in the state, Ponta de Pedras, located at the Alcântara municipality, and Guarapiranga Beach, in the municipality of São José de Ribamar (Costa et al., 2019). Even after the CMA left the area, residents continued to hold the Manatee Fish Preservation Festival and monitor the endangered species although no official marine manatee monitoring has been conducted, and the manatee population situation off the coast of Maranhão is unknown (Costa et al., 2019).

The Manatee Festival at Ilha do Gato has become an important cultural manifestation for communities throughout the region, a symbol of social organization and resistance, in a context that inspired the recognition of the area as a Federal Conservation Unit (Tubarão Bay Extractive Reserve), created by Federal Decree No. 9,340 of April 5, 2018. In May 2019 representatives of the Ilha do Gato community requested that ICMBio actively participate in the Manatee Festival, as this was seen by the Traditional Population as a time to celebrate the creation and management of the Extractive Reserve. In its 13th edition, the Manatee Festival has become an important tool for raising awareness among fishing communities regarding the preservation of this endangered species and its environment. The event also serves to stimulate local culture and strengthen the relationship between managers, residents and Baía do Tubarão Extractive Reserve users.

In this context, the Manatee Festival also fulfills one of its main guidelines, which is to enable and encourage the effective participation of traditional peoples and communities in research development and dissemination and income-generating activities, such as manatee tourism, in addition to other mangrove-occurring species.

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Figure A: Map of Reserva Extrativista Marinha Baía do Tubarão (Marine Extractive Reserve Baía do Tubarão), Source: CNPT/ICMBio.

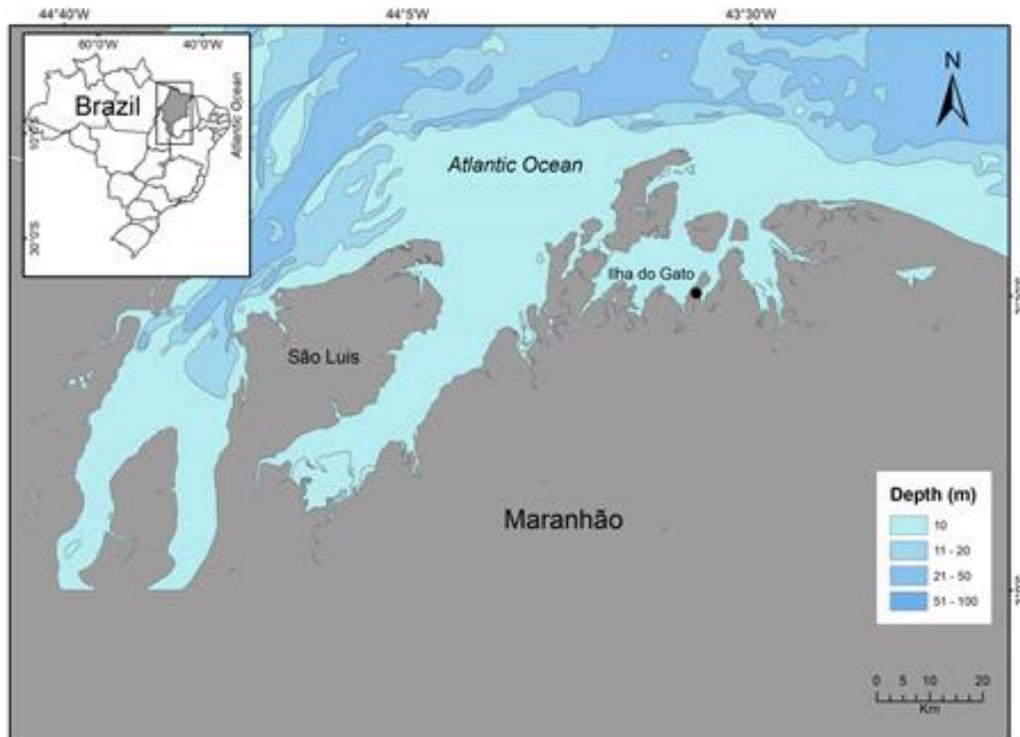


Figure B: Location of Ilha do Gato, Humberto de Campos, Maranhão, Brazil. Map prepared by S.C. Moreira.



Figure C: Former manatee observation platform located at Ilha do Gato, Humberto de Campos, Maranhão, Brazil. Source: M. D. Vidal.



Figure D: Inauguration session 13th Manatee Festival, held from September 6 to 8, 2019 at Ilha do Gato. Photo by S. Siciliano.



Figure E: Visitor Center at Ilha do Gato, Humberto de Campos, Maranhão. Photo by S. Siciliano.



Figure F: Sculptures and marine mammal displays inside the visitor center at Ilha do Gato, Maranhão, Brazil. Photo by M. D. Vidal.



Figure G: Antillean manatee skeleton on display, from a specimen found stranded in 2009. Photo by S. Siciliano.



Figure H: Children's drawings celebrating the Manatee Festival at Ilha do Gato. Photo by M. D. Vidal.



Figure I: Typical fishermen wooden boat at Ilha do Gato, Maranhão, Brazil. Photo by S. Siciliano.

CAMEROON

Eutrophication of Lake Ossa due to inundation of invasive *Salvinia*

Lake Ossa (Cameroon) is a 4000 ha wildlife reserve well-known for its population of African manatees. Categorized on the IUCN Red List as a vulnerable species, illegal hunting has been the leading cause of death. However, we have been observing slow but long-lasting effects that may have a more formidable impact on the decline of the species: the degradation of water quality that modifies the fragile food ecosystem that the manatee relies on for its nutrition.



Since 2017, a vast proliferation of an invasive aquatic fern, called *Salvinia molesta*, is [killing native plants that are food for the manatees](#), in particular the *Echinochloa pyramidalis*. Named “the worst invasive plant in the world” by the US Army Corps of Engineers, the *Salvinia* doubles in size every 7-10 days and has now created an emergency situation. As of this writing, it already covers about 25% of Lake Ossa.



[AMMCO](#) has been conducting research to accurately determine the causes of this proliferation. The first results show a significant enrichment of water in nutrients such as nitrogen and phosphate, which are essential elements to the development of plants. That process, called eutrophication, represents a systemic change in the lake's water. The resulting over-enrichment of minerals and nutrients will induce excessive growth of not just the *Salvinia molesta* but other invasive plants, in a phenomenon called "invasive cascade" where the *Salvinia molesta* may just be the first to spread on the lake before other invasive plants start to develop.

Possible causes include the construction of a dam upstream the Sanaga River that stores important quantities of sediments which flows into the Lake Ossa complex, as well as run-offs carrying fertilizers from agricultural lands. Once established on the lake, the invasive plants cause another inconvenience during the dry season: their massive decomposition consumes much of the oxygen present in the water, thus aggravating its chemical imbalance.



Lake Ossa is actually a lake complex made up of three lakes. Six years ago, AMMCO had identified Mevia as the region of the lake most populated by the manatees. In 2019, *Salvinia* spread more aggressively in this hot-spot of manatees. This likely caused their migration to other non-invaded areas, like Mwembe, initially less colonized, where the presence of the mammals was more and more observed recently through the presence of faeces or direct sightings. It is also possible that some manatees had left the lake to go to the Sanaga River, which connects with Lake Ossa via a small channel about 2km long.



While a key focus of our strategy has been around [the education of the local population to prevent the illegal hunting and bycatch of manatees](#), we came to realize through our continued field research and through conversations with entomology experts at the Rhodes University (South Africa) and Louisiana State University, that a more holistic approach should be planned through the implementation of an integrated water management plan to address the difficult task to preserve the lake biodiversity and habitat for the African manatee.

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FLORIDA

Epimeletic behavior in a Florida manatee

Epimeletic behavior refers to a healthy adult animal giving care or attention to a distressed, injured or dead conspecific, often of a younger age class (Caldwell and Caldwell, 1966). This behavior typically involves an adult female that is inferred or confirmed to be the younger animal's mother (Bearzi et al., 2018). Some terrestrial species exhibit epimeletic behavior, including primates (Anderson et al., 2010; Anderson et al., 2011; De Marco, 2017) and African elephants (*Loxodonta africana*, Douglas-Hamilton et al., 2006). Epimeletic behavior has also been documented in marine mammals, including sea otters (*Enhydra lutris*) and more than 20 species of cetaceans, including both toothed and baleen whales (Reggente et al., 2016; Bearzi et al., 2018).

There is a single reported case of this behavior in sirenians. Hartman (1979) relays a report of a female Florida manatee (*Trichechus manatus latirostris*) in Volusia County, Florida, that kept her dead calf afloat for two days. The report originated from a guide on the Tomoka River. However, no photographic or video evidence is known to exist.

On June 27th, 2019 at approximately 1400 hrs, a citizen observed an adult manatee pushing a small, dead manatee calf within a residential canal in Bishop's Bayou, Longboat Key, Manatee County, Florida (see photo below). The citizen contacted Mote Marine Laboratory (MML) and forwarded a video, which showed the presumed mother pushing the buoyant carcass (which was given a mortality ID: MNW19058) around the canal. MML staff responded and observed the reported behavior. The adult was observed staying at the water surface, keeping its head in close contact with the carcass, occasionally nuzzling the calf's body, and pushing it up in the water and around the canal. The calf carcass had distinct fetal folds and an umbilical skirt. Under the direction of the US Fish and Wildlife Service, the carcass was left with the presumed mother. At approximately 2200 hrs, the complainant observed the presumed mother continuing to push and support the carcass within the canal. The calf carcass was next reported to MML staff at 1436 hrs on June 30th. It was by itself. MML staff recovered the carcass and transported it to the Florida Fish & Wildlife Conservation Commission Marine Mammal Pathobiology Laboratory in St. Petersburg, Florida.

A necropsy was performed the following day, July 1st. Although the total straight length of the carcass (155 cm) was longer than the generally accepted perinatal size class (<151 cm), it is believed that the carcass died around birth due to the presence of fetal folds, umbilical skirt, and meconium in the gastrointestinal tract. Cause of death could not be conclusively determined due to advanced decomposition.

To our knowledge, this is the first confirmed and photo-documented case of epimeletic behavior in manatees, despite the 2,573 perinatal manatee carcasses reported to the FWC since 1975. Thank you to Mote Marine Laboratory's Stranding Investigations Program for documenting the behavior and recovering the carcass; and thank you to Longboat Key Police-Officer Josh Connors for searching for and assisting with recovery of the carcass.

-Sean M. Tennant¹ and Rebecca A. Hazelkorn² (¹Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Marine Mammal Pathobiology Laboratory, Saint Petersburg, Florida, USA; ²Mote Marine Laboratory, Stranding Investigations Program, Sarasota, Florida, USA; Corresponding author¹: Sean.Tennant@MyFWC.com).

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Epimeletic behavior observed in Florida manatee.

INDIA

An update on the “Recovery of Dugongs and their Habitats in India: an Integrated Participatory Approach” programme

Dugong Recovery Program was initiated in 2015 as a multi-stakeholder participatory approach to raise awareness, enhance capacity for monitoring and assess status of dugong populations and seagrass habitats in India. This approach is under implementation since the last 3 years at the dugong distribution areas, i.e. Andaman and Nicobar Islands, Gulf of Mannar and Palk Bay (Tamil Nadu) and Gulf of Kutch (Gujarat) (Sivakumar et al. 2018). Here, we present an update on the major outputs of the work done in these three states.

Andaman & Nicobar Islands

We quantified threats in four Critical Dugong Habitats (CDHs) across the Andaman Islands to understand the nature and intensity of threats (Sivakumar and Nair 2013). A grid-based point count method was used up to 10 km offshore, to document threats in terms of vessel traffic and floating plastic litter. Density of these threats were found to be highest in the South Ritchie’s region (litter=1.14 items/km², vessels= 1.77 boats/ km²), a major tourist destination with known dugong foraging grounds (D’Souza et al. 2015). Strict regulations for low speed limits in these areas and prohibition of disposal of plastic wastes has been recommended. Based on semi-structured questionnaire surveys, we could identify two areas where dugongs are still being poached as bycatch or entangled in gill nets viz; North Andaman (Diglipur) and Little Andaman (Hut bay). Dugong Scholarship Program (Sivakumar et al 2018) was extended to 119 school children from 7 schools in South and North Andaman. Dugong Volunteer Network of fishers, divers, tourists, boatmen, etc. provided 72 records of dugong sightings and strandings.

Gulf of Kachchh, Gujarat

The dugong population in the Gulf of Kachchh (GoK) was believed to be very small, estimated up to 10-15 individuals (Sivakumar & Nair 2013). Extensive complexes of dugong feeding trails >20m length in the meadows of Bhaidar, Chusna and Noru islands were discovered. Several counts of drifting ghost nets and illegal trawling practices inside the gulf were also observed as major threats to dugongs and other megafauna in the region.

Palk Bay and Gulf of Mannar, Tamilnadu

Seagrass habitat assessment in Palk Bay found seven species of seagrasses, namely, *Cymodocea serrulata*, *C. rotundata*, *Halophila ovalis*, *Halodule uninervis*, *Syringodium isoetifolium*, *Enhalus*

accaroides and *Thalassia hemprichii*. The total seagrass cover was found to be maximum in North Palk Bay (88.5%) and 82.67% cover in Central and 49.94% in South Palk Bay. *Cymodocea serrulata* was the most commonly occurring species in Palk Bay. A semi-structured questionnaire survey conducted in the Palk Bay region revealed that the majority of respondents (>75%) had seen dugongs with about 50% being recent sightings (<1 year). Dugong Scholarship Program (Sivakumar et al 2018) was extended to 50 more schools enrolling 153 students. A proposal to designate North Palk bay as a Marine Conservation Reserve is being considered while a Management Plan for Gulf of Mannar Marine National Park was prepared to prioritize dugong conservation in the region.

Capacity building of stakeholders

Between 2017-19, a total of 20 training programs were conducted where about 400 frontline staff from three state forest departments were trained for underwater marine biodiversity monitoring. They were trained in snorkeling, boat survey methods and handling equipment and seagrass mapping by random quadrat method.

During 2016-2019, under state forest departments supervision, so far 10 dugongs have been successfully rescued and released (Tamilnadu = 7, Andaman & Nicobar = 2, Gujrat = 1) in all three dugong ranging sites in India. These rescues have been supported by the frontline staff of Marine Police or coastal security police at these sites and have also helped to avert poaching attempts in two incidences.

Way forward

Efforts are underway to identify and manage the Critical Dugong Habitats outside PAs and conserve these areas with help of local communities. Studies to understand the ecosystem services of seagrass habitats, ecology of dugongs, ecology of seagrasses and its associated fauna and flora, population genetics of dugong, behaviour of dugongs, mapping of critical dugong habitats, etc. are being carried out. Our initial drone surveys have helped us to identify new dugong habitats in India and we are planning to intensify this technique to assess the population status of dugongs in the near future. We are also planning to build capacity to handle the stranded dugongs with help of UNEP-CMS Dugong MoU Secretariat and IWC. We believe that illegal capture of dugongs has been reduced in India and reporting of stranded dugongs has also increased through our extensive volunteer networks.

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Figure 1: SCUBA diving and underwater marine biodiversity monitoring training, Orientation workshop in Andaman and Nicobar Islands.



Figure 2: Participants being trained for seagrass mapping by random quadrat method in Andaman Island.



Figure 3: SCUBA Diving and Marine Biodiversity Monitoring Training in Dwarka for forest frontline staff in Gujarat.



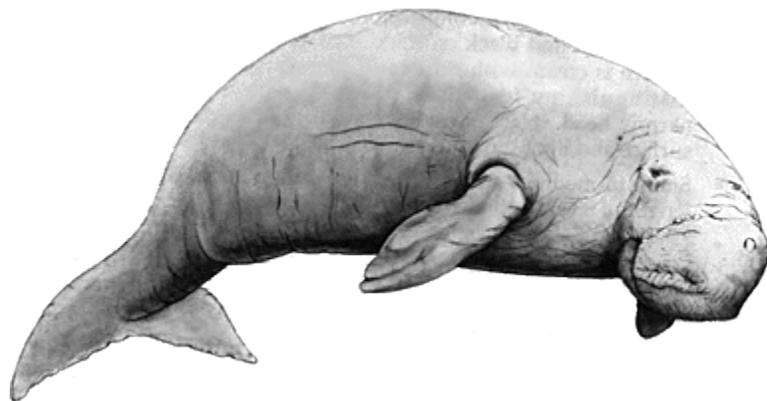
Figure 4: Ghost net beach clean-up by forest department staff in Gujarat



Figure 5: Underwater clean up by Tamil Nadu forest department at Mandapam.



Figure 6: Biodiversity Monitoring Training Course at Tamil Nadu.



Sirenews – Dugong
(Free Web clipart)

JAPAN

Can the northernmost dugong population be saved from extinction?

In March 2019, a 2.9m female dugong died on the west coast of Okinawa, Japan stabbed by a ray barb, presumably while bottom feeding. This animal is the last known dugong in the waters of Okinawa, one of the Nansei islands that occur in Japanese waters between Kyushu and Taiwan. Okinawa is the site of a long battle to conserve dugong habitat threatened by the planned relocation of a U.S. Marine Corps air base. The fight to protect this habitat focused attention away from the main threat, incidental bycatch in fishing operations.

Dugongs were widely distributed in the Nansei Islands, probably in the low hundreds during the late 19th century, but were hunted at an unsustainable rate until the early 20th century. During the past 50 years (1969-2019), the major causes of dugong mortality have been incidental and illegal direct catches. Habitat loss and degradation are becoming greater concerns. Construction of the new base has recently destroyed *ca.* 160 hectares, a substantial proportion of the total area of seagrass around Okinawa but a relatively small proportion of the seagrass habitat in the Nansei Islands.

The Japanese dugong population is geographically distinct and there appears to be little demographic or genetic exchange with other populations. This isolated population has been considered to be under serious threat of local extinction for decades. It is now uncertain whether any dugongs remain in this region. The IUCN Sirenia Specialist Group has lodged a listing assessment for this population with IUCN, the first in the regional assessments of dugongs throughout their range planned by Sirenia SSC. The Sirenia SSC also held a small expert workshop in Japan in September 2019 to suggest a way forward. The workshop, which was hosted by Toba Aquarium and funded by the US Marine Mammal Commission, was attended by 10 people plus Toba Aquarium staff: a representative of the Japanese government, two representatives of Japanese NGOs, and Japanese and international dugong and seagrass experts. The Okinawa Prefecture sent a slide presentation that was delivered by one of the Japanese NGO representatives.

The Japanese Government advised us that the most useful initiative would be for the expert group to develop a research plan for the Japanese dugong population, which is what we did. Our plan outlines multiple approaches to determine if any dugongs remain in Japanese waters. The first priorities will be a comprehensive survey of fishers across the Nansei Islands and a Smartphone App to encourage citizens to report sightings. Subsequent initiatives, which may include e-DNA surveys, drone surveys, and/or extended passive acoustic observations, will be dependent on the results of the fisher surveys and citizen science initiative. The plan also outlines initiatives to improve knowledge of the status of seagrass in the Nansei Islands and to raise public awareness. If dugongs are detected in the Nansei region, a second workshop will be held with the key stakeholders to design conservation initiatives.

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PHILIPPINES

Dugong presence in Concepcion, Iloilo, Philippines after Typhoon Haiyan

In 2013, Category 5 Typhoon Haiyan's (locally named Yolanda) 195 kph winds hit the Municipality of Concepcion and five other Philippine areas, displacing millions of coastal villagers and killing thousands. Alongside such immense human cost, marine ecosystems (e.g. seagrasses and coral reefs) were also devastated.

Prior to 2013, photographs and blogs on Concepcion's dugongs had been uploaded to the Internet. Also, dugong sightings were noted during the July 2012 training on the Dugong Questionnaire Survey held at the request of Concepcion's designated Municipal Tourism coordinator. A signatory to the Memorandum of Understanding on the Conservation and Management of Dugongs and Their Habitats, the Philippines participated in the UNEP-CMS Dugong Catch/By-Catch Questionnaire Survey (Pilcher et al. 2017). Inasmuch as records were lost during Typhoon Haiyan, Concepcion was not reported as part of dugong occurrence in the Red List Status of Marine Mammals in the Philippines (Aquino et al. 2012).

In 2019, this independent study re-conducted the Questionnaire Survey to know if dugongs were still in Concepcion's waters. After the questionnaire was translated from English into the lingua franca (Hiligaynon), 13 coastal residents ≥ 40 years were selected as key informants. Following Pilcher and Kwan (2012), data were encoded in the Upload worksheet while maps were made in Google Earth.

Initial results show that dugongs still occur in low numbers (<10) along four of Concepcion's 17 islands (Figure 1). Accidental capture in fishing gear and boat strike were identified as threats to dugongs but no hunting was known. This on-going study's final report will be presented to stakeholders (especially the Municipal Government) to strengthen conservation of dugongs and related habitats.

Further study will examine how dugongs maintained their presence in Concepcion after Typhoon Haiyan and, hopefully, how dugongs adapt to climate change.

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Acknowledgement: Our thanks to 13 key informants for accommodating 30–45 minute interviews; Municipal Mayor Raul N. Bantias for approving this research; and for fieldwork guidance: Mark Rufino of Municipal Agriculture Office; Jeomar Baldaza and Ian Azucena of Municipal Tourism Office; Emelinda Abian of Conservation International-Philippines.

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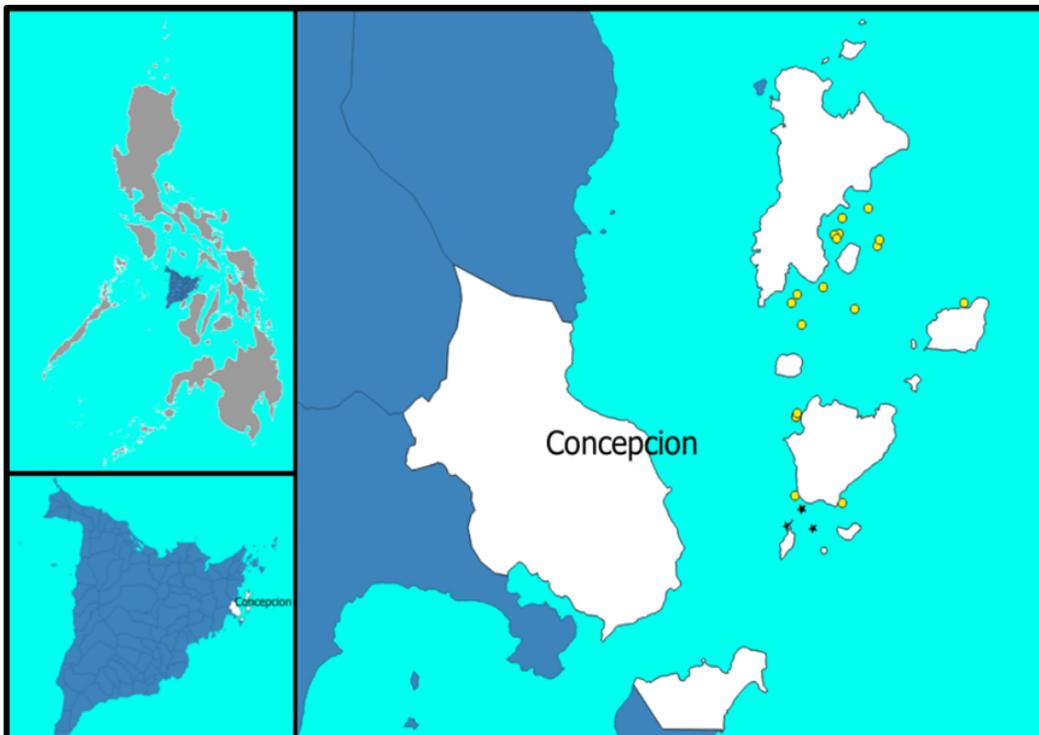


Figure 1. Location of Concepcion, west Panay Island, central Philippines, indicating reported dugong sightings: alive (yellow dots) and dead (black stars).

PUERTO RICO

Use of an invasive seagrass (*Halophila stipulacea*) for manatee pre-release diet training

Herbivorous manatees in Puerto Rico feed on a variety of seagrasses. The four main species of seagrasses in their diet are manatee grass (*Syringodium filiforme*), turtle grass (*Thalassia testudinum*), paddle grass (*Halophila decipiens*) and shoal grass (*Halodule wrightii*).

While at the Puerto Rico Manatee Conservation Center we feed manatees in rehabilitation with different types of vegetables, mostly lettuce, close to the end of their rehabilitation and prior to being released back to the sea, they must learn to eat natural vegetation. For this, the Center offers manatees during the last 6-9 months prior to release, invasive freshwater plants (water lettuce [*Pistia stratiotes*], water hyacinths [*Eichhornia crassipes*], waterthyme [*Hydrilla verticillata*]), and a taste of local seagrasses (manatee and turtle grasses). A “taste” means that these seagrasses are offered, under permit, in limited quantities due to the protected nature of these flowering plants. But the invasive freshwater plants are abundant in lakes and rivers throughout Puerto Rico, and being invasive, it is legal to collect and destroy them as plants that can be detrimental to the environment. However, in this case their collection is for a good cause.

But recently, an unfortunate opportunity has opened up to help manatees in rehabilitation get accustomed to a more natural marine diet prior to being released back to sea. Another invasive plant has been discovered in the Caribbean and Puerto Rico. This is a seagrass from the Red Sea and Indian Ocean named broad-leaf seagrass (*Halophila stipulacea*). The marine plant is now found spreading rapidly in different parts of Puerto Rico, particularly in Culebra, Ceiba and Jobos Bay, the latter two primary habitats for manatees. Biologists from the Department of Natural and Environmental Resources (DNER) and the US Fish and Wildlife Service fear that it may compete and displace local populations of the other natural-occurring seagrasses.

The DNER is removing these in specific natural reserve areas, and in doing so, are offering the collected seagrass to the Center to train manatees scheduled for release onto eating natural marine vegetation. In October 2019, biologists from the DNER Jobos Bay National Estuarine Research Reserve delivered 20 kilograms of broad-leaf seagrass, which the two manatees scheduled for release in January 2020 ate readily.

While the Center does not expect to fulfill the entire dietary needs of manatees in rehabilitation with invasive plants, at least it is a way for naive manatees to hopefully understand that once in the wild, they need to feed on a variety of plants. They need to eat whatever plants are available, which in turn, provides them with a better chance of surviving. Thus, the use of invasive plants, both freshwater and

marine, appear to serve endangered species conservation through their use as supplemental and pre-release diet training while under human care.

It is all a matter of taking a chance on opportunities, even if they come in the way of an invasive species problem. In a way, turning these opportunities into an aquatic plant fiesta for manatees.

-Antonio A. Mignucci-Giannoni VT PhD (Puerto Rico Manatee Conservation Center; E-mail: mignucci@manatipr.org).



Pre-release manatee feeding on *Halophila* at Puerto Rico Manatee Conservation Center.

SYMPOSIA/CONFERENCES

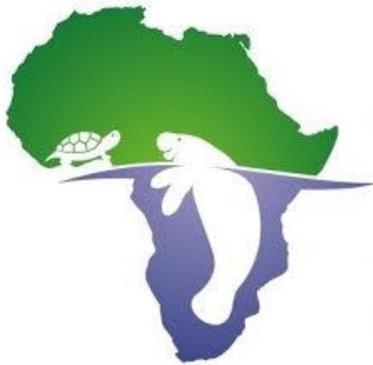
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- **Lucy Keith-Diagne** (Executive Director, African Aquatic Conservation Fund; Email: lkd@africanaquaticconservation.org).

SYMPOSIA/CONFERENCES

SECOND MANATEE RESEARCH SYMPOSIUM AT THE UNIVERSITY OF FLORIDA, 30 AUGUST 2019



Introduction

The UF Aquatic Animal Health Program successfully held its Second Annual Manatee Research Symposium from 8:00 AM – 5:00 PM on Friday, August 30th, at UF CVM Banfield Auditorium A, on the third floor of the University of Florida Small Animal Hospital. There was no cost associated with the event, and coffee, breakfast, and lunch were provided for the attendees. The program was comprised of a broad range of presentations on research advancing our understanding of manatee biology and veterinary medicine.

The event was coordinated by Dr. Iske Larkin, Interim Director, Aquatic Animal Health Program, Department of Large Animal Clinical Sciences, College of Veterinary Medicine, University of Florida. The program was sponsored by the Aquatic Animal Health Program of the College of Veterinary Medicine, University of Florida and the Florida Fish and Wildlife Conservation Commission. The event was well attended and excellent questions were brought up. Keep an eye out for future Manatee Research Symposia.

PRESENTATION AGENDA

8:00	Breakfast	Room #342 and Banfield A/B
9:00	Welcome	Iske Larkin, University of Florida
9:20	<i>Manatee health assessment sampling: tips and tricks for obtaining five-star quality diagnostic and research samples</i>	Laurie Adler & Nicole Stacy, University of Florida
9:50	<i>Florida manatee hearing and boat collisions: Integration of laboratory and field studies</i>	Athena Rycyk, New College of Florida
10:20	<i>Florida manatee algae cover</i>	Athena Rycyk, New College of Florida
10:40	<i>Current methods of reproductive research in male Florida manatees</i>	Jonathan Cowart, University of Florida
11:00	<i>Comparison of different fixation and staining techniques on the morphometric assessment of Florida manatee spermatozoa</i>	Sofia Danford, University of Florida
11:20	<i>How to request Florida manatee biological samples from the U.S. Geological Survey</i>	Jason Ferrante, U.S. Geological Survey
11:40	<i>Transcriptome analysis of Florida manatees exposed to multiple stressors</i>	Maite De Maria Mulet, University of Florida
12:00	Lunch	Banfield A/B
1:00	<i>Diet composition of the African manatee: spatial and temporal variation within the downstream of Sanaga River watershed (DSRW), Cameroon</i>	Aristide Takoukam, University of Florida
1:20	<i>Skin temperature in Antillean manatees</i>	Nicola Erdsack, Mote Marine Laboratory
1:40	<i>Detecting pathogenic bacteria in the manatee microbiome</i>	Madison Hall, University of Central Florida
2:00	<i>Warm-water habitat use and winter movements of GPS-tagged Florida manatees after relocation of a traditional thermal source in the Indian River Lagoon</i>	Chip Deutsch, FWC
2:30	<i>A manatee multigenerational sample archive: Challenges to monitoring population and environmental health parameter changers over 100+ year</i>	Michael Walsh, University of Florida
2:50	Closing Remarks	Iske Larkin, University of Florida

ABSTRACTS

ABSTRACTS OF THE SECOND ANNUAL MANATEE RESEARCH SYMPOSIUM, 30 AUGUST 2019

PRESENTATION ABSTRACTS

1. *Manatee health assessment sampling: tips and tricks for obtaining five-star quality diagnostic and research samples.* **Laurie Adler**¹ and **Nicole Stacy**¹

¹ Aquatic Animal Health Program, University of Florida College of Veterinary Medicine

Key objective of manatee health assessments is the collection of numerous sample types for diagnostics and research projects. To obtain five-star sample quality, substantial efforts are needed for planning and executing logistics, organization, and training, involving all aspects of manatee capture planning through storing and shipping out samples to various collaborative laboratories. The objective of this presentation is to highlight some of the major logistical and organizational aspects and protocols of collection, processing, and temporary storage of various sample types collected from manatees in the field. This information serves to promote best sample quality and will be applicable to research and rehabilitation settings.

2. *Florida manatee (*Trichechus manatus latirostris*) hearing and boat collisions: Integration of laboratory and field studies.* **Athena Rycyk**¹, Roger Reep², Joe Gaspard³, Deborah Colbert-Luke⁴, Doug Nowacek⁵, Chip Deutsch⁶, David Mann⁷, and Gordon Bauer⁸

¹ Division of Natural Sciences, New College of Florida

² Department of Physiological Sciences, University of Florida College of Veterinary Medicine

³ Pittsburgh Zoo & PPG Aquarium

⁴ Society of Conservation Biology

⁵ Nicholas School of the Environment and Pratt School of Engineering, Duke University Marine Laboratory

⁶ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute

⁷ Loggerhead Instruments

⁸ Division of Social Science, New College of Florida

Boat strikes are responsible for about half of adult manatee mortality. Here we integrate research on the hearing capabilities of manatees in human care with field investigations of manatee-boat interactions to assess our understanding of manatee-boat collisions. Laboratory studies have evaluated manatee hearing sensitivities, critical ratios, and ability to localize sound sources. These studies indicate that manatees should be able to detect boat noise. Evidence from field studies indicates that manatees change their behavior in response to close-approaching boats most of the time. We discuss environmental and behavioral factors that increase the likelihood of collisions and identify important directions for future research.

3. *Florida manatee (Trichechus manatus latirostris) algae cover.* **Athena Rycyk**¹, Jessica Skinner², Tyrone Ryba¹, Paul Schueller², and Nicola Erdsack³

¹ Division of Natural Sciences, New College of Florida

² University of South Florida Sarasota

³ Mote Marine Laboratory

Macroalgae cover on manatees varies within the population, some have little algae growth on them while others have a dense fur-like layer of algae. We developed and tested a rubric that categorized macroalgae density and surface area from images of manatee carcasses. After applying a rigorous filter to ensure only suitable manatees were included, we analyzed images of manatee carcasses from the Marine Mammal Pathobiology Laboratory that were recovered between 2008 and 2017. We'll compare algae profiles between age classes, seasons, location, and cause of mortality.

4. *Current methods of reproductive research in male Florida manatees.* **Jonathan Cowart**¹ and Iskande Larkin¹

¹ Aquatic Animal Health Program, University of Florida College of Veterinary Medicine

Increases in our understanding of the reproductive physiology of the Florida manatee have not been adequately represented in the expansive growth of biological information in the field of sirenian research. The current threats and high annual mortality this species faces, necessitates the need for a better understanding of reproduction as it has important implications for the continued survival and growth of the population. Many methodologies to assess reproductive capacity and fertility have been well-established in humans and domestic species, but due to inherent difficulties, are not established for most marine mammal species, especially the Florida manatee. Translating many of these methodologies into Sirenian reproductive research provides vital insights into the reproductive physiology of this species and may help researchers better manage and conserve the population.

5. *Comparison of different fixation and staining techniques on the morphometric assessment of Florida manatee (Trichechus manatus latirostris) spermatozoa.* **Sofia Danford**¹, Jonathan Cowart¹, Danielle Collins¹, and Iskande Larkin¹

¹ Aquatic Animal Health Program, University of Florida College of Veterinary Medicine

The morphometric characteristics of sperm are important factors in determining the reproductive potential of an individual. In many domestic species, protocols for sperm sample processing have been optimized for morphometric analysis, which allows for standardized, objective assessment of spermatozoa. The aims of this study were to compare the influence of different fixation and staining techniques on the head morphometry of Florida manatee (*Trichechus manatus latirostris*) spermatozoa. The data from this study contributes to our overall objective of optimizing sperm sample fixation, staining, and analysis techniques in the Florida manatee. Establishing guidelines for standardized sperm processing and morphometric analysis in this species is important as it helps researchers monitor the reproductive health of the population and plays a key role in identifying potential reproductive issues caused by factors such as inbreeding and environmental contaminants.

6. *How to request Florida manatee biological samples for the U. S. Geological Survey.* **Jason Ferrante**¹ and Margaret Hunter¹

¹ Wetland and Aquatic Research Center, U. S. Geological Survey

The USGS Sirenia Project provides Sirenian biological samples to researchers for the purpose of supporting studies that relate to manatee health, conservation, natural history, and management. Requests are considered on a case-by-case basis for relevance, uniqueness, and likelihood of success. This allows us to maximize the scientific value of our holdings and to reduce the risk of duplicated research efforts, especially when sample loans involve destructive sampling and/or are from archival stocks. When possible, we encourage researchers to submit requests for samples in advance of future health assessments as applicable. Details about the forms and sample availability will be presented.

7. *Transcriptome analysis of Florida manatees exposed to multiple stressors.* **Maite De Maria Mulet**¹, Natalia Garcia-Reyero ², Kevin Kroll¹, Margaret Hunter³, John Alfred Bowden¹, Cecilia Silva-Sanchez¹, Mike Walsh⁴ and Nancy Denslow¹

¹ Department of Physiological Sciences, University of Florida College of Veterinary Medicine

² United States Army Corps of Engineers

³ Wetland and Aquatic Research Center, U. S. Geological Survey

⁴ Aquatic Animal Health Program, University of Florida College of Veterinary Medicine

Florida Manatees (*Trichechus manatus latirostris*) is a threatened species exposed to multiple stressors in the environment. They drink fresh water and they rely on freshwater refuges during winter, when they can be exposed to runoff containing industrial and agricultural contaminants. Toxic substances such as flame retardants (per- and polyfluoroalkyl substances, PFAS) have been detected in their plasma with a higher concentration in manatees from the Atlantic Coast (Brevard County) than in the population considered healthy in Crystal River (Gulf Coast). We have selected 32 manatees from these two populations with widely varying PFAS concentrations for further investigation of their transcriptomes. Manatees from Crystal River range with less than 5 ng PFAS/g plasma (wet weight) while those from Brevard have more than 20 ng PFAS/g (wet weight). In preliminary analysis of a subset of manatees (n=10), we have found that glyphosate, a commonly used herbicide formulated as roundup, is more prevalent in manatees from Brevard County. The mean concentrations we measured were 0.17 (±0.08) ng/mL for Brevard manatees, and 0.1 (±0.11) ng/mL for Crystal River manatees. These substances can produce lymphocyte extravasation and inflammation. Glyphosate exposure in animal models caused immune dysfunction associated with others pathologies. Both chemicals promote the expression of inflammatory cytokines in lymphocytes and immune suppression. Our working hypothesis is that exposure of manatees to multiple stressors hinders their immune systems. To test the hypothesis, we will perform total RNA extraction and RNA sequencing by Illumina on white blood cells collected from 32 manatees from Crystal River and Brevard County. Plasma glyphosate concentrations will be determined for all manatees by LC-MS/MS. Using pathway analysis, we will analyze the transcriptome data to determine the most affected molecular functions. We suspect that multiple contaminant stressors contribute to manatee disease in South Florida.

8. *Diet composition of the African manatee: Spatial and temporal variation within the downstream of Sanaga River watershed (DSRW), Cameroon.* **Aristide Takoukam**¹, Lucy Keith-Diagne², Margaret E. Hunter³, Cathy A. Beck³, Robert K. Bonde³, and Ruth Francis-Floyd¹

¹ Department of Large Animal Clinical Sciences, University of Florida College of Veterinary Medicine

² African Aquatic Conservation Fund

³ Sirenia Project, Wetland and Aquatic Research Center, United States Geological Survey

This study aimed at assessing the diet of the African manatee in the DSRW. The microhistological analysis technique was used to examine plant fragments of 112 free-floating fecal samples from four locations. A total of 36 plant species from 13 families were identified, with 15 species newly reported. The diet was dominated by emergent grasses (96.1%), mostly represented by the family Poaceae (71.1%) and the species *Echinochloa pyramidalis* (53.5%). Both location and season had a significant effect on diet composition. Therefore, food availability may be an important determinant of the critical habitat of the African manatee in the DSRW.

9. *Skin temperature in Antillean manatees.* **Nicola Erdsack**¹ and John Reynolds¹

¹ Mote Marine Laboratory

After presenting skin temperature distribution patterns in Florida manatees last year, we present skin temperatures measured in 6 wild Antillean manatees during health assessments in Belize. Antillean manatees exhibited similar temperature patterns. However, average skin temperature was significantly higher in Antillean manatees than in Florida manatees. Moreover, skin temperatures were significantly higher in manatees captured in Southern Lagoon than in manatees captured west of Placencia. Differences may be due to the smaller body size of Antillean manatees, and differing air and water temperatures. Despite the small sample size these data give valuable insight into manatee heat dissipation and thermoregulation.

10. *Detecting pathogenic bacteria in the manatee microbiome.* **Madison Hall**¹, Graham Worthy¹, Mike Walsh², and Laurie Adler²

¹ University of Central Florida

² Aquatic Animal Health Program, University of Florida College of Veterinary Medicine

Rehabilitated and released manatees that undergo clinical tests may still pose a risk to wild populations by carrying new, resistant bacteria from rehabilitation into the natural environment. We propose a study to describe the manatee oral, nasal, dermatological, genital, and fecal microbiomes in further detail by using DNA metabarcoding methods and then measuring agreement between DNA metabarcoding results and the standard clinical veterinary tests. Results from this proposed study would significantly expand upon previous work by informing marine mammal species research, assessing rehabilitation and release procedures and providing a more complete evaluation of bacterial populations that impact manatee health.

11. *Warm-water habitat use and winter movements of GPS-tagged Florida manatees after relocation of a traditional thermal source in the Indian River Lagoon.* **Charles Deutsch**¹, Margaret Barlas¹, James Reid², and Susan Butler²

¹ Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute

² Sirenia Project, Wetland and Aquatic Research Center, United States Geological Survey

Florida manatees (*Trichechus manatus latirostris*) range along the northern Gulf of Mexico coast from Florida to Louisiana, however little is known about specific manatee use areas and habits west of the Suwannee River. The USGS – Sirenia Project used photo identification techniques and deployed Argos-linked GPS tags to document manatee movement and habitat use patterns along the northern Gulf. Tracking data revealed the use of estuarine and marine seagrass beds that provide ample forage along the Big Bend coast, with abundant freshwater vegetation also accessed within the lower reaches of coastal rivers. Spring migration timing and paths for manatees traveling north from Crystal River varied by individual, but typically included foraging and freshwater resources of coastal creeks and rivers. From late spring through summer, manatees primarily used the coastal estuaries and rivers from the Aucilla River to Apalachicola, with the greatest use concentrated in the Wakulla/St Marks Rivers and Apalachicola Bay. Migrations to warm water refuges were primarily triggered by the onset of early winter cold weather. As part of a USGS study for the Bureau of Ocean Energy Management, these findings on the distribution of resources and patterns of manatee use will be valuable for managing the increasingly large numbers of manatees utilizing the northern extent of their Gulf coast range.



Sirenews – Florida manatee
(Free Web clipart)

12. *Development and challenges of a manatee multigenerational archive for animal and environmental health parameter comparisons over 100 to 200 years.* **Michael Walsh**¹, Margaret Hunter², Jason Ferrante², John Bowden³, Nancy Denslow³, Amanda Moors⁴, Rebecca Pugh⁴, Laurie Adler¹, and Craig Pelton¹

¹ Aquatic Animal Health Program, University of Florida College of Veterinary Medicine

² Sirenia Project, Wetland and Aquatic Research Center, United States Geological Survey

³ Center for Human and Environmental Toxicology, University of Florida

⁴ NIST, Environmental Specimen Bank Group, Hollings Marine Laboratory

In order to evaluate the health of wild individual animals, populations, and their relationship with the environment, organized, intermittent health assessments have been established as a standard method to quantify health parameters of a target species and their ecosystem. Due to the substantial logistics of these health assessments, efforts require an extensive investment of time, resources, and personnel from multiple organizations. They frequently yield high returns by setting baselines for animal and habitat health parameters while enabling monitoring of population health, infectious diseases, contaminants, biotoxins, and environmental changes over time. To better utilize the materials collected, samples including blood, fecal, urine, and tissues, are stored at researching institutions for additional “short-term” diagnostic and research evaluations. This manatee initiative is novel to its species and seeks to establish a long-term 100 year plus archive to enable future investigators to directly compare their research with past findings and provide for future verification of analytical results anticipating the needs of evolving technology and novel diagnostics. Challenges in establishing a well-designed and limited-access archive need to be addressed, including identifying standardized sample collection, processing and archival protocols with identifying funding to ensure a successful biorepository program. A multi-generational archive for manatee samples can then support targeted investigations for the long-term evaluation of the health of manatees and their environment to provide critical information for preservation and future management decisions.

<END OF ABSTRACTS>

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NOTE FROM THE EDITORS: We would like to thank all of those who have contributed articles for *Sirenews*. On occasion, we have taken the liberty to make minor edits in an effort to accommodate our formatting style and provide clarity for our readership. However, we have restrained from making all grammatical edits in an effort to preserve the original intent of the submitting author.



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