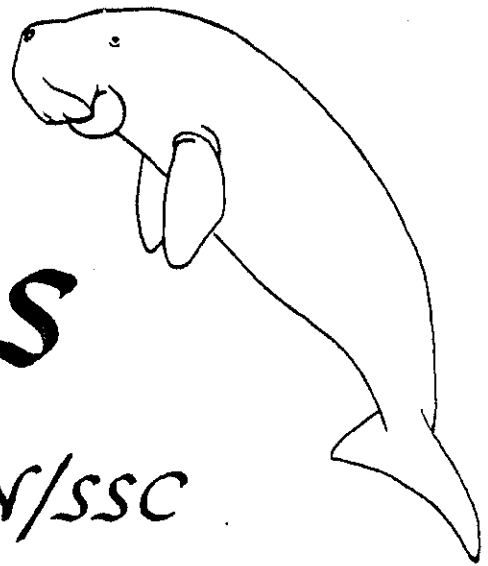


Sirenews



Newsletter of the IUCN/SSC Sirenia Specialist Group

NUMBER 6

OCTOBER 1986

DEVELOPMENT OF DUGONG TELEMETRY GEAR - A PROGRESS REPORT

Several years ago Helene Marsh of James Cook University inquired if personnel of the U.S. Fish and Wildlife Service's Sirenia Research Project could apply the radio-tracking techniques used on manatees in Florida to dugongs in Australia. James Reid and I agreed to develop the belt, tether and transmitter housing for dugongs, based on our experience with manatees (Rathbun, G.B., J.P. Reid, and J.B. Bourassa. 1986. Design and construction of a tethered, floating radio-tag assembly for manatees. Unpubl. MS., U.S. Fish & Wildlife Service, Gainesville, Fla.). Using morphometrics and a cast of the peduncle and fluke region of a dugong, a prototype peduncle belt was designed and built at the Service's Gainesville Research Station in Florida. The VHF transmitter housing used on the manatees was used as a model for an improved version for dugongs. The tether developed for manatees has remained essentially unchanged. In order to test and further develop the new assembly Helene Marsh and I applied for a Marine Technology and Science Grant from the Australian Government, which was approved in late 1985.

The first step in developing the prototype harness was to test it on captive dugongs, which are found only in Japan and Indonesia. The Japanese did not want their animals disturbed, but



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 espèces—Species Survival Commission

Sirenews is edited by Daryl P. Domning, Dept. of Anatomy, Howard University, Washington, D.C. 20059 USA. It is supported by the Species Survival Commission of IUCN, the U.S. Fish and Wildlife Service, and the U.S. Marine Mammal Commission.

the manager of the Jaya Ancol Oceanarium in Jakarta, Mr. Tas'an, agreed to let us work with the two dugongs under his care. With the help of Tas'an, a research proposal to test the attachment on the dugongs in Jakarta was approved by the Indonesian Government in January 1986. Helene Marsh, Anthony Preen from the Meteorology and Environmental Protection Administration of Saudi Arabia, Andrew Smith, a postgraduate student of Marsh's, and I met at the Oceanarium in Jakarta on 11 June 1986. The two captive dugongs were fitted with peduncle belts, tethers, and dummy floating transmitter housings and these were monitored for 16 days, when they were removed. During this time several modifications to the belts were made in order to reduce the possibility of abrading the dugongs' skin.

Additional funding from UNEP has been promised, which will allow us to test the new attachment on free-ranging dugongs. These tests are due to be completed in late 1986 in northern Queensland. - Galen B. Rathbun

[See also news from Florida and Ivory Coast, below. - Ed.]

LOCAL NEWS

AUSTRALIA

Aerial Census of Dugongs. - In 1984 and 1985, dugongs were censused from the air using a strip transect technique at an overall sampling intensity of 9% over a total area of 31,288 sq. km within the northern sections of the Great Barrier Reef Marine Park. Sightings were corrected for perceptual bias (the proportion of animals visible in the transect which are missed by observers) and availability bias (the proportion of animals that are invisible due to water turbidity) using survey-specific correction factors. There were no significant differences between population and density estimates obtained from repeat surveys of the same areas. The resultant population was 8106 ± 1125 dugongs at an overall density of 0.26 ± 0.04 sq. km, a precision of 13.9%.

Dugongs were sighted up to 58 km offshore and in water up to 37 m deep. However, the highest density of animals was seen on coastal seagrass beds at depths of less than five meters. Maps of dugong density and distribution have been developed for this region and will form the basis for the revision of Great Barrier Reef Marine Park Zoning Plans. Due to the expected slow rate of change of the population and the error associated with the population estimate, it is estimated that it will be at least a decade before we can be certain of the status of the dugong in this region. However, I believe that we can be cautiously optimistic about the future. A number of sanctuary areas have been established where the dugongs should be totally protected from man-induced mortality. Legal Aboriginal hunting only occurs at two communities with a combined take of about 40 dugongs per year, and management programs are being developed to keep the harvest within this low level. Less than 50 gill-netters operate in the area and new Fisheries legislation has banned gill-netting from November through January. The area is so remote that habitat damage is likely to be minimal, especially as trawlers are now

prevented from operating in most seagrass beds. - Helene Marsh

BORNEO

During a visit to Sabah, Malaysia, from 28 June through 10 July 1986 I spoke to several people familiar with wildlife conservation in Kota Kinabalu and Sandakan. Fishermen report few, if any, sightings of dugongs, which are considered very rare, or possibly extirpated, along the coast in Sabah. The last animal reported from the Sandakan area was butchered and eaten in 1984. I also spoke to a biologist studying proboscis monkeys in the mangrove forests of Sarawak, Malaysia. Dugongs also are thought to be rare or extirpated in this region of Borneo. Intense fishing and the introduction of nylon fishing nets probably are related to the decline in dugong numbers in northern Borneo.

- Galen B. Rathbun (U.S. Fish & Wildlife Service)

BRAZIL

Manatee Research at INPA. - While Robin Best is working on his doctoral degree at Cambridge, England, manatee research at the Instituto Nacional de Pesquisas da Amazônia in Manaus continues under the interim supervision of Elton Pinto Colares, who reports on recent activities as follows:

The objective of the aquatic mammal project at INPA is to study the distribution, exploitation, and ecology of aquatic mammals in order to better understand their role in the ecosystem and their importance to the human population along the rivers of Amazonia. The project also seeks to study the basic biology, feeding habits, growth, behavior, etc., of aquatic mammals, and on this basis to develop plans for their conservation and rational utilization and techniques for raising them in captivity. To these ends we are carrying out the following investigations on the Amazonian manatee: food preferences; feeding habits; annual variation in aquatic macrophytes and their nutritional constituents; daily food consumption; digestibility of food and passage time through the digestive tract; anatomy of the digestive tract and sites of nutrient absorption; optimum composition of milk formula for development of manatee calves; endocrinology; cytogenetics; and age determination.

New Manatee Legislation. - Robin Best reports that, as a result of new legislation (Portaria No. 011 of Feb. 21, 1986), the Brazilian federal fisheries agency SUDEPE now has authority to protect manatees, small cetaceans, and seals. This should mean that wardens of either IBDF (the federal forestry agency, which has traditionally had jurisdiction over manatees and most other wildlife) or SUDEPE can now protect these animals. Robin had suggested and supported this action, and Sirenews is glad to hear that it has been taken.

New West Indian Manatee Project. - The Environmental Department of IBDF has recently begun a project on the biology of Trichechus manatus in Brazil. This will center around a radio-tracking study, and is based at a field station at Barra de

Mamanguape in Paraiba. The project is headed by Mônica Borobia, a former student of the manatee project in Manaus. Because of the station's remoteness from libraries, she would like very much to receive reprints on marine mammals. Her mailing address is: Mônica Borobia, a/c Dr. Henry Matthews, ESAM, C.P. 137, Mossoró, RN 59.600, Brasil.

FLORIDA

Update on Satellite Telemetry Efforts With Florida Manatees.
- The use of satellites to monitor movements of manatees has generated considerable interest in the international community of sirenian workers. In this report I provide a synopsis of current satellite telemetry trials with West Indian manatees in Florida. My purpose is to keep the community abreast of recent developments and current limitations.

The first experiment to generate interest in satellite telemetry of sirenians was conducted in early 1985 on a manatee released after several years in captivity. The work was primarily the result of efforts by Bruce Mate, Galen Rathbun and Jim Reid, who have provided general descriptions of the experiment elsewhere (*ARGOS Newsletter* 26: 3-7, 1986; *Whalewatcher* 20(2): 8-9, 1986), and are in the process of preparing detailed technical reports. To summarize their work, the manatee (named Beauregard by its keepers) was released on the northwest coast of Florida and tracked through the French ARGOS monitoring system on board polar-orbiting NOAA satellites. The UHF satellite-monitored transmitter (PTT for platform transmitter terminal) was attached by a 2 m tether that allowed it to float at the surface much of the time, avoiding the salinity barrier to signal transmission. The tether was attached to a belt around the manatee's peduncle that was designed to eventually fall off through corrosion of key elements. The tether had a machined weak link to allow the transmitter and tether to pop off if it wedged between objects, allowing the manatee to escape from harm. This tag assembly was developed by Galen and Jim at the Sirenia Project in Gainesville for floating VHF radiotransmitters designed for short-range manual tracking.

Location, water temperature, and activity information were accurately transmitted and received from Beauregard for about five weeks as he moved along the Gulf Coast over distances ranging up to some 75 km. Usually 1-2 locations or more were received per day. Beauregard was located by boat near the end of the projected battery life of about 60 days, and Jim Reid exchanged the PTT with a VHF unit while snorkeling. The PTT was fitted with new batteries, and Jim located Beauregard again using the VHF transmitter and re-attached the PTT. An additional 62 days of successful monitoring followed before the experiment was terminated.

Following the initial success of this experiment, the Florida Department of Natural Resources manatee group, under the direction of Pat Rose, provided funding for additional development of the technique. Bruce Mate and colleagues at Oregon State University, working with Telonics, Inc. of Mesa, Arizona and the Sirenia Project, produced four transmitters in new

housings with an approximate battery life of at least one year. We deployed the transmitters on three manatees in January 1986 at the Orange and Caloosahatchee Rivers in Fort Myers in southwestern Florida. These were wild manatees captured, tagged and released within minutes on site. We also tagged a number of manatees with floating VHF transmitters at the same time (see Lynn Lefebvre's report in Sirenews No. 5, April 1986), and an evaluation of the cost-effectiveness of the two methods will be made at the end of the experiment. As of today (October 3, 1986), one of these manatees is still being tracked by satellite in southwestern Florida, averaging about two locations per day over the past nine months. The transmitter on the second became detached at the pre-designed weak link after 10 weeks when it was pulled off by a fisherman. The third PTT was bitten by an alligator and also popped free at the weak link. These units also averaged about two locations per day, and no serious problems were encountered in the transmission or reception of data.

We recovered these transmitters from the field and have since re-deployed them on manatees frequenting lagoons along Florida's Atlantic Coast. Two were tagged in May 1986. One transmitted data for six days before popping off at the weak link, long enough to record a rapid, direct long-distance northward movement probably related to spring migration. The second transmitter provided information on a similar directed movement but was pulled off at the weak link by a bystander after six weeks. The third and fourth cases on the Atlantic Coast just began with the tagging of two manatees in the Banana River yesterday and today. Acquisition of location information during these Atlantic Coast tracking episodes has been as smooth and productive as the work in Fort Myers.

The most discouraging aspect of the work in Florida is peculiar to this crowded region and unrelated to the telemetry technology: curious people seem to be pulling the tags off. Increased public awareness and tagging of large manatees using a weak link with a higher breaking strength should help reduce the problem. Otherwise the technique seems to be working well in Florida. Can it be applied to other sirenians in other parts of the world? Probably, but researchers should be cognizant of a number of points before seriously considering use of the technique.

1. Cost and availability. The experiments described above are the sum total of what has been accomplished thus far. We are very excited about these accomplishments, but a conservative worker might want to see more results before proceeding, particularly those measuring cost-effectiveness. Short-range manual tracking of VHF units is also not cheap and is labor-intensive. However, the costs of a PTT transmitter and housing and one year of satellite data collection will be at least US\$7,000 per animal. Additional costs of lap computers, telecommunications services, and uplink receivers for ground truthing may also be accrued. Time must be spent in planning duty cycles and other aspects of transmission characteristics before ordering transmitters, which may take weeks or months to manufacture, and administrative arrangements must be made with the receiving system to process and deliver signals.

Investigators will have to build belt and tether systems by hand themselves, with materials ordered from a variety of manufacturers at two to three hundred dollars per assembly. We build our own assemblies following a procedure developed by Galen Rathbun and Jim Reid in a painstaking process extending over several years. We cannot build them for others. However, Rathbun and Reid have been good enough to detail instructions for assembly in a construction manual which should be available soon.

2. Applicability to other species. Adequate numbers of experiments have not been tried with other sirenian species. West Indian manatees have relatively tough hides, and peduncle harnesses cause little or no harm. This may not be the case with all sirenians. The transmitters are not large (2.5 kg) relative to the size of the animals we have tagged, but large individual dugongs or Amazonian manatees may not be as easy to find, capture and tag. The influence of the transmitter size on smaller sirenians has not been determined. West Indian manatees in Florida also are typically found in shallow, relatively calm habitats, favoring frequent reception of signals. Tagged sirenians occupying deep saline waters with rougher surface conditions may not produce as much information. Powell [*Sirenews*, this issue] has had initial success with floating VHF transmitters on two West African manatees tagged in calm waters. A preliminary radiotracking experiment on an Amazonian manatee was described by Montgomery et al. [*Biotropica* 13(2): 81-85, 1981; *Acta Amazonica* 11(2): 247-254, 1981], and Robin Best has done extensive radiotracking of other individuals in a large hydroelectric reservoir. Field trials on dugongs are just getting underway thanks to Galen Rathbun and Helene Marsh [*Sirenews*, this issue], but it is not yet appropriate to extend our conclusions from West Indian manatees to this species.

3. Objectives. The objectives of any research project need to be well thought out and clearly stated. Other techniques may give better or less expensive answers to the problems that need to be solved or the hypotheses that need testing. Satellite telemetry has a glamorous space-age ring to it, but it may not always be an appropriate tool. Objectives should not be defined as an excuse to rush to apply the technology.

4. Timing. Advances will continue to be made rapidly that will affect transmitter package size, software, the kind of information transmitted, ability to localize the animal by hand, cost, and so forth. The number of field trials on different species under different conditions will also increase. It may well be worth waiting to see what improvements are forthcoming.

The above summary is not intended to deter future workers from considering satellite telemetry, but rather to inform readers about its practical aspects and limitations as well as its advantages. The technique is new and encouraging, but it's still developing, and it's still not easy. Entering into the use of satellite telemetry on sirenians will require time, money and dedication. However, such efforts will also precipitate new developments which will continue to improve the technique, and hopefully the chances to better understand and conserve sirenians. - Tom O'Shea

INDIA

Can a Saw-fish (*Pristis* sp.) Kill a Dugong? - On April 15, 1986 a male dugong 2.73 m in length was found floating near Manoli Island in the Gulf of Mannar. The animal was towed to the shore and examined. There were many deep gashing wounds on the ventral side of the dugong. Some of the wounds were as long as 50 cm and 2 cm deep. The flippers were perforated by the injury. The animal had just died, as indicated by the fresh blood in the viscera. The local fishermen say that saw-fish (*Pristis* sp.), which are common in the area, attack dugongs, and similar cases have been seen by them. According to them the saw-fish, which lies buried in the sand, gets provoked when the dugong goes near them browsing the sea-grass. The shadow of the dugong provokes them to attack. The fishermen also seem to be cut by the *Pristis* sp. in these areas. Dr. Francis Day (1878), the well-known author on Indian fishes, also has reported such attacks on fishermen by the saw-fish. Further, two *Echenies naucrates* (sucker-fish) were found attached near the armpit of the dugong.

I would appreciate knowing if any dugongs attacked by saw-fish have been reported by earlier workers. Comments from sirenian workers on these observations are welcome. - R. S. Lal Mohan (Research Centre of CMFRI, West Hill, Calicut 673005, India)

IVORY COAST

Status and Conservation of West African Manatees. - Wildlife Conservation International, in cooperation with the Ministry of Water and Forests of Ivory Coast, are conducting a three-year study to assess the status and distribution of West African manatees (*Trichechus senegalensis*) in Ivory Coast. The aim of the project is to obtain information on the species' feeding habits, reproductive biology, movements and habitat requirements. Information on human-related mortality and competition for resources is being collected to develop a conservation plan for the species.

The geography of Ivory Coast is similar to that of Florida in many respects. There are several large shallow lagoons which are separated from the ocean by barrier islands. The major lagoons communicate or have been connected by canals. Two major rivers, the Bandama and Comoe' Rivers, flow into the sea through the lagoons.

A preliminary aerial survey of areas reported to contain manatees or regions that appeared to have good manatee habitat was conducted in March and April 1986. A total of seven manatees was sighted. One was seen in the mouth of the Bandama River and the rest were seen in the lagoons. Five manatees were sighted in a single, very active group that may have been a mating herd similar to those reported for West Indian manatees. The lagoons were turbid and this may partly account for the low number of manatees seen.

Two manatees have been captured and radiotagged. A male 2.4 m in length was caught in the Bandama River on 21 June and equipped with a radiotag assembly identical to the ones developed

by the U.S. Fish and Wildlife Service for West Indian manatees. Another male manatee, 2.65 m in length, was caught and tagged on 24 July in Ebrie Lagoon.

The first manatee has usually remained within 9 km of the site where he was first caught. In general, he rests in the same area through the day and at night descends the river to feed. It is interesting that he is sometimes found very close to a village where women wash and clean their pots and prepare cassava for cooking. I have been told that manatees will frequent these places to eat discarded cassava. In fact, cassava is often used by locals as a bait to attract and catch manatees. The second manatee, in contrast to the first, has moved considerably since he was caught. The first week he traveled from Ebrie Lagoon through the Asagny Canal and then up the Bandama River, a total distance of about 60 km. The second week he moved 10 km down the river to the area where the first manatee usually rests. He stayed in this region for one week and then again ascended the river approximately 32 km, where he remained for three weeks. He has recently passed by our camp near the mouth of the Bandama River, possibly on his way back to the Ebrie Lagoon.

On 27 July an infant male manatee (1.38 m in length and 43 kg) was caught in a fishing line by local fishermen. He was taken by the fishermen to a government fisheries research laboratory, where he was kept for two weeks. He was later moved to an enclosure at our camp where he can be easily observed and maintained. He has been feeding well on a diet of *Pistia* sp. and a milk formula suggested by Dr. Jesse White (Miami Seaquarium). It is interesting that this young animal, when first caught, had feces containing fibrous plant material.

Poaching of manatees still persists throughout the country and, like everywhere sirenians are found, their meat is relished. Manatees are caught in Ivory Coast using special nets, traps, baited hooks and harpoons. I had first feared that when local fishermen learned about the floating radiotags, they might attempt to harpoon the tagged manatees. However, this has not been the case. Indeed, on several occasions fishermen have told me where to find a tagged manatee even before I had exactly located it with the radio receiver. I have seen fishermen in canoes tending their lines and nets while ignoring the floating transmitter easily visible only a few meters away. Surprisingly, the tagged manatee also rested seemingly undisturbed by the close proximity of the fishermen.

The response by the Government of Ivory Coast to this project has been very good. They have already begun taking preliminary steps to promote manatee conservation which will be based on the results of this study. - James A. Powell (Ivory Coast Manatee Research Project)

SAUDI ARABIA

Dugong Update. - The Meteorology and Environmental Protection Administration's Dugong Replenishment Project has recently completed a quantitative aerial survey of the waters of the United Arab Emirates. Dugongs were found to be common in two areas in the western half of this study area, where extensive

seagrass and sandshoals occur. To the east the area of suitable habitat progressively decreases as mountains approach the coastline near the Straits of Hormuz.

Although dugongs have traditionally been hunted in this area (one archaeological site at Abu Dhabi is noted for its 4000-year-old collection of dugong bones), active hunting has not been conducted for some years now. All the dugongs now sold in the Abu Dhabi fish souk are caught in gill nets set for fish.

Dugongs have also been traditionally hunted in Bahrain, but active hunting here has also been abandoned. The dugongs sold in the Mannama fish market were all accidentally caught in gill nets. Following our discovery of a herd of 600 dugongs between Bahrain and Qatar last February [see Sirenews No. 5], an Emiri decree was issued in Bahrain prohibiting the deliberate killing of any dugong. Hence the sale of as many as one to two dugongs per month has been stopped.

Dugongs are also sold in the Doha markets in Qatar, but at this stage no further information is available. However, by mid-October the waters east of the Qatar peninsula will have been surveyed and fish sellers interviewed.

Following the Qatar survey it is planned to repeat the survey of the waters of Saudi Arabia, Bahrain and Qatar which form the Gulf of Salwa. This area was surveyed during the previous winter, revealing a very localized dugong distribution pattern. Summer qualitative surveys have shown that some of the dugongs which aggregate between Bahrain and Qatar during winter disperse into Saudi waters during the warmer months; however, the extent of this dispersal is as yet unknown. - Tony Preen

MANATEE WORKSHOP IN CANCUN

Plans are developing to hold a workshop on the biology, status, and conservation of the West Indian manatee in conjunction with the upcoming joint meeting of the American Society of Mammalogists (ASM) and the Mexican Mammal Society (Asociacion Mexicana de Mastozoologia, A.C.; AMMAC) The joint meeting is to be held June 28-30 1987 at the Convention Center in Cancun, Quintana Roo, Mexico, three days after the annual ASM meeting in Albuquerque, New Mexico. Mammalian conservation in Latin America will be a special emphasis of the overall meeting. Conservation of manatees in Latin America and the Caribbean will be the focus of the workshop. The workshop will consist of poster sessions and discussion groups. The overall aim will be to bring individuals together from various countries within the species' range to learn of each other's activities, and to become updated on manatee status, research techniques, literature, and conservation efforts. A call for papers will be issued soon by AMMAC, and a mailing list of *Sirenia* workers in the area has been prepared. In order to make sure they are on the list, intending participants from Latin America should send their names and addresses to the local chairman (Daniel Navarro, CIQRO, Apdo. Postal 886, Cancun, Quintana Roo, 77500 Mexico) with a copy to the secretary of AMMAC (Rodrigo A. Medellin, AMMAC, Laboratorio de Mastozoologia, U.N.A.M., Apdo. Postal 70-233, Mexico 04510,

D.F., Mexico). Intending participants from North America should contact the U.S. coordinator (Dr. D. J. Schmidly, Dept. of Wildlife & Fisheries Sciences, Texas A & M University, College Station, Texas 77843, USA). Consult recent and upcoming issues of the Journal of Mammalogy for details on the overall joint meeting. - Tom O'Shea

HAVE YOU ANY EDUCATIONAL MATERIAL ON SIRENIANS?

It has been suggested that the IUCN Sirenia Action Plan, currently under review, be expanded to include conservation and education as well as research options. For this purpose it would be useful to have a list of educational and public awareness material on sirenians that is currently available in different languages and parts of the world. This would include audiovisual materials (films, slides, records, etc.), posters, buttons, stickers, leaflets, pamphlets, and teachers' guides, as well as popular and review articles. Please send to Sirenews examples, copies, or a description (with prices, ordering information, and conditions for reproduction or use where possible) of any such materials that are available in your area. (Hopefully you are already making Sirenews aware of any published articles, popular or technical, that come to your attention!) If the materials cannot be purchased, please let us know of their existence all the same; they may provide examples for others to emulate. UNEP is already preparing a catalogue of such items for marine mammals in general, but it would be worthwhile to develop a more specialized one that could be appended to our Action Plan in order to provide a basis for the development of more specifically appropriate materials for sirenians.

REVIEWS

Judith Delaney, Wendy Hale, and Renee Stone, Manatees: An Educator's Guide to the Natural History, Habitat, Problems, and Conservation of the Order Sirenia. 28-page booklet, 2 leaflets, and 17" x 22" poster. Florida Department of Natural Resources, Tallahassee. (Available on request from the Florida Audubon Society, 1101 Audubon Way, Maitland, Fla. 32751 USA.)

The schoolteacher in search of material for a biology lesson, the student needing information for a class project, the researcher besieged by schoolchildren's requests for "everything you have on manatees" - all can now relax; salvation has come. Florida's Save the Manatee Committee, sponsored by the Florida Audubon Society, has produced an envelope stuffed full of attractively presented, up-to-date information on manatees and their relatives, designed for primary and secondary schools in Florida but marvellously useful wherever teachers, students, and the general public want to know something about seacows. The heart of the package is a booklet filled with information on manatee biology, manatee conservation and regulatory laws in Florida, aquatic ecology, marine mammals in general, and sources

of further information. All this is interspersed with puzzles, suggested activities, and ideas for helping manatee conservation efforts. Four pages are designed to be duplicated for individual students; copy and distribution of all the material are encouraged. As the authors state, the "activities can be adapted to suit the special needs, ages, and abilities of your students and are designed for multidisciplinary study areas."

"While this guide focuses on the West Indian manatee, the importance of interdependencies within the whole ecosystem and the role the manatee plays" are stressed throughout. However, a lot more stress could have been placed on human population growth in Florida as the root cause of the manatee's problems. This is touched on in the suggested activities on pages 19 and 20, which are good as far as they go; but please - let's take off the kid gloves and put the finger on the real issue, even if it is unpopular in certain circles. Why not a graph of Florida's human population growth, for comparison with the graph of manatee mortality? Why not some discussion questions explicitly challenging the belief that increase in our population is a good thing? Come on, teachers, the kids aren't going to get the message if you don't have the courage to tell them!

The booklet is supplemented by a pair of leaflets comprising a concise "manatee fact sheet" of basic natural history data; a list of resource agencies and organizations in Florida concerned with manatees; and two solid pages of references to recent popular and semipopular articles on sirenians, reference books, "books especially for young readers", and available audiovisual aids. Also included is an attractive four-color wall poster by Mary Ruth Sprankel portraying the "Sirenians of the World", with a map of their distribution. The manatee and dugong pictures are quite true-to-life (something never to be taken for granted), and even the one of Steller's sea cow is better than most you will see in the literature.

Throughout, editorial and typographical errors are few, and the facts are accurate. And there's more: "Also available as part of the overall package is a 23 minute video tape program, 'Silent Sirens: Manatees in Peril,' available in either 1/2" or 3/4" format from your district media centers. Written permission must be obtained from the Florida Audubon Society before duplicating this video cassette in part or in its entirety."

I am impressed. Together with the authors, I hope "that the use of this guide will result in informed decisions, responsible behavior, and constructive actions towards the protection of the manatee and its habitat in Florida." It should also serve as a model to be emulated by public awareness programs in other countries. If it doesn't, it won't be the fault of those who created this excellent and unique resource. - DPD

Mary Unterbrink, Manatees: Gentle Giants in Peril. St. Petersburg (Fla.), Great Outdoors Publ. Co., 1984: 1-47. Illus. (Softbound; ISBN 0-8200-9914-7. Order from Great Outdoors Publishing Co., 4747 28th St. North, St. Petersburg, Fla. 33714 USA. Price

US\$2.95 + \$1.00 postage & handling [\$2.00 for orders over \$10.00]; Florida residents add 5% sales tax.)

This little book gives a thorough and readable introduction to the problems faced by the manatee in Florida. Suitable for students in grade school or above, or anyone interested in manatees, it covers the last two decades of research and conservation efforts in an anecdotal style, well seasoned with up-to-date facts on the manatee's life history. Several active manatee researchers contributed information and helped ensure the book's accuracy. The illustrative sketches of manatees by Robert G. Cannon are reasonably true to life, though the drawing of a dugong reflects the fact that most wildlife artists still have little grasp of sirenian anatomy, especially facial anatomy.

Emphasis is properly placed on the various threats posed by man's activities, and the book gives the Manatee Hotline telephone number and the locations of the various manatee sanctuaries in Florida. But it could usefully have included more explicit instructions on what boaters, divers, and would-be manatee watchers should and should not do, in accordance with present knowledge and applicable laws. For example, the various degrees of limitation on boat speeds in and near manatee sanctuaries should have been described, and the restrictions on contact of manatees by divers should have been more clearly explained. Readers would also have welcomed advice on when and where to see wild manatees without disturbing them. It is important for the public to have some background knowledge of what manatees are and how they live, but it is equally important to give them detailed guidance on minimizing the problems we humans create.

The ultimate and most insidious source of these problems is human population growth, yet nowhere does the author hint that Florida's explosive growth in people, boats, marinas, and general busyness is the real issue. The lesson to be driven home is that most wildlife management is really people management. Despite the book's stress on the manatee's present peril, that lesson could have been made still clearer, and this book accurately reflects how far public comprehension of it has yet to go.

Although this booklet does not completely meet the need for a reliable popular work on manatees, it makes a worthwhile contribution, and I hope it will be used by schools and conservation groups as the convenient resource that it is. An improved and expanded edition would go even further toward filling the need, and growing market, for nontechnical sirenian literature. - DPD

ABSTRACTS

Lung Structure and Mechanics of the West Indian Manatee (*Trichechus manatus*) (Michael R. Bergey). - Marine mammals are capable of exchanging lung air very rapidly compared with similarly sized terrestrial mammals. This capability has been attributed to the great stiffness of marine mammal airway walls, which reduces flow-induced restriction of the lumen during rapid

exhalations. In this study, manatee lung morphology and flow mechanics were investigated using specimens harvested from dead, stranded animals. Airway dimensions were measured from vinyl acetate lung casts, direct dissection, and histological sections. Static volume-pressure relationships were recorded by measuring lung volume changes while pressure on the lung surface was varied to simulate chest wall movements. Maximum expiratory flow-volume data were obtained by venting inflated lungs rapidly into an evacuated chamber while recording instantaneous lung volume changes.

Manatee lung airways differed greatly from the terrestrial pattern by possessing cartilage plaques at the level of the respiratory bronchioles, and unbroken rings within the walls of all larger airways. The excised lungs changed volume greatly with small changes in inflation pressure, and demonstrated very small residual volumes when inflation pressure was reduced to zero. Maximum expiratory flow rates for manatees followed the pattern of other marine mammals, in which flow rates at all lung volumes exceeded predictions based on terrestrial mammals. This is consistent with the observed high degree of airway reinforcement in manatee lung airways, which may stabilize airway wall dimensions, preventing flow-induced restriction. [Abstract of a master's thesis in Biological Oceanography submitted to the University of Miami, Florida, in June 1986 and supervised by D.K. Odell.]

The following abstracts are of papers presented at the Annual Meeting of the American Society of Mammalogists, Madison, Wisconsin, June 15-19, 1986.

NUCLEI OF BEHAVIORAL RELEVANCE IN BRAINS OF MANATEES TRICHECHUS MANATUS

John Irwin Johnson, Wally Welker, and Roger L. Reep, Anatomy Department, Michigan State University, East Lansing, Michigan, 48824; Department of Neurophysiology, University of Wisconsin, Madison, Wisconsin, 53706; Department of Physiological Sciences, University of Florida, Gainesville, Florida, 32610

We report here observations from stained serial sections series of brains of Florida manatees Trichechus manatus. Alternate sections, stained for cell bodies and for myelinated fibers, in transverse and horizontal planes, reveal several behaviorally relevant features: 1) large, lobulated somatic sensory nuclei processing information from the face (trigeminal nuclei) and forelimb (cuneate nucleus); 2) massive auditory nuclei, particularly the cochlear nuclei, nuclei of the lateral lemniscus, and medial geniculate nucleus; 3) underdeveloped visual regions of the lateral geniculate nucleus and superior colliculus; 4) scanty motor nuclei innervating eye muscles (oculomotor, trochlear and abducens nuclei). These features indicate a minimal behavioral role of vision; and a perceptuo-motor emphasis on audition, and upon somato-sensation from perioral structures (expected from a browsing animal with large mobile lips and vibrissae) and from the forelimb (not expected). These data confirm the deductions of Verhaart (1972, *Psychiatria Neurol. Neurochir.* [Amsterdam] 75:271), who had only one section series, incompletely stained for myelin. (Supported by NSF grant BRS 8503687.)

GENIC VARIABILITY IN THE FLORIDA MANATEE (TRICHECHUS MANATUS)

Leroy R. McClenaghan and Thomas J. O'Shea, Department of Biology, San Diego State University, San Diego, California 92182 and Sirenia Project, U.S. Fish and Wildlife Service, Gainesville, Florida 32601

Samples of liver, kidney and muscle tissue were obtained from 59 manatees (Trichechus manatus) as part of a salvage program conducted by the U.S. Fish and Wildlife Service's Sirenia Project. Animals from 20 counties in Florida were included in this sample. Allozyme phenotypes at 24 presumptive genetic loci were determined for each individual using horizontal starch-gel electrophoresis. Small sample sizes at individual localities made it necessary to pool animals into five regional groups.

Averages for the proportion of polymorphic loci and mean heterozygosity across regions were 0.300 (range 0.417-0.167) and 0.050 (range 0.063-0.028), respectively. Manatees appear to represent the rather unusual case of an endangered species not displaying reduced genetic variability. These relatively high levels of genic variability also do not support the hypothesis that body size and heterozygosity in mammals are inversely related. A hierarchical analysis of gene diversity demonstrated that among-region diversity accounted for only 4% of the total genic diversity observed. Low genetic distances among regions further indicated that genetic differentiation has been slight. These results suggest that gene flow among manatee populations may be considerable. An analysis of F -statistics revealed a general tendency towards heterozygote deficiencies, which was attributed to the pooling of animals from different breeding units.

RECENT LITERATURE

- Anderson, P.K. 1986. Dugongs of Shark Bay, Australia -- seasonal migration, water temperature, and forage. Natl. Geographic Research, Autumn 1986.
- Bayliss, P. 1986. Factors affecting aerial surveys of marine fauna, and their relationship to a census of dugongs in the coastal waters of the Northern Territory [Australia]. Aust. Wildl. Res. 13(1): 27-38.
- Burn, D.M. 1986. The digestive strategy and efficiency of the West Indian manatee, *Trichechus manatus*. Comp. Biochem. Physiol. 85A, Comp. Physiol., No. 1: 139-142.
- Caldwell, D.K., and M.C. Caldwell. 1985. Manatees - *Trichechus manatus* Linnaeus, 1758; *Trichechus senegalensis* Link, 1795 and *Trichechus inunguis* (Natterer, 1883). In: S.H. Ridgway and R.J. Harrison, eds., Handbook of Marine Mammals. Vol. 3: The Sirenians and Baleen Whales. Academic Press, London: 33-66.
- Domning, D.P., and L.C. Hayek. 1986. Interspecific and intraspecific morphological variation in manatees (Sirenia: *Trichechus*). Marine Mammal Science 2(2): 87-144.
- Domning, D.P., C.E. Ray, and M.C. McKenna. 1986. Two new Oligocene desmostylians and a discussion of tethytherian systematics. Smithsonian Contrib. Paleobiol. 59: iii + 56.
- Frailey, C.D. 1986. Late Miocene and Holocene mammals, exclusive of the Notoungulata, of the Rio Acre region, western Amazonia [Brazil]. Nat. Hist. Mus. Los Angeles County Contrib. Sci. No. 374: 1-46. [Fossil Trichechidae]
- Gallivan, G.J., J.W. Kanwisher, and R.C. Best. 1986. Heart rates and gas exchange in the Amazonian manatee (*Trichechus inunguis*) in relation to diving. J. Comp. Physiol. B. Biochem. Syst. Environ. Physiol. 156(3): 415-424.
- Halstead, L.B. 1985. On the posture of desmostylians: a discussion of Inuzuka's "herpetiform mammals". Mem. Fac. Sci. Kyoto Univ., Ser. Biol. 10(2): 137-144.
- Hanitsch, R. 1908. Guide to the Zoological Collections of the Raffles Museum, Singapore. Singapore, Straits Times Press, Ltd.: 112 pp. [P. 13 mentions a captive dugong exhibited at the Museum for a few weeks in 1895. Bob Brownell thinks this was the earliest instance of a dugong being kept in captivity. Can anybody beat that record?]
- Hudson, B.E.T. 1986. Dugongs and People. Oceanus 29(2): 100-106.
- Hudson, B.E.T. 1986. The hunting of dugong at Daru, Papua New Guinea, during 1978-1982: community management and education

- initiatives. In: A.K. Haines, G.C. Williams, and D. Coates, eds., Torres Strait Fisheries Seminar, Port Moresby, 11-14 Feb. 1985. Canberra, AGPS: 77-94.
- Inuzuka, N. 1985. Are "herpetiform mammals" really impossible? A reply to Halstead's discussion. Mem. Fac. Sci. Kyoto Univ., Ser. Biol. 10(2): 145-150.
- Kamiya, T., P. Pirlot, and Y. Hasegawa. 1985. Comparative brain morphology of miocene and recent sirenians. Fortschritte der Zool. 30: 541-544. [Comparison of a brain of Dugong with endocasts of the desmostylian *Paleoparadoxia*.]
- Kozawa, Y. 1984. The development and the evolution of mammalian enamel structure. In: R.W. Fearnhead and S. Suga, eds., Tooth Enamel IV. Amsterdam, Elsevier: 437-441. [Sirenian and desmostylian enamel structure.]
- Marsh, H. 1986. 'Dugong is Number One Tucker.' Oceanus 29(2): 102.
- Marsh, H. 1986. The status of the dugong in Torres Strait. In: A.K. Haines, G.C. Williams, and D. Coates, eds., Torres Strait Fisheries Seminar, Port Moresby, 11-14 Feb. 1985. Canberra, AGPS: 53-76.
- Marsh, H., T.J. O'Shea, and R.C. Best. 1986. Research on sirenians. Ambio 15(3): 177-180.
- Nishiwaki, M., and H. Marsh. 1985. Dugong, *Dugong dugon* (Müller, 1776). In: S.H. Ridgway and R.J. Harrison, eds., Handbook of Marine Mammals. Vol. 3: The Sirenians and Baleen Whales. Academic Press, London: 1-31.
- Ono, K., and T. Uyeno. 1985. Tertiary vertebrates from Sado Island, Niigata Prefecture, central Japan. Mem. Natl. Sci. Mus. (Tokyo) No. 18: 65-72. [In Japanese; English summary. *Paleoparadoxia*.]
- Pervaiz, S., and K. Brew. 1986. Purification and characterization of the major whey proteins from the milks of the bottlenose dolphin (*Tursiops truncatus*), and Florida manatee (*Trichechus manatus latirostris*) and the beagle (*Canis familiaris*). Arch. Biochem. Biophys. 246(2): 846-854.
- Pervesler, P., and F. Steininger. 1986. Die Seekuh *Metaxytherium krahuletzki*: Skelett eines 22 Millionen Jahre alten Meeressäugtieres aus Kühnring. Katalogreihe des Krahuletz-Museums [Eggenburg, Austria] Nr. 7: 12 pp. [Museum pamphlet on the excavation and exhibition of an Early Miocene sirenian skeleton.]
- Rathbun, G.B., and P.B. Best. 1986. [Review of] S.H. Ridgway and R.J. Harrison, eds., Handbook of Marine Mammals. Vol. 3: The Sirenians and Baleen Whales. Mar. Mamm. Sci. 2(3): 236-239.

[Rathbun reviews Nishiwaki & Marsh, 1985, and Caldwell & Caldwell, 1985, cited above.]

Rowlatt, U., and H. Marsh. 1985. The heart of the dugong (*Dugong dugon*) and the West Indian manatee (*Trichechus manatus*) (*Sirenia*). *J. Morphol.* 186(1): 95-106.

Shoshani, J. 1986. Mammalian phylogeny: comparison of morphological and molecular results. *Molec. Biol. & Evol.* 3(3): 222-242. [Relationships of *Sirenia* and *Desmostylia* within "Paenungulata".]

Takahashi, S., D. Domning, and T. Saito. 1986. *Dusisiren dewana*, n. sp. (Mammalia: *Sirenia*), a new ancestor of Steller's sea cow from the Upper Miocene of Yamagata Prefecture, northeastern Japan. *Trans. Proc. Palaeont. Soc. Japan, N.S.*, No. 141: 296-321.

Wargasasmita, S. 1985. Manatee and other herbivorous animals. *Proc. Ecology & Management of Aquatic Vegetation in the Tropics*, Univ. of Indonesia, Jakarta, March 26-29, 1985: pp. WVI/19-9.

SIRENIAN CROSSWORD PUZZLE

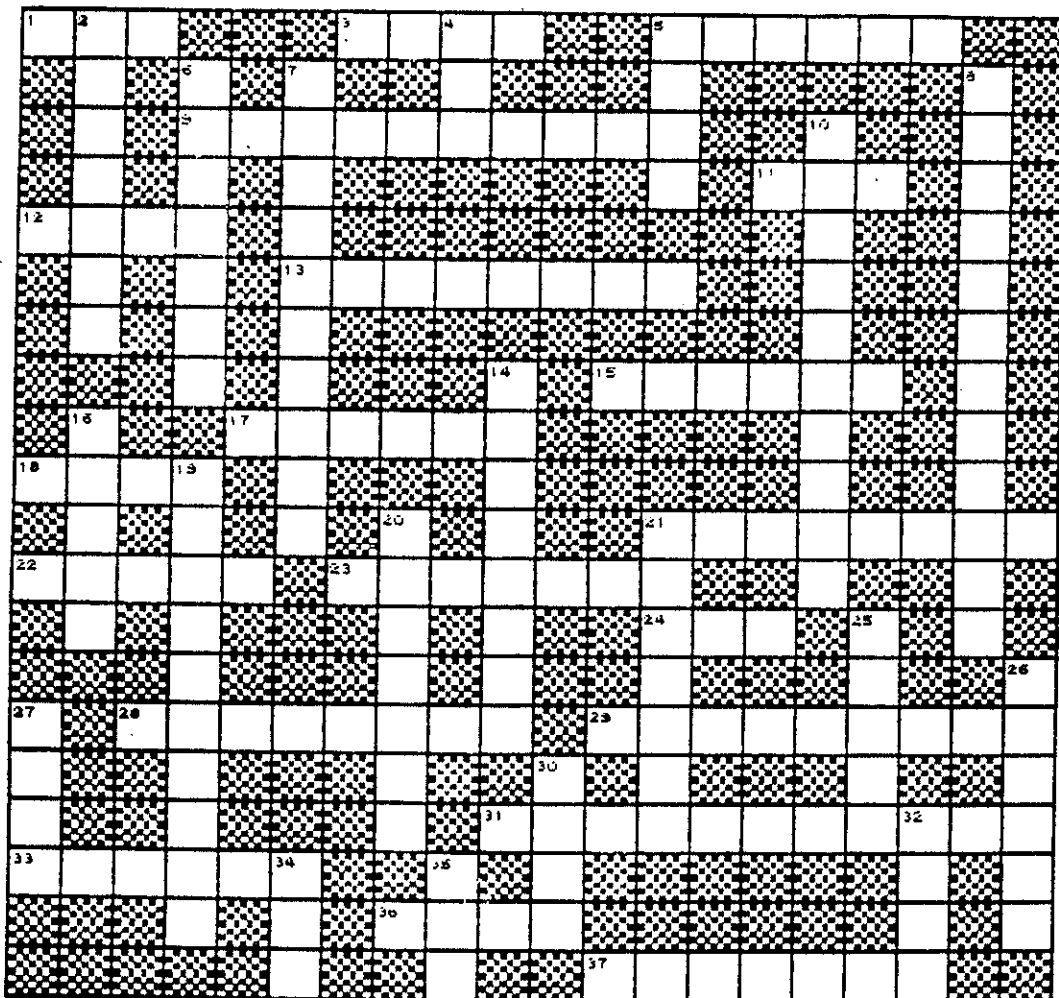
No newspaper is complete without one! Test your knowledge of sirenian trivia. Solution in the next issue. (*Sirenews* thanks Victor Ramey of the Aquatic Weed Program, University of Florida, Gainesville, and the program's computer for assembling these words into a puzzle for us.)

ACROSS CLUES

1. U.S. watchdog agency for aquatic mammals (abbrev.)
3. James ___ University
5. Tropical aquatic plant
9. Saudis' "bride of the sea"
11. Sirenian ballast
12. Captive dugong facility in Japan
13. Nearest living relative of manatees and dugongs
15. Kiwai quarry
17. Woman's breast (Carib)
18. Mammalogist who distinguished subspecies of *T. manatus*
21. Favorite food in Florida
22. Tracking aid
23. Herbivorous _____, alias *Sirenia*
24. ___ Data Book
28. Noted husband-wife team of sirenologists
29. Site of recent manatee release
31. Sirenian lab locale
33. Ludwig _____, noted sirenian scholar
36. Amazonian research center (abbrev.)
37. Obsolete generic name of manatee

DOWN CLUES

2. *T. inunguis* like to graze in floating
4. Spreading problem for marine life
5. South American country having both fossil dugongs and living manatees
6. The most primitive sirenian was found here
7. Amazonian manatee, late of Steinhart Aquarium
8. Name of extinct "water calf"
10. Otto , late authority on Old World fossil sirenians
14. First to binominally name a sirenian
16. Republic where dugongs are in danger
19. Sirenian name meaning "hairy"
20. Suspected of having a sirenian origin
21. Traditional capture tool
25. Scene of Dr. Jesse White's manatee-breeding successes
26. Sven , wrote second-best eyewitness account of Hydrodamalis
27. Young manatee
30. Ancol, Indonesian seaquarium
32. Well developed in sirenians
34. Florida agency responsible for manatees (abbrev.)
35. Nation north of Queensland (abbrev.)



CHANGES OF ADDRESS

Dr. K. Radway Allen, 20/8 Waratah Street, Cronulla, N.S.W. 2230,
Australia

Barbara J. Bernier, Miami Seaquarium, 4400 Rickenbacker Cswy.,
Key Biscayne, Fla. 33149

Dr. R. S. Lal Mohan, Research Centre of CMFRI, West Hill,
Calicut 673005, India

Dr. Thomas E. Lovejoy, World Wildlife Fund, 1255 23rd St. NW,
Washington, D.C. 20037

James A. Powell, Ivory Coast Manatee Research Project, 04 B.P.
1240, Abidjan 04, Côte d'Ivoire, West Africa

A NOTE TO OUR READERS

Please notify us if your address changes or if the address we are using is incorrect. If you no longer wish to receive Sirenews, please send us a postcard to let us know so that we can save on costs of printing and mailing. On the other hand, if you find Sirenews useful in your work, we'd also like to hear from you - in the form of reports of your sirenian-related activities, and copies of any publications on sirenians (popular or technical) that you produce. Several of you are listed in our file as heads of sirenian research projects in your respective countries, but in many cases we have received no news of your projects, whether they are enjoying success or otherwise. The purpose of Sirenews is to foster communication among sirenian workers everywhere, and just as you have benefitted from hearing news of other projects in these pages, others will benefit from hearing about what you are doing. So please write!

>>> COPY DEADLINE FOR NEXT ISSUE: APRIL 1, 1987 <<<