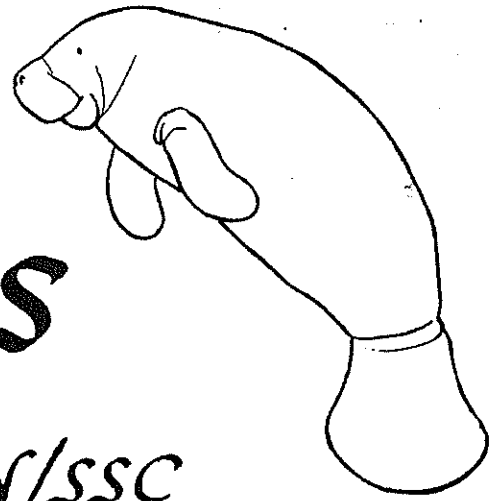


Sirenews



Newsletter of the IUCN/SSC Sirenia Specialist Group

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EDITORIAL: FLORIDA MANATEE FISHERY ACHIEVES NEW RECORD TAKE

The annual harvest of manatees in Florida last year scored an all-time high total of animals taken, according to figures compiled by the state's Department of Environmental Protection. The 1994 summary of manatee mortality lists a total of 70 deaths attributable to human-related causes (watercraft collisions, floodgates/canal locks, and other), the largest number since record-keeping began in 1974. The number of watercraft-related deaths (49) was the third highest on record (after 53 in 1991 and 50 in 1989), and the total number of deaths (192) was second only to the maximum of 206 reached in 1990. These numbers represent an annual mortality of about 10% of the Florida manatee population, based on the current population estimate of around 2,000. (Population models indicate that, even given a low rate of mortality, a sirenian population is capable of increasing at a rate of only about 5-6% per year.)

After showing rapid growth in the late 1980's that peaked in 1991, the harvest went into a two-year slump that many have attributed to poor economic conditions which



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

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discouraged growth in boating. The 1994 statistics indicate that recovery from this slump is now complete, and with human population growth and boat registrations in Florida surging to new highs, it is safe to anticipate the most successful manatee harvest ever in '95.

Despite this continued strong growth in the manatee fishery, however, there is cause for concern over its future in the longer run. This is because of its unusual nature in comparison with other forms of resource use. Typical commercial harvests of living resources obey the ecological laws of predator-prey relationships, because the harvesters' direct nutritional or economic dependence on the harvest creates a negative feedback loop. If the prey are overexploited, the yield diminishes and eventually forces a corresponding diminution of the harvesting effort: the predators either die, go out of business, or start exploiting other resources. This is also true of purely recreational fisheries, since the fishing effort is at least partly a function of the take. The Florida manatee fishery, in contrast, is exempt from this kind of natural regulation, because it constitutes an incidental take that mostly occurs in the absence of any intent or even consciousness on the part of those causing the mortality. Moreover, the carcasses of the harvested animals are not put to any commercial or even recreational use whose loss might be felt. Therefore, not even total extinction of the manatee stock would cause the harvesting effort (e.g., power boating) to diminish.

This lack of natural regulation, then, predicts that the manatee harvest will eventually collapse, owing to practical extinction of the manatee stock. (Indeed, the Potential Biological Removal [PBR] level calculated for this stock by the U.S. Fish and Wildlife Service is already zero individuals per year.) The basic problem we must acknowledge is that the manatee-fishing fleet is already heavily overcapitalized, with too much investment in expensive and overly-efficient fishing gear (hulls and high-powered engines). In the absence of natural feedback to control the accelerating growth of this already too large and efficient fleet, artificial regulation by government (e.g., limits on boat speeds and numbers of launching ramps) is an unfortunate necessity if we are to get the manatee PBR level back up where it belongs and enjoy a healthy harvest of manatees into the next century.

An ominous aspect of this situation, however, is the fact that excess fishing capacity inevitably generates political pressures to increase fishery quotas - in this case, upward from the present PBR of zero. Therefore, without reduction in the human population whose growth is ultimately driving the expansion of this and every other fishing fleet, there is little hope of rebuilding the manatee stock to a safely exploitable level.

One cause for optimism, on the other hand, is the heavy involvement of the Florida state government in manatee conservation. This contrasts with the situation in (for example) Hawaii, where the Hawaiian monk seal recovery effort has been almost entirely the work of federal agencies. When the federal budget is tight, as it has been for years, there is no effective state program with an independent mandate and funding source to take up the slack. The result of this essentially single-source funding base is that the monk seal program has been chronically underfunded and essential recovery tasks have been left undone, to the extent that the Hawaiian monk seal is now seriously in danger of being the world's first managed species of marine mammal to face biological extinction. Florida, in contrast, was willing and able to shoulder an increasing share of the manatee program as the federal involvement diminished over the past decade. As a result, the manatee's status (despite continuing cause for concern) is much less precarious than the monk seal's.

It is, in principle, a healthier and more stable situation when the people of a state claim ownership of, and accept the responsibility for, a local conservation program, rather than leaving Washington (read: the taxpayers of all the other states) to carry the entire burden. It is to be hoped that the Florida state government will continue to recognize the historic importance of its role and responsibility for protecting the manatee in U.S. waters. Much has already been done to fulfill this responsibility, but the greatest and most urgent challenge still lies ahead: to rein in the reckless growth and activity of our own species. - DPD

FUNDS AVAILABLE FOR MANATEE RESEARCH

Save the Manatee Club (SMC) is interested in research projects involving the West Indian manatee in the wild. SMC is specifically interested in projects that are prioritized in the Florida Manatee Recovery Plan and are therefore considered important for the recovery of the Florida manatee. The deadline for receipt of proposals for funding in 1996 is 15 September 1995. Interested individuals should submit a letter of inquiry (no more than two pages) stating explicitly how the proposed research project relates to the goals of the Florida Manatee Recovery Plan and an estimate of cost. (Note: SMC does not pay overhead or similar charges.) The average cost of research projects funded in recent years is approximately \$6000 in the U.S. and about \$1550 out of country. Research proposals involving unforeseen, critical events may be submitted any time. Investigators should determine whether an Endangered Species Permit is required for the proposed work. Contact Patti Thompson, Save the Manatee Club, 500 N. Maitland Ave., Suite 210, Maitland, FL 32751 for further information and instructions for submitting full proposals. Phone 1-800-432-5646.

SUMMER SCHOOL ON ZOO ANIMAL BEHAVIOR AND WELFARE

Edinburgh Zoo, in conjunction with the University of Edinburgh, is offering a two-week summer school from 17 to 28 July 1995 on Zoo Animal Behaviour and Welfare. It is designed for all those involved in management and husbandry of captive animal populations (zoos, safari parks, rear-and-release schemes, etc.), and will update participants on the latest scientific theory and its practical implementation. Edinburgh Zoo's research has resulted in changes in enclosure design and marked reduction in stereotyped behavior and general boredom. The tuition cost is £750 (add-on accommodation package, £140); registration deadline is 31 May 1995. For information, contact Hamish Macandrew, UnivEd Technologies Ltd., Abden House, 1 Marchhall Crescent, Edinburgh EH16 5HP, UK; tel.: 0131-650-3475; fax: 0131-650-3474.

SIRENEWS AND OTHER MANATEE INFORMATION ON THE INTERNET

The Florida Department of Environmental Protection (DEP) now makes several sources of manatee-related information available on the Internet. This includes the contents of brochures on basic manatee biology, protective measures, and safe boating practices in manatee areas. Manatee mortality statistics will also be posted in the future. You can reach this service at the following address: www.dep.state.fl.us (this provides access to DEP's Internet node; the manatee information can then be obtained by choosing the option "Protected Species Management").

Beginning with this issue, *Sirenews* will also be accessible via this service. This may not have happened by the time you receive this issue, but it is in the works for the near future.

READERS PLEASE NOTE: In the event that you find this new way of receiving *Sirenews* sufficient for your needs and you no longer wish to receive the hard-copy version, please notify me of this by fax or regular mail (NOT via e-mail) so that our printing and mailing costs can be kept down. Thanks! - DPD

ABSTRACTS OF PUBLISHED PAPERS IN *SIRENEWS*?

A reader has inquired whether it would be possible for *Sirenews* to print abstracts from published papers in addition to those from unpublished presentations and theses. I do not have the time to do the necessary typing, which would be extremely burdensome (and take up an inordinate amount of space) if I attempted to include all the new papers cited in each issue. However, if authors submit abstracts of their new papers on diskette, I am willing to include

them on a space-available basis. Indeed, I would appreciate it if all submissions were made on diskette, preferably in WordStar or ASCII IBM-compatible format. I'll even return your diskettes! - DPD

LOCAL NEWS

BRAZIL

Preliminary Studies of Manatee (*Trichechus manatus*) Distribution and Status and Conservation Efforts on the Northern Coast of Brazil. - Continuing the work of the "Igarakuê" mobile unit of IBAMA's National Center for Conservation and Management of Sirenians (Centro Peixe-Boi), preliminary studies have been carried out on manatee distribution and status on the northern coast of Brazil.

The study area was approximately 2600 km of coastline, comprising the states of Maranhão, Pará, and Amapá, including also Marajó Island and the mouths of the Amazon River. Between 20 March and 11 September 1992, researchers conducted 136 interviews at 74 localities along the coast of Maranhão, which was divided into five regions: (I) the mouth of the Paraíba River; (II) "Lençóis Maranhenses"; (III) Tubarão Bay; (IV) "Golfão Maranhense"; and (V) "Reentrâncias Maranhenses".

Manatees were found to occur in regions III, IV, and V, with region III the most important. They are absent from large areas. The total population of the Maranhão coast appears to be little more than 100 animals, occupying areas of mangroves and "paturá" (*Spartina* sp.). Harpoon hunting occurs rarely; fishing nets seem to be the main way of capturing manatees in the region.

Between June and August 1993, the Pará coast, Marajó Island, the Amazon mouths and the Amapá coast were surveyed. In Pará, 85 interviews were done and 55 localities visited; in Amapá, 44 interviews and 29 localities. The presence of manatees was recorded in the Gurupi River estuary (the boundary between Pará and Maranhão). They have disappeared from almost the entire Pará coast, but manatees of unknown species (*T. manatus* or *T. inunguis*) are present near the mouth of Marajó Bay. In the inner portion of the bay, on the mainland as far as Belém, we found evidence only of *T. inunguis*, but in the part close to Marajó Island (Soure, Pes-

queiro) we found indications of the occurrence of both species. In the entire area of the Pará River surrounding the island as far as Macapá, as well as on the coasts of the island and the adjacent archipelago, in the Amazon mouths, and in the area of Lake Piratuba (Amapá), we found evidence of the continuous occurrence of *T. inunguis*. Along the Amapá coast from Marajó Island to the Oiapoque River (the boundary between Brazil and French Guiana), the species present is *T. manatus*.

Many harpoon hunters are still actively killing both species. In Amapá they use an interesting method employing a "mutá", a platform on which the hunter waits with his harpoon when the tide rises and the manatees come to feed on the surrounding submerged vegetation.

Through this work the Centro Peixe-Boi has surveyed the range of *T. manatus* along the entire coast of Brazil - a four-year study in ten states, involving 862 interviews and visits to 357 localities. In each locality conservation efforts were developed with the community, through dissemination of information and ongoing participation of the population. - Régis Pinto de Lima (Centro Peixe-Boi, IBAMA, Paripueira, Alagoas)

First Reintroduction of Manatees into the Wild in Northeastern Brazil. - On 10 October 1994, two 3-year-old manatees (*Trichechus m. manatus*), rescued as orphaned calves in 1991 and kept in captivity since then, were transported from the facilities of IBAMA's National Center for Conservation and Management of Sirenians (Itamaraca Island) to Paripueira Beach in Alagoas State, where a circular wooden pen 15 m in diameter was constructed to enclose the animals, providing for gradual readaptation to the natural environment and also for behavioral studies.

The animals, Astro (male) and Lua (female), traveled to Paripueira aboard a truck in a fiberglass tank half filled with water and with its bottom covered with

polyurethane-sponge cushioning. After a 210-mile trip lasting more than 10 hours, they were placed, one at a time, in a stretcher to be moved to an inflatable boat that took them to the pen, approximately 800 m from the beach.

Immediately after the transport, Astro and Lua showed the same pattern of behavior that they used to have in captivity, eating, playing, and resting. During the very first hours they were observed eating algae (*Ulva* sp.) and seagrass (*Halodule* sp.) that grew inside the pen.

Their diet gradually came to include a higher percentage of seagrass and algae collected in the vicinity of the pen. They always welcomed the seagrass (having been fed *Halodule* in captivity), but accepted only a few species of algae. Their feces were collected for future analysis.

Astro and Lua showed very dependent behavior and extensive interactions, even nursing on each other frequently. A bioacoustic study was done to correlate their behavior and vocalizations.

During their first week in the pen, they received a visit from a group of three wild manatees, one adult, one young, and one calf, which remained around the pen for over two hours and then left. No other wild manatees were reported close to the pen.

After 70 days, both animals were judged ready for release. In December they were marked with PTT/VHF transmitters in a cooperative effort between the technicians of the Centro Peixe-Boi and James Reid of the U.S. National Biological Service's Sirenia Project. The animals were then measured, in order to verify any loss of weight after release.

On 15 December, after a short period of training, both animals were accompanied by a diver to the area outside the pen. This procedure was continued for five days, each time going further away but always returning to the pen, until the release day, when the gate was opened and the animals went out by themselves.

Prior to the release, efforts were made to inform all coastal communities of the important role they would play in the release, reporting any sightings of the marked animals or the transmitters. This was done through informal conversations, distribution of posters, TV, and radio, and as a result many

calls were received from all along the coast reporting sightings of Astro, Lua, and wild manatees.

Astro and Lua have been radio-tracked since their release with approximately 10 hours of observation every day. In the first weeks they gradually expanded their range north and south, always using the pen as a reference point. Both animals have lost their transmitters at least twice, but were always retagged. They have now been observed in areas used by wild manatees. They have not lost any considerable amount of weight, and are always observed in shallow waters, feeding, playing, traveling, and resting.

Also worth noting is another first: the creation of the Paripueira Municipal Marine Park, the first marine park of its kind in Latin America, which hopefully will help raise the environmental consciousness of local communities as well as provide additional protection to the manatees' habitat in Alagoas. - Régis Pinto de Lima (Centro Peixe-Boi, IBAMA, Paripueira, Alagoas) (Mario Antonio de Mello, Municipal Secretary for the Environment, Paripueira, also contributed to this report.)

INDONESIA

Indonesia-Netherlands Dugong Research Project Makes Conservation Recommendations. - The joint research project being carried out by Pattimura University (Indonesia) and Leiden University (The Netherlands) considers the dugong a flagship species for coastal conservation in Indonesia. There and throughout coastal Asia, habitats are threatened by unsustainable fishing (e.g., with dynamite or cyanide) and land-based activities causing erosion and sedimentation in seagrass beds. Our observations are based on a small area and thus should be interpreted with care, but since the situation in the Lease islands is representative of many tropical small-island ecosystems outside Australia, our results should be of interest to those working in similar ecosystems.

Since 1990 we have studied seagrass dynamics, the impact of dugong feeding, and dugong movements and behavior in Haruku Strait, between Ambon and Haruku. Aerial surveys (1990-91) indicated a minimum population of 22-37 dugongs. Satellite-

tracking of a subadult male showed that these animals interact with a larger population around Ceram Island to the north.

The available seagrass meadows are confined to a coastal shelf no more than 500 m wide, and all are situated in front of coastal villages. Most of the dugongs consistently foraged on only 2-3 "core areas"; cultivation grazing was common and small (presumably family) groups of dugongs returned regularly to the same feeding plots. Dugongs adapted their feeding strategy to the characteristics of individual meadows. An intertidal meadow showed feeding peaks only during August-October (at the end of the rainy season), when total organic carbon in the below-ground biomass is maximal in these *Halodule*-dominated meadows. In a single subtidal meadow, on the other hand, peak feeding occurred in October-November, when standing crop was maximal. Grazing on the whole was infrequent or absent from January to May, when rhizome/root biomass is low, and frequent from June to December, during and after the onset of the wet monsoon, when rhizome/root biomass is high. There are strong indications that (as in Australia) calving takes place mainly when high rhizome/root biomass is available.

We have concluded that the existing marine reserve in Pulau Pombo is insignificant for dugong conservation because of its relatively sparse seagrass beds, and have recommended to the local government the establishment of dugong sanctuaries in Haruku Strait, Saparua Bay, and Piru. Dugong conservation and management in the Moluccas will in general require enforcement of existing international and national laws respecting dugong catches and trade in dugong products; continued research on dugong migration, distribution, and reproduction; promotion of community-based conservation; and implementation of a coastal-zone management plan that includes dugong protection. Our specific recommendations are as follows:

- a. Enforcement of existing regulations protecting dugongs in East Ambon.
- b. Creation of the dugong sanctuaries mentioned above. Declaration of these sanctuaries should coincide with enforcement and enhancement of traditional conservation systems, like the local "sasi laut".

- c. Restriction of gillnet fishing during periods of high rhizome-root biomass of *Halodule* in sanctuary areas, to prevent incidental catch of neonates.
 - d. Training of Pattimura University students in dugong and seagrass research methods, so that they can take over this research in the future.
 - e. Production and distribution of dugong posters, leaflets, and T-shirts among government offices, village leaders, schoolteachers, pupils, and households in the project area. This should be done in close cooperation with the Asian Wetland Bureau, PHPS, WWF Jakarta, Oceanarium Ancol in Jakarta, and the Yayasan Hualopy in Ambon.
- Hans de Iongh

MEXICO

Manatee Research in Mexico. - Belize and the Mexican state of Quintana Roo share one of the larger populations of West Indian manatees outside Florida. Resource managers from both countries are concerned that the current and future development plans for the region may endanger the manatees, but more information on their habitat needs is required to develop protection plans. Biologists from Quintana Roo and Belize initiated a study of the manatees in the region, including a population assessment using aerial surveys. A radio-tracking study has also been started to determine movement patterns and habitat use of the manatees in Chetumal Bay.

The radio-tracking project is led by Benjamin Morales Vela, a marine mammalogist with the Centro de Investigaciones de Quintana Roo (CIQRO) in the city of Chetumal. Because this is one of the first radio-tracking studies of West Indian manatees outside Florida, CIQRO biologists David Olivera Gomez and Gerardo Rivas Hernandez spent a week in Florida during late October 1994 learning how to construct the specialized radio-tags. In addition, two biologists from the United States National Biological Service, Bob Bonde from the Sirenia Project in Gainesville, Florida, and Galen Rathbun from the Piedras Blancas Research Station in San Simeon, California, traveled to Chetumal to give advice and assistance with the initial phase of the project. The objectives of this initial phase were to develop capture methods

for manatees in the Chetumal Bay area, and train Mexican and Belizian biologists in the techniques of radio-tagging and tracking manatees.

Between 8 and 18 November 1994, Mexican, American, and Belizian biologists worked at capturing and radio-tagging two manatees, under a permit issued by the Mexican government to CIQRO. Bob Bonde brought capture nets from Florida, with the hope of finding some animals in a suitable canal or lagoon where the nets would be effective. Galen Rathbun brought equipment to try and capture manatees in open water with hand-held hoop-nets, a technique that he helped develop for dugongs in Australia.

Both techniques, however, failed. Manatees were not found in any narrow canals or channels in November, and thus the nets were of little use. The capture team also failed to hoop-net any manatees in open water, although some were "almost" captured. The escape behavior of manatees is very different from that of dugongs. Even when fleeing at nearly full-speed, as soon as the manatees sensed a net or noose near their head they tucked and rolled out of the net with incredible speed and agility.

In the end, a chase-and-tire capture method that Mexican fishermen traditionally used in the region was used. In contrast to the fishermen's method, however, an airplane was used to find manatees in good capture locations. At the end of an aerial search, the pilot would drop a map in a plastic bottle to the waiting capture boats, and with this information the capture team efficiently located manatees in clear, shallow water. The boats were used to continually, but gently, chase and herd the same manatee until it tired after 1-2 hours. At this point swimmers entered the water and slipped a rope noose over the head and onto the peduncle. The first manatee captured, named Carmen, was easily brought alongside the boats, where it was sexed, measured, and radio-tagged while surrounded by swimmers standing in chest-deep water. The second manatee, named Gabriela, was captured in deeper water, which gave the opportunity to test a modified inflatable boat to cradle her while she was moved to water where swimmers could stand; it all worked perfectly.

The chase-and-tire technique worked very well in Chetumal Bay, but probably has

limited use in other areas where the water is deeper and more turbid. Unless an individual manatee can be followed for one or two hours until it tires, there is little chance of approaching it with nets or nooses.

The two female manatees have been radio-located one or more times a week since they were tagged. During December and January neither moved more than about 9 km from their capture locations. With the experience and success gained from capturing and radio-tagging these two manatees, plans are being developed to tag up to 10 more individuals in the next two years. However, this plan must now be reassessed in terms of the dynamics of the Mexican peso. - **Benjamín Morales Vela, Galen B. Rathbun, and David Olivera Gomez**

PALAU

Palauan Dugongs Once More "Officially" Endangered. - What one bureaucratic oversight does, another can sometimes undo. Thus it came to pass that way back in 1970, when the U.S. Fish and Wildlife Service listed the dugong as endangered under the Endangered Species Conservation Act of 1969, separate lists of foreign and domestic protected species were being maintained, and the dugong was placed only on the foreign list - although the Palauan population was then under U.S. jurisdiction.

This slip-up was seemingly rectified when the 1969 act was superseded by the Endangered Species Act (ESA) of 1973 and the separate lists were merged into a single one. The dugong was included on this list as endangered throughout its range - including, implicitly and for the first time under U.S. law, Palau.

In 1988, however, the Service belatedly discovered that this inclusion of the Palauan dugong population had been made without the required public notice. Contrary to the ESA's provisions, the Trust Territory of the Pacific Islands had not been notified of the proposed change in listing and invited to comment on it. Upon discovering this second procedural oversight, the Service then deleted the Palauan dugongs from the list. This left them outside the protection of both the ESA and the Marine Mammal Protection Act (which never applied to the Trust Territory), and thus protected only by inadequately-

enforced Palauan law.

Not until August 1993 did the Service finally publish a proposed rule to re-list the Palauan population as endangered. Also in that year, at the instigation of the U.S. Marine Mammal Commission, the drafting of a recovery plan for the population was begun. Both efforts were still underway on 1 October 1994, when Palau became fully independent and the Service's management authority over Palauan dugongs ended.

So where does that leave the dugongs, rule-wise? In the view of sources in the U.S. government, Palauan independence has now rendered the issue moot, because the 1988 listing applied to the dugong's entire range "except USA." Now that dugongs no longer exist in the USA, the Palauan population is, by default, once again considered endangered, with no further legal action required.

Meanwhile, the Palauan population continues its decline, and the recovery plan (which will be turned over to the Palauan Government when completed) cannot be implemented too soon. - (based in part on the *Marine Mammal Commission Annual Reports to Congress*, 1993 and 1994)

UNITED ARAB EMIRATES

Dugong Surveys Planned in the Arabian Gulf. - Recent wildlife surveys in UAE waters of the southern Arabian Gulf by the Abu Dhabi-based National Avian Research Center have pinpointed specific areas apparently used regularly by herds of dugongs. Although precise population estimates are still lacking, anecdotal evidence gleaned from local fishermen suggests that significant numbers remain.

The rather piecemeal observations achieved to date are hopefully to be replaced by systematic aerial surveys and quarterly monitoring flights (during which turtles will also be censused) from late 1995 onward. A proposal to satellite-tag one or more animals is a possibility, with research on the distribution and productivity of seagrass beds also likely. Such work is to be a collaborative venture involving several organizations.

Attempts are presently underway by an independent film company to record the everyday life of dugongs in Abu Dhabi. This will have an educational and scientific value and highlight the threats faced.

It is nine years since an aerial survey conducted by the Meteorological and Environmental Protection Agency of Saudi Arabia estimated 7300 ± 1302 individuals in the entire western Arabian Gulf (Kuwait-UAE). The time is thus right for a repeat survey. Development pressures and seabed reclamation have certainly increased and some harvesting continues. An international effort will be required to effectively manage and conserve Gulf stocks. - **Simon Aspinall** (National Avian Research Center, P.O. Box 45553, Abu Dhabi)

WASHINGTON, D.C.

Progress on Publication of Sirenian Bibliography. - *Domning's Bibliography and Index of the Sirenia and Desmostylia* is now approximately at the page-proof stage. It will appear as No. 80 in the series *Smithsonian Contributions to Paleobiology*. Its progress has been slowed by personnel shortages at the Smithsonian Press, but they say it will definitely be out in 1995, probably in early fall. Ordering information should therefore be available (with luck!) in the October issue of *Sirennews*. - **DPD**

ABSTRACTS

Water flux and osmoregulatory physiology of the West Indian manatee (*Trichechus manatus*) (Rudy Martin Ortiz). - This study provides the first comprehensive analysis addressing the questions of water balance and osmoregulatory physiology in any sirenian species. Water turnover estimations using deuterium oxide dilution were conducted on captive manatees in fresh and salt water. Animals kept under freshwater conditions actively consumed large volumes of water in addition to obtaining relatively large quantities of preformed water in their lettuce diet (about 92% water). As for the lone captive saltwater animal, turnover trials performed on him strongly suggested a lack of mariposia. Four animals temporarily exposed to salt water before being returned to fresh water also did not provide any evidence for active salt water consumption. Further analyses of their osmoregulatory responses to a hypo- and hyper-osmotic environment reveal the capability of these animals to maintain appropriate water balance. Regardless of the habitat, animals were able to maintain osmolality and electrolyte homeostasis by regulating both parameters within narrow ranges similar to other terrestrial and marine mammals. Dehydration was not apparent in any of the animals in salt water. This is not surprising, however, since preformed water obtained in lettuce was substantial. Analysis of PRA-aldosterone profiles reveals that sympathetic stimulation of beta receptor induced-renin release was exhibited and that a functional RAA axis is present in these animals, typical of other terrestrial and marine mammals.

Urine samples were only obtained during the switched salinity experiment. Urinalysis strongly suggested a lack of dehydration in animals during the salt water phase; however, exposure to this habitat was sufficient to significantly elevate pNa^+ and pCl^- and to noticeably increase $pOsm$.

A comparison of plasma osmolality, electrolyte, and hormone levels provided evidence that free-ranging animals exposed to a hyperosmotic environment have the osmoregulatory mechanisms to deal with the osmotic challenge. There was also no significant variation in the measured parameters between representatives of the Florida and Antillean subspecies when exposed to similar conditions. [Abstract of a thesis for the degree of Master of Science in Wildlife and Fisheries Science, submitted to Texas A&M University in 1994.]

Aspects of the chemical ecology of the West Indian manatee, *Trichechus manatus* (Audra L. Ames). - Liver, kidney, and blubber tissues from the West Indian manatee were analyzed using gas chromatography and combined gas chromatograph/mass spectrometry for a variety of chlorinated hydrocarbons. The tissues were also examined for petroleum hydrocarbons, but none was found. Due to the low frequency of observed pesticides, their concentrations could not be related to age, sex, length, or the geographic location where the manatee carcass was recovered. Pesticides (o,p-DDT, o,p-DDD, hexachlorobenzene and lindane) were detected in all three tissues, but found most frequently in the liver and kidney.

The sloughed skin from three captive manatees at Lowry Park Zoological Garden was examined over a period of one year to determine its stable carbon isotopic composition. The foods consumed by these manatees were also sampled and their $\delta^{13}C$ values determined. The sloughed skin $\delta^{13}C$ values from the captive manatees were found to be 1.28 to 7.25 per mil greater than the lettuce they consumed. The skin was 0.67 to 3.55 per mil greater than the wheat sprouts, and the difference between the skin and carrots was -1.45 to 4.26 per mil. $\delta^{13}C$ values of the skin could be related to changes in the manatees' diet.

Finally, $\delta^{13}C$ values for internal tissues (liver, kidney, and blubber) and skin from dead manatees were also determined. These values were compared to values of vegetation that manatees are known to eat in the wild. The $\delta^{13}C$ values of the internal tissues and skin of wild manatees fell in the range of $\delta^{13}C$ values of their expected diet. [Abstract of a thesis for the degree of Master of Science in Marine Science, submitted to the University of South Florida in 1994 and supervised by Edward S. Van Vleet.]

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