Sirenews

Newsletter of the IUCN/SSC Sirenia Specialist Group

NUMBER 3

APRIL 1985

IN THIS ISSUE: - PALAUAN DUGONGS APPEAR DOOMED TO EXTINCTION (p. 7)

- RECORD MANATEE MORTALITY IN FLORIDA (p. 5)

EDITORIAL: WHY SAVE SIRENIANS?

My last editorial brought a response from a colleague who asked whence I derived the obligation I mentioned - to set aside sufficient of this planet's space and resources for the survival of other species. "I've sought in vain," he writes, "for a really convincing answer (other than my own personal pleasure and interest).... Can you come up with a scientifically, economically, or philosophically defensible argument that would, for example, place survival of manatees in Florida ahead of "economic growth" when it comes to the bottom line? Or one that would argue that a starving village should spare the last African manatees?"

A challenge like that cannot be evaded; it is THE challenge that the Sirenia Specialist Group, and conservationists in general, face. I will attempt an answer, and welcome any better ones that others can offer.

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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As with any wild species, many more or less pragmatic reasons for preserving sirenians can be given. I list these roughly in order of their increasing importance to increasing numbers of humans:

1. Food. The most tangible value of sirenians is also the one which can benefit most people the least. By eating an animal we cash it in at the lowest rate of exchange; as with a bond cashed before maturity, there is a severe interest penalty to pay. All its other potential dividends are forfeited. It may be that every part of the carcass is used; the proceeds may fill the stomachs of a subsistence hunter's family or help keep alive the traditions of an ancient culture. Or they may undermine those same traditions by increasing dependence on a cash economy. In any case, the long-term good of the greater number is sacrificed to the immediate needs of a small fraction of the nation's population. Nowhere can this provide a solution to mass hunger, even if entire species are annihilated. Clearly, only very limited hunting of sirenians can be tolerated in the foreseeable future.

2. Weed Control. Often discussed but yet to prove practical on any significant scale, the use of manatees in clearing weed-choked canals and reservoirs is still worth exploring. Aquatic weeds are an economic curse throughout the tropics, and a safe, cheap form of biological control would benefit millions of people. It would also allow multiple use of the manatee resource, but the severe limitations to its applicability - scarcity of sirenians, vulnerability of impounded animals to poaching, and less than complete weed removal - must be acknowledged.

3. Tourism, Education, and Research. Under unusual circumstances, such as clear-water springs in Florida, wild sirenians can be economically significant local tourist attractions while remaining part of their ecosystems. Captive animals can entertain and edify larger numbers of people, a function probably well worth the price of their contributions as wild animals to the larger environment. The results of scientific research on all living species enrich human culture just as do contributions to the other sciences, arts, and humanities.

4. Ecological Value. In this part of the use spectrum, direct user impact on wild sirenian populations is minimal and gains are diffuse and not immediately obvious, but the benefits may in fact be very broad. For example, the role of sirenians in the nutrient cycles of seagrass communities and blackwater tropical rivers could be of significant benefit to fisheries. Aquatic plant communities, as a component of which sirenians evolved and to which they may be important, are both extremely productive and capable of absorbing large quantities of pollutants. More generally, all humanity has an important stake in the health of all ecosystems, which buffer us from the effects of our own mistakes. In this sense every species is a line of defense between ourselves and natural or unnatural disaster. Since we have hardly begun to understand these relationships, prudence dictates the protection of major ecosystem components such as sirenians.

5. Genetic Value. Genetic engineering will revolutionize

civilization in the twenty-first century as computers did in the twentieth, and genetic resources will be as valued as petroleum is today. By that time, unfortunately, the developing tropical nations will have allowed much of their great wealth of biological diversity to be wiped out, thereby squandering what may be their last chance to escape permanent poverty and economic impotence. But the genetic value of sirenians and most other species is still as imponderable today as was the future worth of petroleum in 1785.

6. Aesthetic Value. Aesthetic appreciation of wildlife is a luxury of the "developed" world, a pleasure to be indulged after the children are fed. But if we claim to hope for a day when all people enjoy this luxury, must we not ensure there is something left to enjoy when that day comes?

7. Moral Value. There are some things for which civilized people do not demand economic justification. Heroic medical treatment is given, at frightful cost, to terminally ill and even congenitally retarded individuals regardless of any monetary value their lives might have to society. Aid is sent to starving Africans, not with a view to anticipated return, but because they are starving. Humane treatment of animals is mandated by law because it is deemed right, even if it costs more. Some people oppose some or all of these efforts, and those who support them do so for varied religious and ethical reasons. But there is clearly a consensus that some things ought to be done, and the list of moral desiderata has grown over the centuries. Slaves should be freed, torture should be outlawed, and species should be preserved from extinction. Whether there has been any net moral progress in human history is debated, but if (as I believe) there has, these are its milestones. To borrow a recently current phrase, our institutions and our generation will be judged by how well they protect the powerless; and sirenians, like all other species, are surely now in our power.

In his recent book Biophilia, E. O. Wilson stresses the innate affinity of man with other living things, and the fundamental connection between the value we place on them and the value we place on ourselves. "The phylogenetic continuity of life with humanity," he writes, "seems an adequate reason by itself to tolerate the continued existence of ... other organisms. This does not diminish humanity - it raises the status of nonhuman creatures." But there is a deeper reason: "...we are human in good part because of the particular way we affiliate with other organisms. They are the matrix in which the human mind originated and is permanently rooted...." Other species are part of our own fabric in ways we do not suspect. Our nerve fibers do not extend into their substance; we feel no physical pain when they are cut off from the tree of life. But we are diminished by it all the same. Without them we will never be fully human.

Economic growth? To be sustained, it must be farsighted, and destruction of species and ecosystems is one of the more dangerous forms of myopia. World hunger? It will never go away until we control our population, even if we consume all else and begin eating each other. The "bottom line"? It is our responsibility to foresee and forestall those ultimate confrontations between nature and developers, between wildlife

and starving villagers, by finding creative ways for wildlife to earn its keep and by adopting a sufficiently broad and wise view of its value(s) to us. Responsible stewardship? We are the stewards of this planet, and will be held accountable by posterity and by whatever higher authority we acknowledge. I find those reasons convincing. Do you? - DPD

LOCAL NEWS

BRAZIL

Robin Best writes the following under date of 27 Feb. 1985:

"My present position is drastic as we still have no funding and to keep us employed we are doing faunal surveys for [the electical power agency] ELETRONORTE with all manatee work on hold. ... If I ... leave the whole thing will collapse as I doubt that anyone here will push to finish the new pools etc. ... Through these hydroelectric projects I've contracted four more people so we've got the best potential ever to do the work - but the international apathy doesn't help. ... Time is running out fast.... The desperate writing of projects etc. has slowed down my own production drastically.... Amazônia continues to be threatened as the [present] State Governor is all for the commercial utilization of wild game and the hydroelectric group (ELETRONORTE) have plans for some 200 dams in the area! Colonization and agriculture continue taking their toll! My salary was Cr$9.500 in 1976 and the dollar was Cr$9. Today at 2,400,000 with the dollar at Cr$4200 our salaries are less than half of what they were which doesn't help keep one enthused about staying here under adverse conditions!"

FLORIDA

J.P. Garner, Jr., Director of Nature World in Homosassa Springs, writes under date of 17 December 1984:

"At the present time we have four captive West Indian manatees in a natural area here at Nature World on the Homosassa River. Two of the animals are juveniles recently transported here from Miami Seaquarium. We also house one adult pre-act [Marine Mammal Protection Act of 1972] female and one adult post-act male. These animals are in an area [of the Homosassa River] which is fenced with vertical bars spaced eight inches apart. They can actually have nose to nose contact with the wild manatee which naturally winter here....

"As of December 10, 1984, the County (Citrus County) purchased this facility so as not to let it fall into the hands of developers. Our Board of County Commissioners has expressed their thought as to keeping this place as natural as possible. The County Operations Committee is also interested in this natural facility being used for manatee research and breeding...."

The following items were contributed by the Gainesville lab:

Manatee Mortality. - 1984 ended with the highest number of manatee deaths in one year: 131 deaths were documented. One manatee was recovered from Puerto Rico, one from Georgia, one from North Carolina, and 127 from Florida. An additional manatee death in Florida was verified but the carcass was not examined. Necropsy results yielded the following numbers of cases in each death category: boat or barge collision, 35; crushed or drowned in floodgate or canal lock, 3; other human-related, 1; dependent calves, 26; natural 25; undetermined, 40.

The total number of manatee deaths in January and February 1985 was 35, which was less than the January and February 1984 total of 49. Three of the 35 carcasses were recovered from Puerto Rico and one from South Carolina. The causes of death and number of cases in each category were: boat or barge collision, 5; other human-related, 3; dependent calf, 1; natural, 11; undetermined, 14; and one carcass was verified but not recovered.

Salvage Highlights. - The two largest manatees ever recorded were recently recovered in Florida. A pregnant female that was struck by a boat was collected in November 1984 from Hendry County. She was 376 cm in length and weighed a record 1401 kg. Manatees get even larger, though. In February 1985 a 375 cm, 1620 kg female was recovered from Crystal River in Citrus County. She had also been hit by a boat. This case was particularly unfortunate, as she was a well-known female with a reproductive history going back to 1977.

[EDITOR'S NOTE: Gunter (1941) recorded a male T. manatus said to have been 15 feet 3 inches (465 cm) long and weighing 1310 pounds (595 kg). However, his information was received at third hand and these figures may well have been garbled.]

Radio-tracking Project. - During the passage of a cold front on 7 January 1985, personnel of the Denver Wildlife Research Center (DWRC) Sirenia Project captured 20 West Indian manatees in Fort Myers, Florida. Sixteen of these animals were fitted with newly designed floating radio transmitters, which were developed in cooperation with the DWRC electronics personnel. The floating transmitters are tethered to a belt around the peduncle with a six-foot-long nylon rod. The one-day-long capture was the most successful manatee capture and tagging operation ever undertaken in Florida and was made possible by the cooperation of personnel from several agencies and organizations, including the J. N. "Ding" Darling National Wildlife Refuge, the Florida Power and Light Company, Lee County Parks and Recreation, the Florida Department of Natural Resources, the Department of Wildlife and Range Sciences of the University of Florida, and several volunteers. The radio-tagged manatees will now be tracked during the next year to determine areas of special importance to this endangered marine mammal. This radio-tracking project has taken on even greater importance recently because several artificial warm-water refuges that are used during the winter by manatees, including the Fort Myers Power Plant, have been altered. By following the radio-tagged manatees, vital information on

movement patterns in relation to warm water (or lack of warm water) will be gathered.

In 1979 a cold-stressed male West Indian manatee was rescued near Gulfport, Mississippi and rehabilitated at oceanaria in Florida. In captivity this manatee, named "Beauregard", was used to develop a method of attaching radio-frequency transmitter packages for tracking free-ranging animals in saltwater habitats. In February 1985 the manatee was released into the Homosassa River on the central west coast of Florida with a satellite PTT (platform terminal transmitter) tag. The unit consisted of a modified Telonics wildlife PTT and battery pack capable of powering the unit for 60 days, housed in a floating cylinder attached to a 2-meter-long tether secured to a belt around the peduncle. Transmitted data included internal PTT temperature and the cumulative changes in the attitude of the housing. Two polar-orbiting satellites, each carrying ARGOS Data Collection System packages, were used to monitor the signals. Location of the animal could be calculated as often as nine times per day. During the first week of tracking, nearly 20% of the satellite overpasses resulted in location fixes and over 50% resulted in reception of data. The manatee travelled about 75 km to the mouth of the Suwannee River during this time.

Mexico-U.S. Cooperation. - The Sirenia Project recently was host to a biologist from the Mexican Government. From 10 February through 2 March 1985, Manuel Vasquez visited various field sites and offices in Florida to learn more about research techniques currently being used to study manatee biology. The status of manatees in Mexico was also discussed during the visit, and it is hoped that Manuel's visit will eventually lead to other cooperative manatee work between Mexico and the US.

Staff Changes. - On 3 February 1985 Dr. Thomas J. O'Shea became Project Leader of the U.S. Fish and Wildlife Service's Sirenia Research Project. This change was brought about due to Dr. Galen Rathbun's transfer to the Service's California Sea Otter Research Project. Although Galen's principal duties will be related to sea otter research, he will remain active with various manatee and dugong research projects overseas. Dr. Lynn Lefebvre will be transferring to the Sirenia Research Project this summer. Lynn currently works for the Service's animal damage control research facility in Gainesville.

Another recent change in the staff of the Sirenia Research Project was brought about due to funding cuts to the project and the expanded role the State of Florida is playing in manatee conservation. Kipp Frohlich, who has done carcass salvage and radio-tracking work for the project in the Fort Myers area for the last 18 months, has transferred to the Florida Department of Natural Resources. Sirenia Project biologists will continue to work closely with Kipp in Fort Myers.

Manatee Brain Research. - The U.S. National Science Foundation has awarded approximately $250,000 to a consortium of researchers at four universities to analyze the phylogenetic position of the Sirenia among other mammals on the basis of

neuroanatomy and DNA hybridization. Drs. J. I. Johnson, Jr. (Anatomy Department, Michigan State University, East Lansing), J. A. W. Kirsch, W. I. Welker (University of Wisconsin), R. L. Reep (University of Florida), and R. C. Switzer III (University of Tennessee) will study sectioned brains of Trichechus manatus to produce a detailed microneuroanatomical analysis and atlas. This will move the manatee brain from being one of the least-known to one of the best-known brains of rare species. Together with the DNA study, these data will serve to reassess phylogenetic hypotheses previously derived from bones, teeth, and proteins. The results will be very welcome, inasmuch as new fossil data on sirenians and their relatives are also stimulating reevaluations of "paenungulate" phylogeny at this time. Contributions of appropriate material representing other sirenian species, particularly Dugong, would no doubt be welcome.

PALAU

The following is quoted from Administration of the Marine Mammal Protection Act of 1972, January 1, 1983 to December 31, 1983: Annual Report of the Fish and Wildlife Service, U.S. Department of the Interior (1984), pp. 31-32:

"...The [U.S. Fish and Wildlife] Service has executed a Memorandum of Understanding (MOU) with the Republic of Palau providing for technical assistance in resource conservation. An item in the MOU is the provision for review of research proposals. This provision was included at the specific request of the Republic of Palau. They do not presently have the staff to make these evaluations or to conduct baseline studies of their resources.

"Aerial surveys and citizen interviews designed to determine the distribution and status of dugongs around the Island of Palau were completed....

"Traditionally, the dugong had high cultural significance to the Palauans, as well as affording a good source of protein. A bracelet made from the atlas vertebra of a dugong could be worn only by the chiefs of villages or municipalities, and as a consequence, the dugong was effectively conserved by the chief. At the present, the role of traditional chiefs has been greatly diminished resulting in little protection for this species.

"Modern technology (speed boats, explosives, spear guns, etc.) has also had a tremendous impact on the taking of this species. The limited resources of the Republic of Palau are insufficient to promote protection of the dugong from illegal taking.

"Unregulated taking of the dugong has become critical. There is substantial disagreement among Palauans and outside researchers on the number of dugongs present in Palau. Aerial surveys made by Brownell, Anderson, Owen and Ralls in 1977 and 1978 led them to estimate that the population consisted of not more than 50 individuals, substantially less than estimates offered by most local residents. Brownell et al. speculated that even if there were 150 animals, the estimated poaching rate of 20 dugongs per year probably exceeded annual recruitment. Therefore,

the Palau dugong population could be exterminated by the end of this century.

"Service efforts have been directed towards developing a census methodology that is understood and accepted by the Palauans. Without this acceptance, any results derived will be suspect. However, this effort has not been a sustained one due to insufficient resources. An effective methodology which incorporates the observations and concerns of the Palauans is essential. Unless the fragile nature of this isolated dugong population can be clearly demonstrated to the Palauans, any effort to promote conservation of the dugong will be virtually ineffectual."

TRINIDAD AND TOBAGO

Geddes Hislop, a wildlife trainee in the Forest Division, Port-of-Spain, contributed the following report:

The West Indian manatee, locally known as the "sea-cow", used to be occasionally sighted in the Nariva Swamp, Trinidad's largest freshwater wetland. Since the 1960's, however, reports of manatee sightings have been so few and far between that the species was believed extinct and the "sea-cow" was only mentioned in fishermen's tales. In the early part of 1984 Dr. John Bindernagel, Coordinator of a UNDP/FAO project on Natural Resources in Trinidad and Tobago, sighted manatees in the Nariva River both from the air and from a small boat. Later in the year more sightings were made by Wildlife Research Officers from the Forestry Division. Information from local residents implied that manatees may have been in the swamp for about a year or more before the sightings were made. This may be due to the annual flooding of the Orinoco River, the overall nature of the swamp, and the inaccessibility of the upper reaches of the Nariva River, which provides an effective barrier to the curious local fisherman. During the dry season (January to June) the swamp is less hazardous and researchers were able to penetrate much further than the local fishermen in order to reach manatee feeding areas.

Research on manatee ecology in Trinidad is to begin in the 1985 dry season as part of research on endangered species. More recent reports of sightings in the North Oropuche River are still to be confirmed. Although the sea-cow is not harvested in Trinidad, a further report of a sea-cow becoming entangled in a fishing net in the North Oropuche River and subsequently being eaten is to be investigated.

During the 1984 wet season, heavy rainstorms and flooding in the low-lying areas of the island may have had their effect on the manatee population, perhaps pushing them further into the swamp itself or further upriver. This remains to be seen.

Present threats to the manatee are indirect environmental ones - such as long-term development plans that may affect swamp hydrology/ecology.

WASHINGTON, D.C.

Daryl Domning and Lee-Ann Hayek have completed the statistical analysis of quantitative and qualitative data on 272 manatee skulls (86 T. inunguis, 37 T. senegalensis, and 149 T. manatus). These are by far the largest samples ever used to characterize the interspecific and intraspecific variation in Trichechus. One preliminary conclusion is that Hatt's (1934) nominal subspecies T. m. manatus and T. m. latirostris may have some morphological basis after all. Using cranial osteology alone, a specimen can be assigned to the Florida or the Central and South American form with at least 82% accuracy. Specimens from the Antilles group with the latter form, as do ones from Texas, whereas a skull from Louisiana groups with the Florida population. This supports the conclusions of earlier writers that manatees found in Texas have historically been summer immigrants from Mexico, while those found on more eastern parts of the Gulf Coast come from Florida. Therefore, continued use of Hatt's subspecific names seems justifiable. (Incidentally, the occasional carcasses being salvaged by the Gainesville lab from Puerto Rico might merit special attention in this light, since they are a source of material that seems to be genetically and taxonomically distinct from Florida manatees.)

Yet another range extension for sirenians - the earliest records of the order in the Pacific basin have come to light almost simultaneously on both sides of that ocean. An amateur fossil collector working in the Late Oligocene Yaquina Formation of coastal Oregon found the partial skull and dentition of an unidentified small dugongid, which is currently being prepared for study at the Smithsonian Institution. Hardly had this specimen been recognized as a sirenian when Okazaki (1984) reported a pair of dugongid caudal vertebrae from Late Oligocene rocks in Kyushu, Japan! These finds antedate by several million years the previously known Early or Middle Miocene sirenians of Baja California and Peru, and except possibly for some rib fragments from southern Mexico, no other sirenians are definitely known from the Pacific Paleogene. But it appears that they had a significant pre-Miocene history in that region which has hitherto not been suspected, let alone explored.

SIRENIA WORKSHOP - ITC IV

The following partial list of papers and posters has been submitted for the Workshop "Sirenia: Biology and Conservation" that will be held at the Fourth International Theriological Congress in Edmonton, Canada, 13-20 August 1985. Additional titles are forthcoming, with approximately eight to be submitted by dugong researchers.

The manatee cecum. (R. L. Snipes)
Age determination in the West Indian manatee based on thoracic flipper radiographs. (A. G. Watson)
Estimating age of young West Indian manatees, Trichechus manatus, from dental layers. (A. C. Myrick, Jr.)

Distribution of manatees in Puerto Rico. (G. B. Rathbun, T. Carr, and N. H. Carr)
Behavioral ecology of sirenians. (G. B. Rathbun and T. J. O'Shea)**
Female-offspring behavior in West Indian manatees. (T. J. O'Shea and S. H. Shane)
Mortality patterns in manatees from Florida. (R. K. Bonde, T. J. O'Shea, and D. K. Odell)
The parasites of sirenians. (C. Beck, D. Blair, and G. B. Rathbun)
Cataloging West Indian manatees in Florida. (G. B. Rathbun and J. P. Reid)
Radio-tag attachments for Sirenia. (J. P. Reid, G. B. Rathbun, and J. Bourassa)
Analysis of stomach contents of West Indian manatee carcasses salvaged from Brevard and Duval Counties, Florida. (L. A. Hurst and G. B. Rathbun)
Research program in information processing and social behavior in captive West Indian manatees. (H. D. Woodyard)
The Sirenia: past, present, and the future? (D. P. Domning)**
Distribution, status, and conservation of manatees in Mexico. (L. C. Colmenero R.)
Strategies for protection of non-exploited sirenian populations. (J. M. Packard and P. M. Rose)**
Manatee response to a power plant shut-down in southwestern Florida. (R. K. Frohlich and J. M. Packard)
A century of observations of sirenian brains. (J. I. Johnson, Jr., R. L. Reep, and W. I. Welker)

** (These papers are invited spoken contributions.)

We look forward to a full and very interesting program, and hope to see a large turnout of sirenian researchers at this workshop.

RESULTS OF OPINION SURVEY

In the last issue, responses were invited to the question: "What do you think are the most important unanswered questions that we as scientists can ask about sirenians?" To date, only two responses have been received.

Paul Anderson's nominations were "study of the ecology and ethology of dugong reproduction. We have only tentative ideas as to breeding season and the factors which may influence it and know nothing of habitat requirements or the role of social interaction. What environmental factors influence age at maturity and frequency of reproductive activity in either sex? Are reproductive activities particularly sensitive to disturbance? Have declines in numbers been due to reproductive failure as well as over-hunting? What roles do foraging opportunities, thermal stress, and diet quality play in reproduction?"

Tom O'Shea answered that "the [question] that intrigues me most comes from repeated days of following radiotagged manatees as they swim purposefully for many km in turbid water or at

night, seemingly knowing all the correct turns, routes and channels; from knowing the long distance resightings of [hundreds] of km and the tracing of long annual circuits; and from the probable long life spans of these animals. These observations suggest that manatees must have a tremendous capacity for learning spatial characteristics of their environment and a remarkable memory for recall of such seemingly detailed information over many km and years. How do they do this? From a comparative zoological viewpoint, there may be some extremely interesting findings to be had here in terms of sensory perception, orientation, navigation, and learning. It would be a very, very difficult job to try to get at these points and would require some highly creative work. Perhaps the brain studies [see news from Florida, above] will help begin to get us on the right track in comprehending this. Or perhaps it's much simpler than it seems."

For my part, I got carried away and came up with a score of questions, divisible into physiological/anatomical, behavioral/ecological, and evolutionary categories:

Physiological and Anatomical:

- How important is animal protein in sirenian diets?
- How do euryhaline manatees adapt to abrupt changes in salinity?
- Is Trichechus inunguis confined to fresh water by a lack of salinity tolerance?
- Why do sirenians have so many retia mirabilia?
- Why do sirenians have bifurcated hearts?
- Why do sirenians have monopodial bronchial trees?
- What is the significance of sirenian bone density?
- What is/are/were the function(s) of dugongid tusks?
- How important to sirenians are chemical senses, and how do they work?

Behavioral and Ecological:

- What are the functions of sirenian vocalizations?
- How and why do females choose particular males as mates? (Or do they?)
- How ecologically typical of T. manatus are Florida manatees?
- How might sympatric sirenian species (or paleospecies) partition the available resources?
- What effects do sirenians have on energy flow and community structure of seagrass and other aquatic ecosystems?

Evolutionary:

- What effects have sirenians had on evolution of seagrass and other aquatic ecosystems?
- Why have all sirenians except Hydrodamalis apparently failed to adapt to cool climates?
- How are sirenians related genealogically to other mammals?
- How much of sirenian biology reflects primitive mammalian conditions? For example, what if anything does sirenian sociality signify regarding evolution of sociality in mammals?
- Why did halitheriine dugongids die out?

Is bottom-feeding, as exemplified by Dugong, an overspecialization and evolutionary dead end for sirenians?

We already have partial answers to some of these questions, or maybe even complete answers that are not yet published. The rate at which new knowledge of sirenians is being generated is gratifying, but I still wonder whether we are in danger of running out of good questions. Further suggestions are welcome at any time! - DPD

REQUEST

Dr. Rodney Salm (Dept. of Tourism, Ministry of Commerce & Industry, P.O. Box 550, Muscat, Oman) asks: "Would any readers know of references to dugongs in Oman? No matter how old!"

ABSTRACTS

Submerged Times of Dugongs (P.K. Anderson). - Dugongs, like cetaceans, are restricted to the water and carry out most of their activities beneath the surface, but must surface to breathe. The interval between appearances at the surface (down-time) has been found to vary with locality, foraging mode and forage species, activity, and reproductive status. An attempt was made in 1983 to examine the relationship between down-time and depth of water. Individual dugongs were followed and kept in view by divers. Down-times recorded by this method were longer than those recorded previously by surface methods. Data obtained in water of varying depths suggest a trend for dugongs to remain submerged longer in deeper water. Possible explanations of these variations are discussed. [From IX International Reunion of the Mexican Society for the Study of Marine Mammals, La Paz, Baja Calif. Sur, March 29-31, 1984.]

Ecology and Behavior of Manatees (Trichechus manatus) in the Region of Emiliano Zapata, Tabasco (L. del C. Colmenero Rolon, E.E. Hoz Zavala, et al.). - Other papers have indicated the importance of the region of Emiliano Zapata in Tabasco state [Mexico] as a place of aggregation of manatees. This can be attributed to the influence of rivers and lagoons that have physical and chemical conditions for supporting large numbers of this mammal and a vegetation pattern favorable for them. The observations made indicate that the manatees move from rivers to the proximal lagoons according to the availability of food and that these local movements are correlated also with seasonal changes. The rainy season produces the increment of water level of the rivers and permits the approach of the manatees to the lagoons. They retreat later when the water level declines in the dry season. It has also been observed that their reproductive behavior is closely related to seasonal changes. The answers to questions asked many local persons permit us to corroborate the idea that the manatee population in this region is recovering, thanks to the protection that this species receives. [From IX

International Reunion of the Mexican Society for the Study of Marine Mammals, La Paz, Baja Calif. Sur, March 29-31, 1984.]

Ecology, Distribution, and Conservation of the Amazonian Manatee, Trichechus inunguis, in Ecuador (R.M. Timm and L. Albuja V.). - The Amazonian manatee, T. inunguis, is one of the largest mammals on the South American continent, but it remains poorly known. The recorded distribution of Amazonian manatees includes much of the central Amazon basin in Brazil, eastern Peru, and extreme southeastern Colombia. We suspected that Amazonian manatees might also occur in eastern Ecuador, and during the fall of 1983 we searched for them in several river systems of the Rio Napo drainage. We observed T. inunguis at three separate localities in Napo Province, Ecuador: on 1 October at Laguna Grande de Cuyabeno (00 00', 76 11'W, el. 210 m), on 28 October at Laguna Zancudo Cocha (00 34'S, 75 29'W, el. 200 m), and on 2 November at Laguna Lagarto Cocha (00 29'S, 75 07'W, el. 200 m). All observations were either early in the morning or at sundown. Water temperatures at the surface ranged from 25.5 C to 32.5 C; pH ranged from 5.5 to 6.0. These waters are considered blackwater lagoons. At Laguna Grande de Cuyabeno the population of manatees is small and essentially not harvested at present by the Siona Indians. At Laguna Zancudo Cocha the population of manatees is small and there is a limited harvest each year by the local settlers and military. At present there is a good population of manatees at Laguna Lagarto Cocha, but harvest from a single meat hunter is extensive. Trichechus inunguis is in need of complete protection in Ecuador. [From 64th Annual Meeting of the American Society of Mammalogists, Arcata, Calif., June 24-28, 1984.]

The following three abstracts are of papers presented to the II Encontro Sobre Mamíferos Aquáticos, XII Congresso Brasileiro de Zoologia, Campinas, Brazil, Jan. 27-Feb. 1, 1985. They are here translated from the Portuguese.

Digestibility of Aquatic Plants by the Amazonian Manatee (Trichechus inunguis) (R.C. Best, J. Atkinson, R. Prince, and G.R.S. Moreira). - As part of a study on the biology and conservation of the Amazonian manatee, we made tests of digestibility using aquatic and semiaquatic plants from different areas. These were: capim colônia [pasture grass] (Brachiaria nutria), Cabomba sp., and water lettuce (Pistia stratiotes). Feces and urine of manatees (n=6) were collected on the last 4 days of a 15-day experimental period. Plant consumption varied between 4% and 12% of the live weight of the animals. Using lignin (which is indigestible) as an indicator, we calculated the apparent digestibility (AD) of the dry material of the plants. The results were: 58% for Brachiaria; 51.3% for Cabomba; and 53.4% for Pistia. These efficiencies are similar to those of other large herbivores. The digestions of protein-N of the diets were 58%, -9.1%, and 42.3%, respectively; the negative digestibility of protein in the Cabomba diet is related to the presence of tannins in this plant. The AD of cellulose was 63%, 80.6%, and 73.8%, respectively, showing a high utilization of fiber in the monogastric digestive tract. The assimilation of

energy was 53.2%, 22.8%, and 26.4%, showing a greater utilization of the grasses than of the aquatic plants. Analyses of Na+ in the urine, given that the level of Na+ can be very low in the grass diet (X/=20.5 mEq/l; max=31.9 mEq/l) or high as in the Cabomba diet (X/=94.1 mEq/l; max=135 mEq/l), showed that the manatee can excrete extremely dilute urine to avoid loss of salts. These results are discussed in relation to the ecology and possible captive breeding of this endangered species.

Preliminary Studies on the Digestive Ecophysiology of the Amazonian Manatee (Trichechus inunguis) (J.A.A. Gomes and R.C. Best). - In order to obtain basic data indispensable to the understanding of the ecology and digestive physiology of the Amazonian manatee, we studied the voluntary consumption and rate of passage of food through the digestive tract of Trichechus inunguis. We also examined the changes in these parameters using four different diets and three kinds of solid plastic markers. In this experiment we employed two males and two females with body weights of from 78 to 175 kg. The percent daily consumption, in relation to body weight, varied between 2.87% (diet B) and 3.81% (diet A). We found a negative correlation between the percent consumption and body weight. The daily consumption varied inversely with the fiber content of the diets. The different markers differed significantly in retention time. The retention time of food seems to vary directly with the fiber content of the diet. Individual variations were found. We intend to continue these studies in order to obtain more specific data on digestibility in the manatee.

Gross Anatomy of the Kidneys of Sotalia fluviatilis (Cetacea = Delphinidae) and Trichechus inunguis (Sirenia = Trichechidae) (A.L.P. Miranda). - Material was obtained from a male Sotalia fluviatilis and five Trichechus inunguis. In S. fluviatilis the renal lobules were separated and sorted into 6 groups according to their external appearance (apparently one lobule - Group I; two lobules apparently fused - Group II; etc.). The numbers of lobules in the right and left kidneys were 316 and 284, respectively. After this sorting, the lobules were cut in a sagittal plane, their dimensions were noted, and they were separated into 3 new groups according to the number of papillae (lobule with one papilla - Group 1; with two papillae - Group 2; etc.). In the right kidney, the classification by external appearance coincided with the classification by papilla count with an accuracy of of 93.5% in Group I, 23.2% in Group II, and 2.3% in Group III. There was no agreement in the other groups. The left kidney the agreement was 95.38% in Group I, 19.64% in Group II, and 2.74% in Group III, again with no agreement in the other groups. The mean weights of a lobule and papilla were 0.09 ±0.01 g and 0.06±0.01 g, while the maximum and minimum were 0.1 g and 0.03 g, respectively. The kidneys of T. inunguis were also cut in a sagittal plane. No form of internal or external lobulation was observed. In the 5 animals examined, the papillae were counted, weights and measurements were taken, and the volume was examined.

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