

EDITORIAL

This issue inaugurates the publication of a newsletter serving the IUCN/SSC Sirenia Specialist Group. I have taken on its editorship at the request of group chairman Robin Best, and I look forward to working with the entire sirenian research and conservation community to disseminate news and useful information in as timely a manner as possible. I have long felt a need for such an organ of communication, and believe it can help to increase the tempo of research and protective efforts on behalf of our favorite animals at a time when the tempo of threats to their survival is all too obviously increasing.

The present publication had a short-lived forerunner, the Dugong Newsletter of the Townsville group, of which unfortunately only a single issue appeared (in 1979). I intend to at least equal the commendable breadth of content envisioned for that newsletter. Sirenian-related news of all sorts will be welcomed - on biology and ethnobiology, conservation and native concerns, anecdotal observations and new techniques, literature citations, abstracts and reviews, letters and editorials, and anything else you wish to communicate to your colleagues. Those who know my interests will not be surprised to find items of a paleobiological nature also. The past is not purely of antiquarian concern; it can rise either to help or to haunt us, as shown by the review in this issue.

This will be an informal forum, not to be considered citable, formally-published literature; it will not be "peer-reviewed", and contributions to it should not be quoted without the written permission of the author. Certainly the opinions expressed will be those of the writers and not necessarily those of IUCN or other organizations. Therefore, I hope that contributors will feel free to offer informal speculations and ideas as well as news in the interest of rapid communication.

In the beginning, publication of two or three issues per year can be expected. These will be sent gratis to members of the Sirenia Specialist Group and, for the time being, to some others. Later it may be necessary to institute subscriptions. Addresses of those who are or may be interested in receiving Sirennews should be sent to me. Its size, frequency of appearance, and ultimately its success, of course, will depend on you and on the volume of news you generate and submit. I am confident, however, that we now have a critical mass of active sirenologists and sirenophiles, and that this will be a fully self-sustaining enterprise.

All material to be published in Sirennews should be sent directly to me. The deadline for receipt of copy for the second issue will be September 3, 1984. THIS IS THE ONLY NOTICE YOU WILL RECEIVE!

For those who were expecting this newsletter to be called The Siren, an explanation is in order. Dave Laist called my attention to the fact that that name (complete with a manatee logo!) has been preempted by a publication of the UNEP Regional Seas Programme. Any who dislike the present title are strongly

encouraged to suggest a better one.

I thank all the contributors to this first issue, and acknowledge the aid of IUCN, the U.S. Marine Mammal Commission, the U.S. Fish and Wildlife Service, and the Howard University Department of Anatomy in producing and distributing it. I welcome this opportunity to serve you in your efforts to protect and understand the unique animals to which we have devoted our collective labors. - DPD

SIRENIAN RESEARCH PLAN

In October 1983, a meeting was held at the U.S. Fish and Wildlife Service Laboratory at San Simeon, California, to draw up a series of sirenian research proposals for the utilization of US\$1 million as part of the United Nations Environmental Program's Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals. Dr. Helene Marsh of the James Cook University chaired the meeting, which was attended by P. Anderson, K. Radway Allen (UNEP), R. Best, R. Brownell, Jr., and G. Rathbun.

The UNEP Global Plan puts forward a series of 39 immediate and long-term Recommendations in five areas of concentration: (1) Formulation of Objectives; (2) Regulatory and Protective Measures; (3) Improvement of Scientific Knowledge; (4) Improvement of Law and its Application; and (5) Enhancement of Public Understanding. One of the 39 recommendations proposed that a sum of \$10 million be made available for the support of a comprehensive research program: \$6 million for cetaceans, \$3 million for pinnipeds, and \$1 million for sirenians. The San Simeon meeting resulted in a 73-page prioritized list of 26 worthwhile sirenian research projects, including outlines of objectives and cost estimates. Sixteen of these are studies of distribution and status; the rest emphasize basic biology. Projects in the first category are required in developing countries where little or no work on sirenians has been done in the past. On the other hand, the committee considered that projects concerned with increasing knowledge of sirenian biology will generally be most successfully developed as extensions of existing projects to take advantage of the expertise of experienced sirenian biologists and the facilities available at their institutions. The report rightly stresses the potential importance of the proposed program for ensuring continued support for the three centers of sirenian research (Gainesville, Manaus, and Townsville), whose survival is essential to world capability to undertake research on sirenians in the future.

The fate of these proposals is uncertain. Dr. Radway Allen advises that they were considered at a consultation in January 1984 between UNEP, FAO and other interested international organizations. Since then, he believes that they have been considered at discussions between UNEP and the permanent representatives of its various member governments in Nairobi. The proposals which the member governments are likely to support will, apparently, be considered by the Governing Council of UNEP in May of this year. In response to a query from one sirenian biologist, Dr. Radway Allen says that he does not think the U.S.

withdrawal from UNESCO will affect the progress of the proposals.

SIRENIAN WORKSHOP

The Fourth International Theriological Congress will be held at the University of Alberta, Edmonton, Canada from 13-20 August 1985. The program will include 25 Symposia and 11 Workshops. One of the Workshops will be entitled "Sirenia: Biology and Conservation." It will take an entire day, including a plenary lecture, poster session, five half-hour papers (selected on the basis of submitted abstracts), and a round-table discussion. The papers should deal with sirenian biology emphasizing implications for conservation.

This will be the first workshop to be held on the Sirenia as a whole, and should be a unique opportunity for interested biologists to exchange information and ideas. The convenors (Marsh, Best, Rathbun, and O'Shea) plan to have many more posters than platform presentations, in order to stimulate discussion and personal contact. They hope to obtain travel funds for attendees, particularly from Third World countries.

Those interested should write Dr. Helene Marsh, Zoology Department, James Cook University, Townsville, Qld. 4811, Australia. State whether you wish to present a poster or a paper and whether you will require travel funds for your attendance. The deadline for provisional registration is 31 May 1984.

MARINE MAMMAL WORKSHOP

The First South American Workshop on Marine and Freshwater Mammals will be held in June or July 1984 in Buenos Aires, Argentina, one week prior to the IWC meeting in the same city. Argentine, Brazilian, Chilean, and Uruguayan specialists on cetaceans, sirenians, otters and pinnipeds will present over 25 papers on biology and conservation of southwest Atlantic and Amazonian species. Researchers and conservationists are invited to participate in several discussion meetings. For information, write Lic. Hugo P. Castello, Museo Argentino de Ciencias Naturales, Av. A. Gallardo 470, 1405 Buenos Aires, Argentina.

LOCAL NEWS

AUSTRALIA (Shark Bay)

In a recent report to the Fund For Animals (Australia), Paul Anderson made numerous recommendations for future research on dugongs at this unique and vitally important site. In addition to detailing the many areas of dugong biology still inadequately understood, he included the following observations: "Studies of the seagrasses conducted in 1981-82 suggest problems of forage quality (but not quantity) in winter that need further clarification.... They also suggest that there may be a quantitative problem (overgrazing) with high-quality summer forage on the Wooramel delta, and that this might be the factor limiting dugong numbers at present.... Best (1983) has recently

published evidence that Amazonian manatees may fast for up to seven months during the unfavorable (dry) season. While dugongs clearly feed on *Amphibolis* (as indicated by both observed ingestion and fecal production) the feeding appears to be inefficient and the forage quality low at a time when energy desirable for thermoregulation may be high. Studies (perhaps in "captivity" in one of the Shark Bay lagoon areas) of actual food intake are needed to test the hypothesis that dugongs in Shark Bay may be on a semi-fast during the winter months.... Work in 1983 has confirmed that local movements occur in response to weather patterns which cool inshore waters in the preferred winter habitats, and has shown that the effects of these movements on foraging efficiency can be studied."

Paul also reports that Shark Bay is being considered for both World Heritage and National Park or Marine Reserve status. Permanent protection for this site is vital and certainly should receive the unqualified support of the *Sirenia* Specialist Group. Paul hopes to get back to Shark Bay himself, "tentatively around 1986-87", and continue his work there.

AUSTRALIA (Townsville)

Helene Marsh reports that there are now five biologists affiliated with James Cook University who have a research interest in dugongs:

George Heinsohn has temporarily defected to studying cetaceans while he is on sabbatical with Dr. Ken Norris at the University of California at Santa Cruz.

Helene Marsh is completing her study of dugong life history and reproductive biology based on the study of specimens obtained from over 500 animals killed in indigenous fisheries or accidentally drowned in nets. A large proportion of this material was collected by the Papua New Guinea Division of Wildlife Dugong Project. The study indicates that dugongs have a maximum lifespan of up to 60 or 70 years, a minimum pre-reproductive period of nine or ten years for both sexes, a usual litter size of one and a mean calving interval variously estimated for several populations as three to seven years. Population simulations using various combinations of these life history parameters indicate that even with a very low schedule of natural mortality, an unharvested dugong population is unlikely to increase at a rate of more than about 5 per cent per year.

Calving, ovarian activity and testicular activity are all diffusely seasonal. There is evidence for significant fluctuations between years in the proportion of both mature females and males in breeding condition and in the apparent pregnancy rate. Three papers are in press from this work in the *Australian Journal of Zoology* and another two should be completed late in 1984.

Brydget Hudson, former leader of the Papua New Guinea Dugong Project which was discontinued in late 1981 due to lack of funds, is now enrolled in a joint Zoology/Geography master's program at

James Cook University. She is writing up her work on the PNG Dugong Conservation and Public Education Programme, including the development of the Maza Wildlife Management Area based on the dugong fishery at Daru in Torres Strait. Brydget advises that she has a VHS video copy of the excellent 50-minute documentary "The Kiwai: Dugong Hunters of Daru", which was produced by the Australian Broadcasting Commission and which she is prepared to lend for meetings, etc. This film has already had significant impact when shown in dugong-hunting communities in Australia, PNG and Vanuatu and is an excellent public education tool.

Andrew Smith, a Ph.D. student at the University's Sir George Fisher Centre for Tropical Marine Studies, is collecting and collating information on the indigenous knowledge of the biology and behavior of dugongs as part of his study on the current and traditional use of marine resources by Aboriginal communities on the east coast of Cape York Peninsula (Queensland, Australia). He is also studying the indigenous exploitation of dugongs in the Starcke River region to provide a basis for possible management strategies. His work is funded by the Great Barrier Reef Marine Park Authority.

Janet Lanyon, a student at Monash University, Clayton, Victoria, has begun a Ph.D. project (under Gordon Sanson and Helene Marsh) on the functional morphology and nutrition of dugongs in relation to seagrasses. Her field program is based at James Cook University. Janet is sampling tropical seagrasses in dugong feeding areas on a seasonal basis to study their abundance, species diversity, growth patterns, development, and nutritional quality. She is also investigating the functional morphology of the dugong dentition in relation to its seagrass diet and examining seagrasses from an ultrastructural perspective to relate this structure to the digestive processes employed by the dugong for plant breakdown. This study of feeding biology may prove to be important in explaining the seasonality of dugong reproduction. Janet would be most interested to hear from anyone who has attempted a similar study of manatees.

Torres Strait Survey. - An aerial survey to determine the relative density of dugongs in Torres Strait was carried out in November 1983 by scientists from the Papua New Guinea Division of Wildlife and James Cook University. The project was funded by the Australian National Wildlife Service. The survey was carried out as a strip census using a survey design similar to that developed for kangaroos by Dr. Graeme Caughley.

The survey returned a minimum estimate of only 1455 \pm S.E. 276 dugongs for this area. It is not possible to convert this minimum estimate into an absolute population estimate because the proportion of dugongs which are actually sighted under survey conditions has not been calibrated. However, given the generally excellent survey conditions and the experience of the survey team, it seems highly unlikely that there could be enough dugongs in the area to sustain the level of hunting that allegedly took place in 1983. The Islanders themselves estimate that in 1983 they killed on the order of 1000 dugongs, many of which were

caught by indigenous fishermen operating crayboats with freezer facilities. This estimate is not confirmed, and Wallace MacFarlane, of the CSIRO Traditional Fisheries Programme (see below), believes that the true figure is more likely to be 400-500 animals.

Population simulations indicate that even with the most optimistic combination of life history parameters, 9000 dugongs would be required to sustain an unselected annual harvest of 500. If the life history parameters suggested by the 450 specimens collected from the Daru harvest are correct, the population required would be 29,000 animals.

There is considerable evidence that dugong numbers have declined dramatically in Torres Strait in recent years. For example, the number of animals passing through the Daru market has declined from 207 in 1979 to less than 50 (probably on the order of 20) in 1983. In contrast, the fishing effort (measured by the number of sea turtles passing through the market) has increased (see also CSIRO Traditional Fisheries Programme, below).

Cooperative management initiatives between Australia and Papua New Guinea are clearly urgently required if dugongs are to be prevented from becoming rare or extinct in this area, which probably contains the most extensive subtidal seagrass beds yet recorded.

Plans for 1985. - The James Cook group plans to concentrate research efforts for 1985 on refining aerial survey methodology in order to develop methods to track the numbers of dugongs at various locations in northern Australia over time. The results of this research will be used by the various management agencies to assess the efficacy of their programs and to suggest sustainable catch quotas to indigenous communities.

CSIRO Traditional Fisheries Project. - Dr. Bob Johannes and Wallace MacFarlane are investigating the Torres Strait Islanders' traditional fishing practices, including the harvest of dugongs and sea turtles. Preliminary figures from three communities indicate that the number of dugongs being caught is now substantially less than the catches Nietschmann recorded from the same communities in 1976-78.

Northern Territory Conservation Commission. - Peter Bayliss recently completed the first of a series of aerial surveys aimed at determining the status of dugongs along the Northern Territory coast. During his survey he conducted preliminary experiments aimed at refining aerial survey methodology and at developing factors to correct for the animals missed by observers during a survey. A program to salvage specimen materials from dugongs being killed by indigenous hunters in the Northern Territory is also being developed.

BRAZIL

Robin Best reports progress at INPA in Manaus "even in the face of the country's drastic economic situation" (the following

is quoted from the IUCN/SSC Newsletter, Feb. 1984):

"Firstly, donations of Cr\$15.4 million (US\$26,000) from the Amazonas State Government and Cr\$20 million (US\$33,500) from the IBM company made it possible to construct permanent research pools for our 14 captive-reared manatees and also for river dolphins and giant otters (we already have one male). This helps our research greatly as we can now maintain reproductive groups of manatees together and hopefully can expand our research on these into the area of reproductive endocrinology and finally captive breeding. We expect that through the more visible tanks, etc., the interest generated by being able to see the animals in the tanks will bring more local and government support of our research. We hope to arrange a visitation programme of visits for school children so that they get the 'conservation message' via the manatee project.

"Secondly, the Brazilian Institute for Forestry Development (IBDF), the government agency responsible for fauna protection, is currently sponsoring a campaign for the preservation of manatees, with our collaboration, including television ads, radio programmes, posters, and booklets. This is the first time such a large-scale programme has been drawn up for manatees in this country.

"Lastly, we were able to introduce a further 12 manatees to the first hydroelectric reservoir of the Amazon, Curua'-una near Santare'm, making a total of 42 manatees introduced there since 1980. Most of these animals were captured by us on the Rio Japura', some 1000 km distant from the reservoir, and had to be barged down river for 7-10 days and then trucked 80 km to the damsite. We have put WWF(US)-provided radio-transmitters on all of them and have reams of data now on daily and seasonal movements and social interactions, as well as habitat usage. A few manatees have come from the fiscalization efforts of IBDF as this species is protected by the Brazilian Endangered Species Act of 1971. The Brazilian Electric Company (ELETROBRAS) is extremely interested in the continuation of this project and is including the next three hydroelectric dams in the same programme. These new man-made lakes, although extremely damaging in terms of habitat destruction for terrestrial fauna, may at least be good for manatees in that large new stable habitats are being created and are relatively easily protected, especially as the lake-shore colonists are generally from NE Brazil where agriculture, and not fishing, is their primary occupation."

FLORIDA

The following news items were contributed by the Gainesville lab:

1983 Manatee Mortality in Florida. - The mild temperatures in 1983 resulted in relatively few manatee deaths in Florida. Eighty dead manatees were reported and 78 were recovered and examined at necropsy. Thirty-nine were examined at the University of Miami and 36 at Gainesville; the remaining 3 were necropsied at a newly established field facility on the J.N. "Ding" Darling National Wildlife Refuge near Ft. Myers, Florida.

The causes of death for 1983 and the number of cases for each factor were: collision with a boat or barge, 14; crushed or drowned in floodgates or canal locks, 7 (5 in floodgates, 2 in locks); entrapment in culverts, 4; entanglement in crab trap line, 1; dependent calves, 18; natural factors, 5 (2 of pneumonia, 2 of enteritis and starvation, 1 of congestive heart failure); undetermined, 29 (mostly too decomposed for accurate necropsy).

1984 Cold-related Mortality in Florida. - During January 1984 a record 33 carcasses of manatees were recovered in Florida, with one additional case from North Carolina. Six died of various human-related causes, 2 were dependent calves, and 10 died of undetermined causes. Cold stress was thought to be responsible for 16 of the deaths. Florida experienced a severe, record-breaking freeze in late December 1983, and cool weather extended through early January. Manatee mortality was consistent with previous findings: most cases involved smaller-sized, sexually immature manatees, often marked by a cachetic state with low body fat reserves and an absence of food in the upper gastrointestinal tract. Most were not recovered in the immediate vicinity of warm-water discharges or springs where manatees typically take refuge in winter. Precise causes of death remain undiagnosed, but circumstantial evidence suggests that metabolic drains on manatees inexperienced at using warm water refuges may be great enough to result in hypothermia and subsequent death without significant pathological lesions.

In January 1984, deaths were most prominent in two areas: the lower St. Johns River and other waterways in Duval, Nassau, Clay, and St. Johns Counties in northeastern Florida, and Lee, Collier, and Charlotte Counties in southwestern Florida. Carcasses recovered in early January typically were fresh and were sunk on the bottom, visible only at low tide. Those recovered in middle and late January showed advanced decomposition and were afloat. This indicates that most of the mortality took place in the early part of the month when water temperatures were lowest.

Cataloging Manatees in Florida. - Photographs of manatees distinctively marked either naturally or by propeller wounds have been assembled in a state-wide identification catalog. A total of 652 manatees have been cataloged based on photos taken at nine different aggregation sites around Florida. Brevard County has been monitored for five years; Jacksonville, Riviera Beach, and Port Everglades for three years; and Ft. Myers and Tampa Bay for only one year. Blue Springs and Crystal River have been monitored for nearly a decade.

Resightings of cataloged individuals have documented summer site fidelity in Brevard County and winter site fidelity at Jacksonville, Riviera Beach, and Port Everglades. Several manatees, however, have changed winter aggregation sites both within and between winter seasons. Long-term resighting data for some individuals have confirmed a seasonal north-south migration along the eastern coast of Florida. Movements in excess of 600 km have been documented for two individuals that travelled between

Port Everglades and Jacksonville over two and three year periods, respectively. These findings suggest that manatees along the east coast do not form discrete subpopulations.

Status of the West Indian Manatee in the Northern Gulf of Mexico. - A review of historical records indicates that manatee numbers have declined in Texas, but increased in Louisiana and Mississippi. This is due to their extinction in Mexico and dramatic increase along the southern Big Bend coast of northwestern peninsular Florida. Their distribution in the latter area is related to their need for warm water and submerged salt- and freshwater food plants. The spring-fed headwaters of the Crystal and Homosassa Rivers are important warm-water winter refuges, with nearly 90% of the same individuals returning each winter. The estuaries and grass beds associated with these two rivers and the Suwannee, Withlacoochee, and Chassahowitzka Rivers are the principal summer habitats. The Suwannee and Crystal Rivers are used more heavily than the others. Low human-caused mortality, high fecundity, some immigration, and high site fidelity are responsible for the increasing numbers of manatees using the south Big Bend coast. Since this region has experienced relatively little development compared to the rest of Florida, it offers the best long-term future for the manatee in the United States.

New Radio-tag Being Developed for Manatees. - The U.S. Fish and Wildlife Service Sirenia Research Project in Gainesville is putting the final touches on an entirely newly designed radio-tag assembly that will enable biologists to track manatees in salt water habitats. Because salt water attenuates radio signals, the objective of the new attachment is to keep the transmitter antenna above the water surface as much as possible. This has been achieved by using a modified marine turtle transmitter housing designed by the Service's Denver Wildlife Research Center. The transmitter floats, and is attached to a belt around the manatee's peduncle by a 2-meter-long flexible plastic tether.

Another innovative feature of the new assembly is the buckle used to secure the belt around the peduncle. All past tagging efforts have required a manatee to be measured before being fitted with a custom-sized belt. The new buckle allows belts to be fitted and then locked in place without knowing the circumference of the peduncle.

Twinning in the West Indian Manatee. - On 24 April 1983 a very large dead manatee (M-331) was reported to the Sirenia Project in Gainesville. The 375 cm long, 1161 kg female was necropsied the next day. Cause of death was evident from the large, fresh propeller wounds on the back and tail. Internal bone damage and hemorrhage were consistent with observations in other cases of collisions with large boats.

External examination revealed a greatly distended abdomen and vulva. Mucus and bloody fluid were exuding from the dilated vagina. Internally, the animal had very heavy fat deposits and was moderately decomposed. The GI tract was full of aquatic vegetation. Organ configuration was unremarkable, except that the

greatly distended uterus occupied nearly half of the abdominal cavity. It contained two full-term fetuses, both female and both weighing 39 kg, one 135 cm and the other 132 cm long. Although twinning in marine mammals is rare, it has been suspected to occur occasionally in manatees. Gumilla, in *El Orinoco Ilustrado* (1745), reported seeing two 25-pound fetuses taken from a female manatee, but this is the first case of twinning in sirenians confirmed in modern times.

The Fish and Wildlife Service also reports that the Proposed Research/Management Plan for Crystal River Manatees was distributed for public review at the end of February 1984. This plan, written by Jane Packard and associates at the University of Florida and based on a concept originally developed and funded by the Marine Mammal Commission, is intended to provide a framework for meeting the present and future needs of the Crystal River manatee population in concert with the needs of the area's developing human community. It summarizes present information about the manatee population, identifies gaps in the existing data base, describes potential threats to the Crystal River environment, and recommends research consistent with maintaining planned public use of the area.

The proposed plan has no regulatory or legal standing. Rather, it is intended to serve as a reference source and guide for local decision-making in the area. In accord with a recommendation contained in the plan, the Fish and Wildlife Service is considering the sponsorship of a Steering Committee, under the leadership of local officials, to work towards implementation of the plan. This committee would serve as a forum for broad public and private involvement in the effort, and make recommendations for future updates of the plan.

The plan has an innovative design, and consists of three separate documents: (I) an illustrated, nontechnical booklet of 31 pages which summarizes the information in the plan; (II) the plan itself (250 pages), intended for agencies and professional people involved with planning, research, regulatory actions, etc., in the Crystal River area; and (III) a 350-page "compendium" of research papers (mostly previously published) and review comments used as the basis for the information and recommendations in the plan.

The Service has distributed the proposed plan for review to interested agencies, organizations, and professional individuals involved with management of manatees and other resources of the area. Copies will also be available for public review at public libraries in Citrus and Levy Counties, Florida. However, due to printing costs, copies of volumes II and III are not presently available on request, and probably will not be in the future unless there is great demand for them. Single copies of Volume I (the summary), which contains the central elements of the plan along with background information on manatee biology and research efforts, will be provided to anyone who requests them from the Endangered Species Field Station, U.S. Fish & Wildlife Service, 2747 Art Museum Drive, Jacksonville, Fla. 32207.

THE GAMBIA

Dean Treadwell, wildlife ecologist with the USAID Gambia River Basin Study, reports the following in a letter to Robin Best, dated 24 January 1984:

"Since I have spent most of my time thus far up in eastern Senegal and the Guinea highlands, my manatee information is minimal. I have heard of sizable numbers (10-20?) spotted from the air in the Sine Saloum Delta (the drainage immediately north of the Gambia). Most of the sightings in the Gambia thus far (n=3) appear to be well up-river away from any sea water intrusion. You also inquired into captive manatee - in 1980, there was one at the zoo in Bamako, Mali (Niger River Basin)."

HAITI

The Gainesville group reports that during a recent aerial and interview survey for manatees in Haiti, they were found to still occur near the mouths of the larger rivers, especially along the northern coasts of both the northern and southern peninsulas. However, they are still hunted (illegally) for their meat and their numbers appear to be greatly reduced compared to the adjoining Dominican Republic and other islands in the Greater Antilles.

INDONESIA

Colin Bertram sent a copy of a report by R.V. Salm and G. Usher entitled "The magical tears of the dugong" (WWF Monthly Report, December 1983, Project 3108, Indonesia - Marine Conservation, pp. 677-679). It says that good numbers of dugongs remain in only two provinces of Indonesia: Maluku and West Irian. WWF/IUCN are supporting a project in Maluku for the establishment of marine reserves which will include protection for dugongs. Three reserves have already been declared, at Pulau Pombo, Pulau Kasa, and Pulau Banda. A proposed reserve at Aru Tenggara in the Aru Islands is particularly important because it has what is possibly the largest population of dugongs in Indonesia. Toward the end of 1979 dugongs were relatively numerous in the Aru Islands. However, they were intensively hunted and an estimated 1000 animals were killed each year, despite protection by a ministerial decree. They are harpooned at night in shallows, and caught accidentally in shark nets. The meat of an adult can fetch the fisherman up to US\$33, half the average annual income of a local fisherman. Dugong tusks can fetch double the price of the meat; they are used for cigarette holders believed to have aphrodisiac properties. Young dugongs, caught after their mothers have been harpooned, are kept alive out of the water and their "tears" collected drop by drop. A cotton swab dampened with these tears sells for US\$1 and is thought to bring good luck, prosperity, and success with women. The Aru Tenggara Reserve will protect both dugongs and turtles; an estimated 3000 to 6000 green turtles are killed and 2 million eggs are collected each year in the Aru Islands.

SAUDI ARABIA

The Nowruz Oil Spill. - A major oil spill in the Arabian Gulf began in January 1983 with accidental discharge from a damaged well of the Nowruz oil field, located in Iranian waters. In March 1983 two additional platforms were damaged as a result of military activities in the area and the wells set on fire. This spill and some of its ecological consequences are the subject of a report published in October 1983 by the Saudi Arabian Meteorology and Environmental Protection Administration (MEPA), and entitled "The Nowruz Oil Spill, January 1983: The Saudi Arabian Response. Interim Report No. 1" (15 pp.).

According to the MEPA report, the discharge rate in August 1983 was estimated at around 4500 bbl/day. One well was capped in September, reducing the discharge to about 2500 bbl/day. In addition, oil was burning at two wellheads at the time of the report; but the fire was reaching a critical level near the water surface, and if it were extinguished, a total output to the sea of 16,000 bbl/day could be expected. The total oil released to Gulf waters up to 1 Oct. 1983 was about 900,000 bbl (38 million U.S. gallons). Up to half of this volume, especially the low molecular weight compounds, may have been lost by evaporation and other dispersion processes.

Observation and control of the discharge have of course been hampered by its location in a war zone, and confounded by the existence in Saudi Arabian waters of other sources of discharge such as industrial spills, ships pumping ballast, and a well in the Khafji field which had been burning and polluting the sea surface for 18 months as of March 1983. During the first half of 1983, rafts of weathered oil hundreds of meters long, oil sheen covering many square kilometers, and numerous tarballs were blown onto the coasts of Saudi Arabia, Bahrain, Qatar, and eastern regions of the United Arab Emirates. As weathering proceeded, many of the oil mats evidently sank and carpeted sizable areas of the sea floor.

The MEPA report states that "a dugong population of 50-60 specimens was estimated in 1979 for the Gulf of Salwah, associated with the high salinity seagrass beds.... From early March to mid-April, dead invertebrates, fish (600+)(pelagic, reefal, benthic), seasnakes (1500+), turtles (56)(hawksbill, green), birds (200+), dugong (32) and porpoises (33) were found on Saudi Arabian Gulf coastlines.... Mortality and stress in coral, a major monoculture algal bloom, and an apparent reduction in reef flat grazer populations were observed.... No further 'marine animal kills' have been observed in Saudi Arabian waters since mid-April nor have similar 'kills' been reported from other Gulf states, except for two dugong and some dead fish in Bahrain." About 50% of the dead dugongs are said to have been juveniles. "These surveys did not include all the Saudi Arabian Gulf of Salwah shore and no information is available from Qatar. Two live dugong were sighted by aerial surveillance in late April. The MEPA assessment is that the Gulf of Salwah dugong population has been reduced to a dangerously low and probably non-viable level and may very well become extinct."

In view of the foregoing observations, including observations of oiled birds, and an admission that coral

mortality was probably directly due to Nowruz oil derivatives, it is most surprising to find the following statement in the MEPA report: "Coincident with the 'marine animal kill' reports was the entry of oil sheen and tarballs into and progressing through Saudi Arabian waters. However, there is no proof that the 'kill' was a result of Nowruz oil or its chemical/physical effects on Gulf waters." If this statement is meant to imply that a causal connection between oil pollution and the kills is in doubt, then the statement appears indefensible and a more realistic assessment by MEPA would seem to be in order.

International efforts to monitor, halt, and clean up the spill are said to be continuing. The report notes in passing that "the sightings of mines in Saudi Arabia/Bahrain/Qatar waters has introduced an element of surprise to this program."

The report concludes that "irrespective of the causal factor involved in the death of the dugongs and hawksbill turtles, these populations have been severely affected. A faunal replenishment program is included in the Saudi Arabian Plan of Action for the Nowruz oil spill. This is aimed at evaluating and effecting a population 'transplant' to re-establish and maintain both endangered species in Gulf waters, after effective capping of the wells." It is not explained how such a "transplant" might be carried out, nor where the transplanted animals might be taken from. This situation bears watching by all international wildlife agencies, in regard to both the continued danger from the spill itself and the danger that ill-advised "transplants" or other well-intentioned remedial measures might aggravate rather than alleviate the harm already done.

WASHINGTON, D.C.

Sirenian research goes on even here, far from the sunny tropics. Daryl Domning and Lee-Ann Hayek's paper on horizontal tooth replacement in *Trichechus inunguis* is finally due for publication this spring, more than two and a half years after the MS. was accepted by *Mammalia* (prospective contributors to that journal take note). This will just about exhaust the backlog of manuscripts stemming from Daryl's two years in Brazil (1976-78), and he is now once again putting most of his research effort into fossil sirenians.

With Larry Barnes and Clayton Ray, he reviewed the status of fossil marine mammal studies for the new Society for Marine Mammalogy's meeting in Boston in November 1983; the MS. will appear in the first issue of the Society's new journal. North Pacific sirenians still keep surfacing: Domning and Tom Deme're' report new specimens of *Hydrodamalis cuestae* from San Diego County, California, including the partial skull of the largest individual sirenian ever found (*Trans. San Diego Soc. Nat. Hist.*, in press). Its direct ancestor, a new Late Miocene species ("Dusisiren Species D" of Domning, 1978), has been found in Japan and will soon be described; its well-preserved flipper supports Steller's sometimes-doubted statement that *Hydrodamalis* had no phalanges. And it can now be revealed that sirenians once made it to the southeastern Pacific: Christian de Muizon has discovered Early Miocene specimens of

Metaxytherium on the coast of Peru!

Daryl spent a very productive nine weeks of 1983 studying fossils in European museums. As one result, he and Herbert Thomas of Paris are straightening out the Old World Metaxytherium using cladistic analysis (the mess they were in required drastic measures!), as an adjunct to describing the Early Pliocene ones from Sahabi, Libya.

Meanwhile, slow progress is being made toward making sense of the West Atlantic and Caribbean dugongids. There are several undescribed genera and species lurking in the Oligocene and Miocene, most of them known only from tantalizing bone scraps. Two of them are extremely small - maybe less than two meters long as adults. Most surprising is the repeatedly-encountered pattern of sympatry, with two or even three taxa coexisting. Typically there is a small one, a normal-sized one (3-4 meters long) with very small tusks, and an equally large or larger one with big bladelike tusks somewhat like Dugong - all presumably competing for the available seagrasses. Suggestions for niche-partitioning strategies are earnestly solicited!

REVIEW

Richard Bradley, "The Pre-Columbian exploitation of the manatee in Mesoamerica." (With Introduction by S.J. Thompson and Comments by F.W. Lange, F.O. Loveland, B.L. Stark, B.L. Turner II, and C.R. Wicke.) University of Oklahoma Department of Anthropology, Papers in Anthropology 24(1): i + 82. 8 figs. Spring 1983. (Price US\$10.00.)

This is one of the more curious items in the annals of sirenian bibliography, as much on account of its format as its contents. The core of the work (pp. 13-58) is an M.A. thesis in anthropology by Bradley. What is unusual is that it is sandwiched between an editor's introduction (pp. 3-8) explaining apologetically why the work was published, and critical comments on it by five other anthropologists (pp. 61-82). The introduction explains that while the research was based only on literature surveys and a few informant interviews but no new excavations, the lack of information on the topic and the "admittedly speculative" but provocative conclusions justify dissemination in order to stimulate discussion and, hopefully, additional research effort. At least for being "willing to stick their necks out and, if need be, take their lumps," the author and editors are to be commended.

What, then, are the unorthodox ideas put forward so gingerly? In brief: That "the Olmec had an intricate relationship with the manatee"; that they may have used it as an important protein source and may even have raised it in artificial lagoons; that it served also as a religious symbol, the so-called "were-jaguar" motif in Olmec art actually representing a manatee; and that manatee calves may even have been ritually sacrificed.

On what evidence are these surprising conclusions based? In regard to manatees, Bradley has done his homework fairly thoroughly. The bibliography is up-to-date and even includes several unpublished theses relevant to the topic. His background

summary of manatee biology and exploitation (pp. 14-31) is detailed and no more inaccurate than the primary and secondary sources presently available. The choice of topic is significant, because the Olmec "may have been America's first civilization"; Bradley implies that a number of Olmec sites were founded as a direct result of manatee exploitation and argues that "the manatee may be partially responsible for the development and expansion of the Olmec in Mesoamerica." The archaeological evidence, however, is very scanty. Only a few sites in Belize, Yucata'n, Guatemala, and Panama have actually yielded manatee bones, and none of these, apparently, are Olmec sites. San Lorenzo Tenochtitla'n, the site of most concern to Bradley, produced no manatees among the faunal remains excavated. (This he plausibly attributes to butchering at the kill site and/or ritual return of manatee bones to the kill site, as is done by modern Rama Indians in Nicaragua.) Nor are harpoons known to have been used by the Olmecs (though they did have fish spears and nets). Bradley is, in fact, forced to rely entirely on speculation based on the (reasonably) presumed former existence of the manatee in the area, its potential food value to the human population, and the Olmecs' apparent heavy reliance on aquatic rather than terrestrial food animals in general. Under the circumstances, his detailed speculations about hunting methods and social and economic organization of Olmec manatee hunters are audacious, to say the least. But he goes still further and surmises that, to avoid over-exploiting the manatee resource, they resorted to rearing manatees in artificial lagoons.

The purpose of an aqueduct and over 20 artificial lagoons at San Lorenzo has not been satisfactorily explained. Discounting suggestions that they served as ritual baths or for raising crocodiles, Bradley proposes that they were used to hold and even to breed manatees captured in nearby rivers and lakes. The aqueduct and drain system may have provided a flow-through water supply, and the captive manatees would have provided a reliable year-round protein supply (assuming that their natural occurrence in the area was seasonal, a point not documented) while allowing conservation of the wild population. As commentator Stark points out, however, this idea is not consistent with off-site butchering and absence of manatee remains at San Lorenzo. Moreover, says Turner, such waterworks were not specific to the Olmec but were built throughout the Central American lowlands, mainly for water collection, drainage, and agriculture.

If correct, Bradley's interpretation has serious implications for present-day conservation strategies. Schemes for raising manatees in captivity or semi-captivity, for meat or weed control, have been repeatedly proposed over the past century. It will be asked: If the Olmecs did it 3000 years ago, why can't we? Therefore Bradley's ideas must be scrutinized with great care, lest their uncritical acceptance by policy-makers further cloud debates on the necessity of maintaining viable wild populations and habitats. My own view has long been that, if the aim is to increase numbers of manatees for human use, there is little point to labor-intensive hand-rearing in tanks when manatees are quite capable of feeding and reproducing themselves if left alone in

the wild, where they can be easily harvested when desired. In the present case, we must ask further how many manatees the Olmecs' lagoons would have held and whether a breeding stock of this size could have produced an economically significant annual yield - which I consider highly doubtful. If they were used merely as holding tanks for captured animals, and if manatees were otherwise seasonally unavailable, then Bradley's thesis becomes more credible; but such a situation must be clearly distinguished from captive breeding. Besides, it has yet to be demonstrated that the lagoons were not simply reservoirs or fishponds and that the Olmecs ever ate manatees at all.

Economically significant animals may or may not have religious significance, and Bradley's case for the manatee's importance in Olmec art and ritual is even weaker. As Erich von Däniken demonstrated, the highly stylized nature of Mesoamerican iconography lends itself to imaginative interpretations. Says Stark, "the eye of the beholder seems eager to take up where the Olmecs left off." Wicke, the art specialist among the commentators, is unconvinced that manatees ever appear in Mesoamerican art, and the biologist examining Bradley's arguments readily sides with Wicke. Bradley's attempts to show similarities between manatees and the "were-jaguar" motif are more than strained. He quotes one verbal description (by Jones and Johnson) apparently without realizing that it refers not to a manatee but to a manatee skull! Also cited as a point of resemblance are the manatee's "crescent-" or "crest-shaped eyebrows" - a notion Bradley may have formed from wrinkles visible in a manatee photo he reproduces, but certainly not from any first-hand familiarity with the beast. He makes much of "human-like" attributes of manatees, repeating the fable that they nurse their young in their "arms" while floating (?) erect half out of the water. From such comparisons, he leaps to the wholly unsupported speculation that manatee calves were sacrificed, and then suggests that "this may have been the model for later instances of real human sacrifice"!

I am relieved to report that the five anthropologist commentators take a uniformly dim view of such undisciplined fancy. The most trenchant observation is Turner's: "What issue does the manatee thesis possibly resolve? What incongruent data or interpretations is it meant to correct? Were the Olmec occupying a fauna deficient zone? Is there evidence that they consumed an enormous amount of protein, the source of which must be identified? No. The rationale seems to be Bradley's fascination with the species and the fact that Mesoamericanists have not paid sufficient attention to its possible significance." I agree. Sparking discussion is a worthy goal, but when the spark is generated by pure imagination rather than evidence, it is tantamount to crying wolf and invites the same response. Here there is the additional though opposite danger, already noted, of unwelcome repercussions on proposed management policies. Everyone concerned with sirenian conservation and husbandry should be acquainted with this publication, and prepared to counter with biological facts the sort of well-meaning but ill-informed and faulty reasoning it could encourage. - DPD

REQUEST

Tissue samples of sirenians (skeletal muscle, liver, heart, brain, heparinized blood) are needed for molecular studies. Tissues need to be stored and mailed frozen, preferably in dry ice. Donors will be acknowledged. Contact Hezy Shoshani, Dept. of Biological Sciences, Wayne State University, Detroit, Mich. 48202 (313) 577-2865 or Morris Goodman (313) 577-1004.

ABSTRACTS

The following are abstracts of papers submitted to the Fifth Biennial Conference on the Biology of Marine Mammals, Boston, 27 Nov.-1 Dec. 1983.

Distribution of Freshwater Dolphins and Manatees in the Upper Rios Negro and Orinoco (R.C. Best and V.M.F. da Silva). - Observations of Amazonian manatees (*Trichechus inunguis*) and the freshwater dolphins (*Inia geoffrensis* and *Sotalia fluviatilis*) on the Rio Negro and headwaters of the Orinoco suggest that although these two large river systems are linked by the Casiquiare Canal, this canal has not been an important factor in the distribution of any of these species from one basin to the other. Contrary to the probably misinterpreted reports of von Humboldt (1838), Amazonian manatees apparently do not occur in the headwaters of the Orinoco or Rio Negro (above the mouth of the Rio Canberi). *Sotalia* occurs in the lower reaches of both the Orinoco and Negro rivers. Although common on the extent of the Rio Negro, we did not observe any *Sotalia* from Sa~o Gabriel de Cachoeira, upriver from the rapids of Camanans, through to the Orinoco, during our boat trip from May 10-18, 1983. *Inia*, which has only once been reported from the upper Orinoco, was frequently seen from Cucui on the Rio Negro through the Casiquiare Canal and upstream on the Orinoco at least as far as La Esmeralda. This *Inia* appeared to be darker and smaller than the large pink *Inias* common on the lower Rio Negro in the area of Manaus. The distribution patterns of these species are discussed in relation to the geological events leading to the separation of the Orinoco and Amazon basins.

Manatee Deaths in Association with an Outbreak of Red Tide in Lee County, Florida, During 1982 (R.K. Bonde). - An outbreak of red tide off Lee County, Florida is implicated as the cause of a die-off involving 41 West Indian manatees (*Trichechus manatus*) during the months of February, March, and April 1982. Carcasses were examined in a broadscale cooperative effort enlisting many researchers and pursuing many avenues of investigation to eliminate other possible causes of death. Circumstantial evidence linked this die-off with several normally unrelated concurrent events: (1) the early winter dispersal of manatees using the local power plant; (2) a failure of seasonal rains; (3) a severe outbreak of red tide; and (4) a relatively large local population of ascidians (tunicates). It is suspected that 37 of the manatees examined died either directly or indirectly from

a neurologic agent, most likely derived from the red tide organism, *Ptychodiscus brevis*. One likely route of exposure involves the incidental ingestion of ascidians and other filter feeding invertebrates by manatees feeding in seagrass beds.

Influence of Feeding and Fasting on the Metabolism of the Amazonian Manatee (*Trichechus inunguis*) (G.J. Gallivan and R.C. Best). - Understanding the energy flow through an animal requires knowledge of the cost of assimilating energy and of special metabolic adaptations to periods of environmental stress. The present study was conducted to determine the metabolic cost of digestion in Amazonian manatees, a species being evaluated for aquatic weed control, and also to determine if this species exhibits any special metabolic adaptation for the periods of food deprivation which occur during the Amazonian dry season. Based on metabolic rate, the cost of eating for two subadult male manatees was 3.6 L O₂/kg for grass (*Brachiaria mutica*) and 4.0 L O₂/kg for water hyacinth (*Eichhornia crassipes*). Unlike other marine mammals, there was no elevation of metabolic rate after feeding. Given the prolonged passage time (7-11 days) and hindgut fermentation of manatees this would suggest that the cost of digestion is a component of the resting metabolic rate rather than a single event. Two weeks of fasting caused a 22% decrease in metabolic rate. This was proportional to the decrease in body weight, thus there was no change in the weight-specific metabolic rate. Observations during the fast indicate that manatees reduce their energy requirements primarily by a reduction in activity.

Food Habits of the West Indian Manatee, *Trichechus manatus*, in South Florida (D.A. Ledder). - Gut contents were collected from 84 animals over a five-year period in order to describe the diet of *T. manatus* in south Florida.

Microhistological analysis was used to identify plant species sampled from the stomach, duodenum, and cecum. A gross analysis was also done to estimate the ratio of surface to subsurface portions of the plants consumed.

Manatees fed in both fresh and salt water. The seagrass *Halodule wrightii* composed the largest portion of the diet (23.4%), followed by the freshwater species *Hydrilla verticillata* (12.3%). Significant contributions were also made by the seagrass *Syringodium filiforme* (8.9%), and the euryhaline species *Ruppia maritima* (8.0%). Algae were found in significant amounts in five of the animals, contributing 6.0% to the diet. Subsurface portions of plants contributed more to the diet for saltwater species (mean ratio of surface/subsurface portions = 46/54) than for freshwater species (86/14).

Manatee (*Trichechus manatus*) Reproduction in Florida (G.B. Rathbun and J.A. Powell). - Longitudinal records of free-ranging individually recognizable manatees at clear-water winter refuges in northern Florida were used to determine the timing of several reproductive events. Mortality records and aerial survey data were also used. The adult sex ratio is 1:1; gestation is

12-14 months; litter size is 1-2; the proportion of calves in the population is about 10%; the average calving interval is 2.4 years; the minimum age at first reproduction is 5 years; and there is a slight peak in mating activity during the spring in northern Florida. These data suggest that manatees in Florida may have a greater reproductive potential than was previously estimated.

Results of Winter Aerial Surveys of Manatees (*Trichechus manatus*) Around Florida Power Plants in 1982-1983, and Comparisons with Similar Surveys of the Previous Five Years (J.E. Reynolds III, P.M. Rose, and J.R. Wilcox). - Intensive winter aerial surveys to assess manatee abundance and distribution around selected Florida power plants have been done in a relatively consistent manner for the past 6 years. In winter, 1982-1983, 930 animals were sighted during 7 surveys of 5 power plant effluents, and 261 manatees were observed away from the plants. These counts are the lowest in the 6 survey years. Winter of 1982-1983 was warmer than the previous 5 winters, so that low counts may indicate insufficient cold weather to induce large numbers of manatees to aggregate at sites of warm water. It should not be assumed that recent low counts of manatees around power plants indicate a lower manatee population in Florida.

Calves represented 10.0% of the total animals sighted in 1982-1983. An overall calving rate from all 6 years of surveys being considered was 10.8%, as compared to a combined calving rate of 9.1% for other manatee surveys. These rates are statistically different, suggesting that the effluents are used to a greater extent by females with calves than by other manatees. By providing sanctuary for calves, the power plants serve an especially valuable function.

RECENT LITERATURE

[Editor's Note: The following compilation is intended to emphasize publications appearing in 1983 and 1984, and includes papers of that period which the editor was able to remember or dig out of his files while compiling this newsletter. Some significant pre-1983 papers are also included. Readers are invited to submit references at any time, either new ones (post-1983) or old ones of general interest which they think their colleagues may have overlooked. Owing to space limitations, abstracts of published papers will generally not be reprinted in this newsletter unless there is significant reader demand for this service.]

Bengtson, J.L. 1983. Estimating food consumption of free-ranging manatees in Florida. *J. Wildl. Manage.* 47(4): 1186-1192.

Best, R.C. 1982. Seasonal breeding in the Amazonian manatee, *Trichechus inunguis* (Mammalia: Sirenia). *Biotropica* 14(1): 76-78.

Best, R.C. 1982. A salvac,a~o de uma espe'cie: novas

perspectivas para o peixe-boi da Amazo[^]nia. Revista IBM No. 14: 10 pp.

Best, R.C. 1983. Apparent dry-season fasting in Amazonian manatees (Mammalia: Sirenia). *Biotropica* 15(1): 61-64.

Best, R.C., G.G. Montgomery, and M. Yamakoshi. 1982. Avaliac[~]o de te[^]cnicas de ra[^]dio-rastreamento e marcac[~]o do peixe-boi da Amazo[^]nia, *Trichechus inunguis* (Mammalia: Sirenia). *Acta Amazonica* 11(2): 247-254.

Best, R.C., G. Ribeiro, M. Yamakoshi, and V. da Silva. 1982. Artificial feeding for unweaned Amazonian manatees *Trichechus inunguis*. *Internat. Zoo Yearbook* 22: 263-267.

Best, R.C., and D.M. Teixeira. 1982. Notas sobre a distribuic[~]o e "status" aparentes dos peixes-bois (Mammalia: Sirenia) nas costas amapaenses brasileiras. *Bol. FBCN (Rio de Janeiro)* 17: 41-47.

Bizzotto, B. 1983. *Prototherium intermedium* n. sp. (Sirenia) dell'Eocene Superiore di Possagno e proposta di revisione sistematica del taxon *Eotheroides* Palmer 1899. *Mem. Sci. Geol., Ist. Geol. Min. Univ. Padova* 36: 95-116.

Bonde, R.K., T.J. O'Shea, and C.A. Beck. 1983. Manual of procedures for the salvage and necropsy of carcasses of the West Indian manatee (*Trichechus manatus*). Sirenia Project, U.S. Fish and Wildlife Service, Gainesville, Fla.: v + 175. (Available for sale from National Technical Information Service, Springfield, Va. 22161; document no. PB83-255273.)

Buergelt, C.D., and R.K. Bonde. 1983. Toxoplasmic meningoencephalitis in a West Indian manatee. *J. Amer. Vet. Med. Assoc.* 183(11): 1294-1296.

Domning, D.P. 1983. Marching teeth of the manatee. *Nat. Hist.* 92(5): 8, 10-11. May 1983.

Eberhardt, L.L. 1982. Censusing manatees: A report on the feasibility of using aerial surveys and mark and recapture techniques to conduct a population survey of the West Indian Manatee. Prepared for U.S. Fish & Wildlife Service by Florida Coop. Fish & Wildlife Research Unit, Gainesville: Manatee Population Research Report No. 1: 1-18.

Furusawa, H., and M. Kimura. 1982. Discovery of new species of Sirenia from the Lower Pliocene in the Sorachi River, Takikawa city, Hokkaido. *J. Geol. Soc. Japan* 88(10): 849-852. [In Japanese. Discovery of a partial skeleton of *Hydrodamalis* is reported, but no new species are actually described.]

Gallivan, G.J., and R.C. Best. 1983. Temperature regulation in the Amazonian manatee *Trichechus inunguis*. *Physiol. Zool.*

56(2): 255-262.

Irvine, A.B. 1983. Manatee metabolism and its influence on distribution in Florida. *Biol. Conserv.* 25(4): 315-334.

Irvine, A.B., and M.D. Scott. 1984. Development and use of marking techniques to study manatees in Florida. *Fla. Sci.* 47(1): 12-26.

Kimura, M., et al. 1983. Occurrences of Early-Middle Pleistocene mammalian fossils from the Nopporo Hills in the Ishikari Lowland, Hokkaido. *Earth Sci. (Chikyu Kagaku)* 37(3): 162-177. [In Japanese; English summary. Reports a partial skeleton of *Hydrodamalis*.]

Kinnaird, M.F. 1983. Aerial census of manatees and boats over the lower St. Johns River and the Intracoastal Waterway in northeastern Florida. *Site-Specific Reduction of Manatee Boat/Barge Mortality Research Report No. 2*: iv + 56.

Kinnaird, M.F. 1983. Evaluation of potential management strategies for the reduction of boat-related mortality of manatees. *Site-Specific Reduction of Manatee Boat/Barge Mortality Research Report No. 3*: ii + 43. [Includes discussion of propeller guard designs, artificial barriers, and acoustic repellents.]

Kinnaird, M.F. 1983. Site-specific analysis of factors potentially influencing manatee boat/barge mortality. *Site-Specific Reduction of Manatee Boat/Barge Mortality Research Report No. 4*: iv + 41.

Kinnaird, M.F., and J. Valade. 1983. Manatee use of two power plant effluents on the St. Johns River in Jacksonville, Florida. *Site-Specific Reduction of Manatee Boat/Barge Mortality Research Report No. 1*: iii + 63. [This and other papers in this series available on request from Endangered Species Field Office, U.S. Fish & Wildlife Service, 2747 Art Museum Drive, Jacksonville, Fla. 32207.]

Kleinschmidt, A. 1982. Wissenswertes u"ber die Sa"ugerordnung der Seeku"he (Sirenia) unter besonderer Beru"cksichtigung der Stellerschen Riesenseekuh *Rhytina gigas* (Zimmermann, 1780) sowie ihre hochgradige Anpassung an das Wasserleben im Vergleich zu den Walen. *Braunsch. Naturk. Schr.* 1(3): 367-418.

Kleinschmidt, A. 1983. Notiz zu weiterem Skelet-Material der Stellerschen Riesenseekuh *Rhytina gigas* (Sirenia, Mammalia). *Braunsch. Naturk. Schr.* 1(4): 763-765.

Loveland, F.O. 1976. Tapirs and manatees: Cosmological categories and social process among the Rama Indians of eastern Nicaragua. In: M.W. Helms and F.O. Loveland (eds.), *Frontier Adaptations in Lower Central America*. Philadelphia, Inst.

for Study of Human Issues: 67-82. [The Rama quite rightly regard manatees as the embodiment of culture, society, and order.]

Nishiwaki, M., et al. 1982. Recent survey on the distribution of the African manatee. Sci. Rept. Whales Res. Inst. 34: 137-147.

Packard, J.M., R.C. Summers, and L.B. Barnes. 1983. Correction factors for observability of manatees during aerial surveys. Florida Coop. Fish & Wildlife Research Unit, Gainesville: Tech. Report No. 8, Manatee Population Research Report No. 3: 1-10. [Available from Coop. Fish & Wildlife Research Unit, 117 Newins-Ziegler Hall, Univ. of Florida, Gainesville, Fla. 32611.]

Piggins, D., W.R.A. Muntz, and R.C. Best. 1983. Physical and morphological aspects of the eye of the manatee *Trichechus inunguis* Natterer 1883: (Sirenia: Mammalia). Mar. Behav. Physiol. 9(2): 111-129.

Rathbun, G.B., J.A. Powell, and G. Cruz. 1983. Status of the West Indian manatee in Honduras. Biol. Conserv. 26(4): 301-308.

Rich, V. 1983. Sea-cow relics for museum. Nature 306: 415. Dec. 1, 1983. [Reports discovery on Bering Island of "a virtually complete skeleton" of *Hydrodamalis*, to be kept and displayed on Bering Island itself.]

Shane, S.H. 1983. Manatees and power plants. Sea Frontiers 29(1):40-44.

Shane, S.H. 1983. Abundance, distribution and movement of manatees (*Trichechus manatus*) in Brevard County, Florida. Bull. Mar. Sci. 33(1): 1-9.

Sprent, J.F.A. 1983. Ascaridoid nematodes of sirenians - a new species in the Senegal manatee. J. Helminth. 57: 69-76.

Steel, C. 1983. Vocalization patterns and corresponding behavior of the West Indian manatee (*Trichechus manatus*). Dissert. Abstrs. Internat. B. Sci. Eng. 43(10): 3160.

Takahashi, S. et al. 1983. Report on the excavation of the great Yamagata sea cow. Yamagata Prefectural Museum, Special Publ.: 1-76. [In Japanese. Concerns a new Late Miocene species of *Dusisiren*, ancestral to *Hydrodamalis*, which will be formally described elsewhere.]

Tiedemann, J.A. 1983. Observations of the West Indian manatee, *Trichechus manatus*, in Turkey Creek, Brevard County, Florida. Fla. Sci. 46(1): 1-8.

Wells, N.A., and P.D. Gingerich. 1983. Review of Eocene Anthracobunidae (Mammalia, Proboscidea) with a new genus and

species, *Jozaria palustris*, from the Kuldana Formation of Kohat (Pakistan). *Contrib. Mus. Pal. Univ. Michigan* 26(7): 117-139. [Proposes, probably incorrectly, that sirenians are descended from anthracobunids.]

Werzinger, J. 1982. Sensation im Tiergarten Nu"rnberg: Die Flaschen-Seekuh. *Tier* 22(11): 34-37.

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