Sirenews (ISSN 1017-3439) is edited by
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NUMBER 15 APRIL 1991

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EDITORIAL

In the six months since our last issue, the world has seen a violent and tragic war unfold in the Middle East. A complete reckoning of that war's casualties may never be made; indeed, at this writing the casualties, to humans as well as other species, are still being inflicted. Spilled and burning oil continues to pollute the air and waters of the Persian Gulf on an unprecedented and almost apocalyptic scale. Amid this devastation, the news media have struggled to obtain reliable information about the impacts of these catastrophes on the biota of the Gulf, including dugongs. (Indeed, if there is any scrap of gratification to be found in the

aftermath of the war, it may be that the existence of the dugong has been made known through news reports to millions of people who doubtless had never heard of the animal.)

In this issue, Sirenews is pleased to present what may be the most detailed description of postwar conditions in the marine environment to have emerged so far from the Gulf - an eyewitness account by Tony Preen, author of a recently-published monographic study of dugong status in the Arabian region. Tony is now once again in the Gulf, assisting with the evaluation and cleanup of the oil-spill damage, and we are indebted to him for this timely and authoritative report.

Happily, the news regarding the dugong is good: no mortality or other direct impact attributable to the spills - so far. But the damage continues to mount, and other species have suffered major blows. Meanwhile, elsewhere in the world, the sirenian news is a similar mixture of good and bad. Dugongs are holding their own on remote Cape York, but the manatee body count continues to climb in the increasingly human-choked peninsula of Florida, while the Brazilian government not only fails to enforce its own laws protecting manatees but routinely tabulates in its fishery statistics the number of tons of manatee meat sold in Amazonian markets. We have a long way to go. - DPD

SIRENIAN WORKSHOP IN 1993?

The first Sirenian Workshop was held in Edmonton, Canada in 1985 as part of the Fourth International Theriological Congress (ITC). ITC VI will be held in Brisbane, Australia in August 1993. Professor Michael Bryden and I have been asked to help convene a symposium on Marine Mammals. The details are not finalized as yet, but we are planning a symposium entitled "The Status of Marine Mammals". This would consist of a series of invited reviews on the status of species in major taxonomic groups, plus posters on particular species.

I suggest that it would also be timely to hold a second Sirenian Workshop in association with this conference. A workshop is more appropriate than a symposium for a small specialist group like ours. The format would also consist of invited review papers and posters, as this is the ITC style.

A DECISION TO GO AHEAD WITH THE WORKSHOP WILL DEPEND ON YOUR RESPONSE. IF YOU ARE INTERESTED IN COMING, PLEASE LET ME KNOW. ICANNOT GUARANTEE ASSISTANCE WITH TRAVEL, BUT IF THE WORKSHOP LOOKS VIABLE, WE WILL TRY TO OBTAIN ASSISTANCE FOR POTENTIAL PARTICIPANTS FROM DEVELOPING COUNTRIES. - Helene Marsh

EDUCATIONAL MATERIAL ON DUGONGS

The Fisheries Branch of the Queensland Department of Primary Industries has produced educational modules on dugongs and seagrasses. The modules consist of student activity sheets and teacher's guides. The material is aimed at primary school students. Copies can be obtained from Ms. Dawn Couchman, GPO Box 46, Brisbane, Queensland 4001, Australia.

LOCAL NEWS

AUSTRALIA

Status of Dugongs off the East Coast of Cape York. - In November 1985, I carried out an aerial survey over 31,288 square kilometers of northern Great Barrier Reef waters off the east coast of Cape York. This resulted in a population estimate for the region of 8110 +_ s.e. 1073 dugongs. The Great Barrier Reef Marine Park Authority accepted my recommendation that the survey be repeated after five years and funded another survey in November-December 1990. As a result of this survey, we estimated that there were 10,472 +_ 1579 dugongs in the region; the difference between surveys was not significant. The distribution of dugongs was very similar for the two surveys. I conclude that dugong numbers have not declined in this region in the last five years.

Anthropogenic impacts in this region are low as it is very sparsely populated. The major impacts are probably incidental drownings in gill nets and traditional hunting from two communities. On the basis of the data on this traditional catch that Andrew Smith collected between 1984 and 1987, he and I concluded that it was likely to be sustainable, a conclusion supported by the results of my recent survey. - Helene Marsh

Mating Herd off Cape York. - In October and November 1988, Tony Preen observed the mating behavior of dugongs in Moreton Bay in southern Queensland (Marine Mammal Science 5: 382-387, 1989). The behaviors he described had many similarities with those of the mating herds of West Indian manatees, but the competition for oestrous females was more intense and more violent. In contrast, Anderson (Sirenews No. 11, April 1989) reported that in Shark Bay on the other side of Australia, dugongs make use of a lek mating system. Individuals patrol mutually exclusive territories and defend them through displays and combat. This difference between the mating behaviors of dugongs in different geographical areas is very interesting but not unprecedented, as lekking in mammals has so far always been found to be facultative rather than obligatory.

What happens in other areas? In hundreds of hours of aerial survey in northern Australia, mostly in October and November, I had never seen mating dugongs. However, on 12 December 1990, during the aerial survey of the waters off Cape York (see above), we saw a dugong mating herd in water about 22 m deep about 22 km off the coast east of the mouth of the

Stewart River (14 04' S, 143 41' E) in Princess Charlotte Bay. This is the locale of the famous paper written by Donald Thomson on the basis of his research in 1928 and entitled "Dugong hunters of Cape York" (Jour. Roy. Anthrop. Inst. 64: 237-264, 1934). As described by Thomson, dugongs are fairly numerous in this area but tend to occur in small groups. Although it was out of our transect, we were attracted by the size and behavior of this herd and decided to abort the transect.

We circled the herd for about five minutes. A tight group of five or six animals was surrounded by a dispersed aggregation of 18 others. Animals in the central group were creating a great deal of splash as four or five animals attempted to cling to and mount the focal animal, presumably a cow in oestrus. This animal was in an upright horizontal position just below the surface. Up to three animals were ventral side up, attempting to dive under the cow. The two animals closest to the mounted group were also very active, and I have photographs of one ramming the side of the other with its head. The other animals were swimming around actively and showed no evidence of feeding behavior. The behavior of this group is very similar to that observed in Moreton Bay. We still need information from other areas. - Helene Marsh

BRAZIL

Activities of the INPA Aquatic Mammal Laboratory. - The Laboratory of Aquatic Mammals at the National Institute of Amazonian Research (INPA) in Manaus began its activities in 1974 with a single captive manatee. After 1976 it broadened its range of studies to include Amazonian river dolphins, otters, and the ariranha (giant otter). The number of manatees held in captivity also increased. Presently we have 11 captive animals (5 females and 6 males), including a male calf about 6 months old which is being fed an artificial milk formula developed by us.

The captive manatees have been used in a series of studies on their physiology, food preferences, annual variations in the aquatic macrophytes constituting their diet, and the nutritional constituents of these plants. Also studied have been daily food consumption, anatomy of the digestive tract, nursing of calves, dispersal of seeds of aquatic grasses by manatees, cytogenetics, hematology and blood biochemistry, age determination, craniometry, and diseases.

Some studies are still in progress, among them those of craniometry, grass-seed dispersal by manatees, and age determination. New projects are being elaborated for 1991, 1992, and 1993, involving the present status of the manatee in the Brazilian Amazon, radiotelemetry in the wild, histological, anatomical and physiological studies of the digestive tract, and endocrinology.

We are presently finishing the construction of our new aquatic park. One of the manatee tanks is already in the final stage of construction, and the rest should be completed in 1991.

Our research team presently includes the following personnel: Vera Maria Ferreira da Silva, M.Sc.; Fernando Cesar Weber Rosas, M.Sc.; Elton Pinto Colares, B.Sc.; Ioni Gonc,

alves Colares, B.Sc.; and Francisco Antonio Pinto Colares, B.Sc. Ioni is scheduled to defend her master's thesis (on food habits of Trichechus inunguis) in February 1991; Elton is scheduled to defend his (on physiology and biochemistry of blood plasma in T. inunguis) in March 1991. - Ioni Colares

West Indian Manatee Project. - Monica Borobia reports that the West Indian manatee project based in Paraiba, Brazil, seems likely to be reinstated. Its status has been changed; it is now called the "Centro de Estudos e Conservac,ao de Sirenios" (Sirenian Research and Conservation Center) and is directly under the umbrella of IBAMA (Brazilian Institute of the Environment and Renewable Natural Resources). Along with foreign funding, this must have significantly improved the project's financial support, given the considerable improvement in its field base installations and equipment since the time when Monica worked in Barra de Mamanguape. In addition, an office has been set up in Joao Pessoa, the capital of Paraiba, one hour away. Worth noting is the well-planned conservation/education campaign directed to coastal communities of the Brazilian Northeast. However, it seems that research efforts have been mainly concentrated at Barra de Mamanguape.

There is increasing and encouraging evidence of manatee presence in other parts of the Northeast, including southern Bahia where manatees had not recently been known to occur. For example, Monica sent photos of a manatee rib she found in the zoological collection of the Federal University of Alagoas in Maceio'. It appears to be quite broad (more than 5.5 cm) in its midsection, as is characteristic of Trichechus manatus. She feels that these records should warrant an in-depth survey of the entire region, and that a good look might yield surprising results, as has been the case for other aquatic mammals in Brazil, such as Pontoporia.

Manatees Still Commercially Exploited in Brazil. - A not-so-encouraging aspect of Monica Borobia's report is that commercial hunting of manatees may actually be continuing in Brazil with the knowledge and apparent approval of that country's federal government. She quotes the following excerpt of a letter to her from the well-known Brazilian conservationist Admiral Ibsen G. Camara, dated 12 March 1990 (her translation):

"It's interesting that the Anua'rio Estati'stico do Brasil [the official government compilation of commercial data, published by the Instituto Brasileiro de Geografia e Estati'stica], year 1989, shows in the fisheries statistics, 7 tons of manatee for 1985, 2 for 1986 and another 2 for 1987; it is probably from T. inunguis, but in any case it's surprising that a protected species should be included in the [statistics on] fisheries production."

This news prompted a look at earlier volumes of the Anuario Estatistico, which yielded the following data:

Species	Year	Catch (tons)		Value (Cr$1000)	
		Total	Freshwater	Total	Freshwater

Aquatic mammals	1970	8074	54	3260	52
" "	1971	9813	63	4420	76
" "	1972	3069	14	2291	27
" "	1973	7375	55	4122	114
" "	1974	6568	--	5610	--
Cetaceans	1975	6631	--	6498	--
"	1976	5816	--	4045	--
"	1977	4120	--	4120	--
"	1978	3700	--	9920	--
"	1979	3064	--	26440	--
Manatee	1980	5	5	0	0*
"	1981	14	14	1	1
"	1982	19	19	2	2
"	1983	5	5	1	1
"	1984	9	9	10	10
"	1985	7	7	18	18
"	1986	2	2	26	26

* Note: From 1980 on, the units of value are millions of cruzeiros rather than thousands.

The data compilations for the years 1970 to 1974 do not specify what sort of freshwater aquatic mammals are included in the catch, the bulk of which comprised whales. Presumably the freshwater mammals were T. inunguis. Manatee hunting was totally banned in Brazil in 1973, whereupon the reporting of such statistics as the above (though not, of course, the actual hunting) abruptly ceased (see Domning, Biol. Conserv. 22(2): 101-126, 1982). From 1975 to 1979, the data category for aquatic mammal production was accordingly labeled simply "Cetaceans", and all the production in this category was attributed to salt water. Beginning with 1980, however, the "Cetaceans" category (later renamed "Aquatic mammals") was explicitly broken down into "Whale" (data not shown here) and "Manatee", and production of manatee products (presumably meat, and all from fresh water) was again officially reported.

The federal government's ban on hunting of both T. inunguis and T. manatus was reiterated on February 21, 1986 (Portaria SUDEPE No. N-011). (The text of this regulatory decree can be found in FBCN/Informativo [Rio de Janeiro, Fundac,ao Brasileira para a Conservac,ao da Natureza] 10(2), April-June, 1986.) Yet the commercial exploitation of manatees continued throughout the 1980's, obviously with the government's knowledge since the statistics quoted above were published by the government, and were still being published as of 1989.

Monica comments that this seems to be a prime example of the unfortunate lack of law

enforcement on the part of Brazilian government agencies. Hopefully, researchers at the two manatee research centers in Brazil can investigate the origin of these statistics. In any event, government agencies capable of gathering statistics on illegal fishing activity should be able to do more in the way of putting a stop to it. In the opinion of Sirenews, it would be desirable for the Brazilian agencies concerned (such as IBDF and SUDEPE) to take more seriously their responsibility to enforce their country's existing laws and their own regulations - especially at a time when preparations for the U.N. Conference on Environment and Development, to be held in Brazil in 1992 (see Sirenews No. 14), are focusing increased world attention on Brazil's conservation track record.

CARIBBEAN REGION

Outlook for Manatee Survival Grim Unless Rapid Action is Taken. - In September 1989, [after] answering a call for a live manatee stranding in Puerto Rico, the local police informed us that the caller had stated: "There is a live manatee on shore; can we shoot it so we can eat it?" Upon [our] reaching the locality to assess the situation, the manatee was not found. We concluded that poachers got there first.

Four months later, an adult manatee was found floating dead with no obvious evidence of cause of death. Upon examination, it was determined that the animal was carrying an almost full-term fetus, and that she died from a boat collision which ruptured her internal organs. Death cases in Puerto Rico also attributed to the same cause occurred in 1988, 1989, and this past October 1990.

Traveling to Colombia in April 1990, I examined a manatee captured by local fishermen, which was sold for $300 to the Barranquilla Zoo, where it is kept for exhibition. Local biologists worry for its health given that it is in a very small and shallow tank without a filter, and it has a fractured flipper and other infected wounds.

In October 1990, I visited the city market in Santo Domingo, Dominican Republic. I wanted to see for myself if there was an actual market for manatee bones, in addition to the use of manatee meat as food. To my surprise, different stores sold polished and carved manatee ribs mounted on wood stands. They also sold manatee oil for treating chest colds. One of the store owners took me in the storage area, where I saw a box holding about 50 to 75 ribs and vertebrae to be processed during the following days. Pressures such as these are greater than the small localized manatee populations in the Caribbean can withstand. Studies conducted in the late 1970's and in 1984 suggest that only 100 to 200 manatees exist today off the Caribbean islands.

This endangered status, probably compounded by a genetic bottleneck and low reproductive rate, is aggravated by up to six reported deaths each year for the past 15 years. The 45 deaths reported since 1975 do not include those manatees taken by poachers for their meat. During the Christmas holidays, it is a tradition for some families living in coastal areas to eat manatee meat. The leading causes of manatee mortality are human-related, either by

poaching, incidental takes, or boat collisions. Most deaths were thought to be due to accidental gill net entanglement, but recent research revealed that these nets are set specifically to catch manatees for human consumption....

It is only through research, education and the type of cooperative action exhibited by the creation of the Caribbean Stranding Network [see Sirenews No. 14] that the Antillean manatee will have a chance to survive throughout its entire range. - Antonio A. Mignucci Giannoni (reprinted by permission from the Save the Manatee Club Newsletter, March 1991)

FLORIDA

Synoptic Manatee Aerial Surveys. - Nearly simultaneous aerial surveys throughout the State of Florida and parts of southern Georgia, made in an attempt to count as many individual manatees as possible, have yielded a maximum count of 1,465 animals, in close agreement with the previous minimum estimate of 1,200 manatees in the state.

On 23-24 January and again on 17-18 February, more than 30 biologists, representing 19 local, state, and federal agencies, private research groups, and independent contractors, were mobilized by the State's Department of Natural Resources (DNR) in an all-out effort to count manatees. Counts were made from 25 planes and 3 helicopters in the first survey; 26 aerial teams participated in the second. Two ground crews also aided in each survey. Each team included a biologist experienced in manatee aerial surveys. The surveys were planned to follow in the wake of cold fronts, when many manatees would be concentrated at warm-water sources. A prolonged cold spell would have provided ideal conditions for the census. However, the past winter was a mild one in Florida, and the two cold fronts used for the surveys were not as severe as many in the past; but the survey coordinators judged that no better opportunities were likely to occur this year. The survey teams had been designated and on standby since 15 December.

The January survey yielded a preliminary total count of 1,268 manatees, 679 on the east coast and 589 on the west coast of Florida. The February survey, which enjoyed more favorable conditions following a more severe cold front, counted 1,465 (813 on the east coast and 652 on the west). The second survey also included some areas not covered the first time, such as a naval base previously off limits due to preparations for the Persian Gulf war, power plants where overflights had been restricted for fear of terrorist attacks, and other areas missed because of aircraft engine problems or bad weather. These raw figures may be reduced slightly by removal of probable duplicate sightings. Although both surveys concentrated on areas known to be used by manatees as warm-water refugia, the intervening areas of rivers and coastal waters were also surveyed. The results of both surveys were consistent with each other and with previous knowledge of manatee habits and distribution: manatees in the colder northern part of the state were concentrated at refugia, whereas in the south they were more widely dispersed.

The total counts were in close agreement with the minimum population estimate of 1,200, which was based on compilation of data from non-simultaneous surveys of the individual warm-

water refugia. That estimate had been revised upward in 1985 from the previous minimum estimate of 1,000.

The simultaneous statewide surveys were first planned three years ago, but were not carried out until now due to unusually warm winters in the last two years. The surveys were a response to public pressure, particularly from boating industry spokesmen who opposed the increased regulation of boating being urged for the sake of manatee protection. They contended that the biologists' minimum estimate of only 1,200 Florida manatees was much too low and that tightened regulation was unnecessary. They argued that, in fact, no one really knew how many manatees there were and hence there was no reason to think they were endangered.

Manatee biologists, for their part, were generally critical of the proposed statewide census, on several grounds. They pointed out that what was important to conservation efforts was not the total number of manatees, but the trend in the numbers over time. This trend could only be established by surveys repeated, with consistent methods, over five to ten years. The one-time census proposed would not be statistically comparable to any survey done in the past, and because the results would be expected to vary with the intensity of cold fronts, it would be difficult or impossible to replicate the conditions of the census in future years. Moreover, the cost and the daunting logistical complexity of the census would discourage repeat attempts. The biologists argued that continued monitoring of the known manatee aggregation sites by the long-established survey methods already in place would yield a more accurate picture of any population trend, and probably just as good an estimate of the total population size, at much lower cost and effort. Finally, they noted that, given any plausible model of manatee population dynamics, the present mortality rate of over two hundred animals a year (see below) could not be consistent with population stability. They feared that whatever number a census produced, whether accurate or inaccurate, would be misinterpreted by the public and used to obscure these basic facts that dictated strengthened conservation measures regardless of the actual number of manatees.

Caught in the middle of this controversy, DNR eventually yielded to the political pressures and organized the census. Fortunately, the result has vindicated the biologists' previous population estimates and provided no comfort to the boating lobby. Although the new minimum count of 1,465 manatees exceeds the previous minimum estimate of 1,200, this doubtless resulted from increased survey effort and cannot be interpreted as a sign of a population increase, nor is it out of line with any previous thinking on the part of manatee researchers. All who have studied the relevant data agree that the manatee population in Florida is most likely declining, due to high rates of human-caused mortality and habitat loss (see below).

The census also stands as another, and perhaps the most dramatic, landmark in the long and laudable history of interagency cooperation on behalf of the Florida manatee. Dr. Bruce Ackerman, the project leader, and his collaborators had to overcome what they termed "horrendous" logistical difficulties - as will be appreciated by anyone experienced in such operations. For this they deserve the applause of all those involved in sirenian conservation.

- DPD

New All-time Manatee Mortality Record. - The Florida manatee salvage program has once again, for the third consecutive year, logged an unprecedented number of dead manatees. The 1990 grand total was 206, compared with 166 in 1989 and 133 in 1988. The previous maximum was 128 in 1984.

The new mortality peak in 1990 was due largely to a major cold-related manatee kill in winter 1989-90. However, human-related mortality also remained high. Boat kills numbered 47, only slightly below the 1989 record of 50. There were also 3 deaths in flood gates or canal locks, and 4 other human-related deaths. Perinatal deaths also set a disturbing new record of 44, surpassing the 1989 record of 36. 66 other natural (including cold-related) deaths and 42 of undetermined causes made up the total of 206.

Meanwhile, the 1990 U.S. Census showed that nine of the 12 fastest-growing metropolises in the United States were in Florida. Seven of these nine are coastal cities within the manatee's year-round range: Naples (which grew by 77% since 1980), Fort Pierce (66%), Fort Myers (63%), West Palm Beach (50%), Melbourne-Titusville (46%), Daytona Beach (43%), and Bradenton (43%). The inland cities of Ocala and Orlando grew by 59% and 53%, respectively. Florida now has three cities with over 1 million people: Miami (3,192,582, up 21% since 1980), Tampa (2,067,959, up 28%), and Orlando (1,072,748). To a large extent this growth was fueled by retirees.

Watercraft-related manatee deaths in Florida during 1986-90 showed a 68% increase over the previous 5-year period (1981-85) and a 124% increase over the period from 1976 to 1980. - (Sources: Florida Dept. of Natural Resources and The Washington Post.)

INDIA

Dugongs and Ganges River Dolphins Featured on Postage Stamps. - Postage stamps featuring the river dolphin (Platanista gangetica; denomination Rs.4.00) and the dugong (Rs.6.50), along with a first-day cover showing the common dolphin (Delphinus delphis), were released by the Indian Postal Department on 4.3.1991 at Cochin, India. The proposal for the stamps and the basis for the designs were provided by Dr. R. S. Lal Mohan, Principal Scientist of the Central Marine Fisheries Research Station, Calicut, and a member of the IUCN Cetacean Specialist Group. He also provided the write-ups on the animals for an accompanying brochure.

This is the first time an aquatic mammal stamp has been issued by India. It is also the first time a stamp has featured the Ganges River dolphin. One million stamps were printed and kept for sales all over India. They were released by Justice K. Sukumaran of the Kerala High

Court. The ceremony was announced in the newspapers and well covered by nationwide radio and television. The stamps are intended to create awareness among the people, as many of them are not even aware that the river dolphins are found in the Indian rivers Ganges and Brahmaputra, or that the dugong is distributed along the southeast coast of India. It is hoped that these stamps will help in the efforts to protect these animals.

MEXICO

National Manatee Research Program. - Mexican marine mammalogists assembled at the Workshop on Marine Mammals in Mexico City, 15-17 October 1990, elaborated a National Program for the Investigation, Conservation and Management of Marine Mammals in Mexico. As part of this program, a group of workers interested in manatees proposed a project entitled "Situacion Actual, Ecologia y Conservacion del Manati Trichechus manatus en el Sureste de Mexico [Status, Ecology and Conservation of the Manatee in Southeastern Mexico]." Any researchers interested in collaborating on this project are encouraged to establish communication with Luz Colmenero at her new address given below.

PERSIAN GULF

Dugongs Threatened by Kuwait Oil Spill. - As all of our readers are by now aware, the massive oil spills resulting from the war in the Persian Gulf have caused extensive damage to the environment and wildlife of that shallow, landlocked sea. Up to this point, however, casualties among the Gulf's dugong population have fortunately been nonexistent.

The actual size of the spill is itself, of course, still in doubt. In early April, press reports of official estimates gave its volume as at least 1.5 million barrels, with the possibility that it may eventually prove to be between 4 and 7 million barrels - in any event, the largest such disaster in history.

Dugongs were not among the organisms most immediately threatened. According to Tony Preen's 1989 study of dugong status

and conservation in the Arabian region (Saudi Arabia, Meteorological & Environmental Protection Administration Coastal and Marine Management Series Report No. 10, 2 vols.), they do not normally occur in the waters of Iran, Iraq, Kuwait, or northern Saudi Arabia north of Ras Tanura (near Dhahran). Dugongs in the Gulf are mainly found along the western and southern coasts between Ras Tanura and Abu Dhabi. One of the most important dugong

areas, and the only one likely to suffer significant impacts from the spill, is the Gulf of Salwa, which separates Saudi Arabia from western Qatar and surrounds the island of Bahrain. Preen estimated the dugong population of the entire Gulf at 7307 +_ s.e. 1302 (coefficient of variation 17.8%). About 54% of this population was located in the Gulf of Salwa during Preen's summer aerial surveys (August and October 1986).

So far, the oil slicks have moved slowly, and the shores most affected have been those well to the north of Ras Tanura. With time and the approach of warmer weather, the oil can be expected to partly evaporate and partly sink; and the lack of heavy wave and current action should tend to keep most of the oil concentrated north of the major dugong habitats. On the negative side, of course, the wildlife habitats where the oil remains suffer correspondingly heavier damage, and cleanup work is very limited in scope and proceeding slowly.

Of uncertain import is the fact that the northern Gulf was heavily polluted by oil even before the recent war. Preen pointedout the possibility that chronic low-level exposure to hydrocarbons "may in the long-term be the most damaging effect of petroleum pollution on dugongs in the Gulf." Given the additional fact that extreme salinities and low winter water temperatures make the Gulf to some degree a marginal and possibly stressful habitat for dugongs to begin with, the new spills "could more readily exceed the tolerance limits of dugongs in this region than in other areas, where environmental conditions are less extreme."

The foregoing may provide useful background to the following on-the-scene report from our special correspondent, who has gone to the Gulf to study the situation at first hand. - DPD

Gulf War Oil Spill: A Situation Report. - I have been in Saudi Arabia since 25 February, assisting with the response to the Gulf war oil spills. The following is a brief account of the situation.

The oil spills commenced on 19 January 1991. At least seven sources are known, including tankers, terminals and refineries. Early estimates of spill volume, based on remote sensing, ranged from 5 to 11 million barrels. Measurements of tank capacities and pumping rates have not been obtained, but two vessels known to have been deliberately emptied each contained 1 million barrels. To date no consensus estimate has been determined, but it is likely to be on the order of 6 million barrels.

At the time of writing (5 April 1991), oil continues to be discharged from several sources. Total discharge is estimated at about 3000 +_ 1500 barrels per day.

The spills have resulted in two types of slick: (1) very thin slicks, located in the center of the Gulf, and (2) a very thick slick which impacted the Saudi coast. A series of thin slicks, composed of small amounts of oil (10,000-20,000 barrels), formed large areas (thousands of square kilometers) of sheen with streamers and patches of thicker oil mousse. These slicks have gradually moved southeast, down the center of the Gulf. In the process they have impacted some of the offshore islands and, recently, the north and northwest coasts of Bahrain and Qatar. As a result, 80% of the shoreline of Karan Island was covered with thick oil. After five days of impact, beaches of north Bahrain were very lightly oiled with about 3% cover of fresh tar balls

(up to golf ball size).

By far the majority of the spilt oil moved south along the Saudi coast, eventually impacting all the shoreline north of Abu Ali, a coastline distance of 460 km (see map). This coast includes open beaches and complex, low-energy embayments. Along a transect from dry land into the water, these embayments contain: algal mats, irregularly inundated saltmarshes, regularly inundated saltmarshes, some relict patches of mangroves, intertidal mud/sand flats, subtidal seagrass beds and occasional patch coral reefs.

Effects on habitats. Along sandy beaches the oil occurs in a band 10-100 m wide. Surface coverage within bands is about 100%. On the beach slope the oil has been worked into the sediment to a depth of 2-30 cm. At the base of the beach slope the oil has often pooled to depths of several centimeters.

The intertidal and supralittoral zones have been very heavily impacted. Oil has been driven by wind and high tides into the most distant reaches of the saltmarshes. Over scores of square kilometers the oil lies 500 m to 1 km landward of the normal mean high water line. Surface coverage is 100%. I know of one location where the oil has been driven inland 5 km beyond the shore.

The saltmarshes and mangroves have acted as natural traps for the oil. Within the 460 km of impacted coastline, only one patch of saltmarsh has not been oiled. All the mangroves have been oiled. Hence all the mangroves and virtually all the saltmarshes will die.

Oil has now settled in large patches on intertidal mud/sand flats. The oil has not settled in subtidal areas and there are no apparent short-term lethal impacts of the pollution on the seagrass beds or reefs. Similarly, the intertidal shores of some offshore coral islands have been heavily impacted, but the reefs appear to be unaffected.

Effects on wildlife. By the time the oil struck the Saudi coast, most of the toxic compounds had apparently evaporated, and its main impact on organisms has been by smothering. Hence there has been less mortality of marine fauna than was expected.

The most obvious mortality has been among the seabirds. In particular, the regionally endemic Socotra cormorant as well as the Great cormorant and the Black-necked and Great-crested grebes have suffered. A total mortality of 20,000-30,000 birds has been estimated. During the peak period in February, 90 oiled birds were brought to the Wildlife Rescue Center each day.

Marine mammals have not been significantly affected by the oil. Dugongs do not normally occur within the heavily-impacted area - their range commences 120 km south of Abu Ali. There has been no significant mortality of dolphins. I have seen many humpback dolphins (Sousa chinensis) and bottlenose dolphins (Tursiops truncatus) near oil, and I have seen several Sousa chinensis surfacing through oil sheen. At least two dolphins and one dugong have died during the spill. These all died well south of the main spill area and there is no evidence of a causal relation. Early plans to capture the dugong population and relocate it to Oman have been reconsidered.

At least three turtles (two green and one hawksbill) have died in oiled areas. Cause of death

was not determined. Two green turtles have been treated at the Wildlife Rescue Center and released. They had ingested oil and were very ill when captured. A small number of sea snakes (I counted 11 along 5 km of shore) died on Karan Island as a result of smothering by the oil. Very few dead sea snakes have been seen along the mainland coast.

Fish mortalities have been localized. Shrimp, crabs and molluscs have been the most conspicuous invertebrate victims, all dying in huge numbers.

The direct impacts from oiling and the impacts from loss of intertidal habitats are expected to have a major impact on the populations of wading birds which migrate through or reside in the Gulf. An estimated 1-2 million waders representing 70 species use the area. Mortality is expected to be small in the Gulf, but high mortalities are predicted en route to Siberia and Europe for waders with oiled feathers. Those that do complete their migration may not have the energy reserves to breed.

Recovery and cleanup. The Exxon Valdez spilled 224,000 barrels of oil. So far, over 600,000 barrels of oil have been recovered from the Gulf war spills. A flight along the coast, watching kilometer after kilometer after kilometer of oiled coastline, is ended with a pass over the principal storage pit for collected oil. The absolute insignificance of this quantity, compared to what is still along the shoreline, is absurd.

Due to the magnitude of this spill, the types of habitat impacted and the extreme inaccessibility of some areas (saltmarshes backed by kilometers of often treacherously boggy saltpan), it is unrealistic to expect that much of the coast will be cleaned. We are now identifying the most important sites, which upon recovery may act as sources of propagules for the recolonization of other sites. The recovery of the saltmarsh and mangrove habitats will doubtless take decades, if they ever return to their previous state.

Cleanup of selected habitats is about to begin. By the end of April the gross oil and oiled sand will be removed from the beach of Karan Island, the most important green turtle rookery in the Gulf and an important nesting site for three species of tern. The flushing of free oil from the mangroves of Ghurmah Island will commence in a few days and the washing of some saltmarshes in Dawhat ad-Dafi will begin in about one week.

A final concern worthy of mention regards the oil fires in Kuwait. A huge volume of oil is not burning and is forming huge lakes. It is feared that these may eventually flood into wadis and into the Gulf, potentially creating a spill of even greater magnitude. - Anthony Preen (International Environment Team of the Oil Spill Response Group and Zoology Dept., James Cook University, Townsville, Australia)

Adding Insult to Injury; or, How Much Worse Can It Get? - Colin Bertram has called our attention to the following item, here quoted from New Scientist, 24 November 1990:

"A strange tale appears in The Guardian of teenage heroes (Our Boys in the Gulf) and mutant turtles. Apart from the pollution arising simply from the presence of 300 000 troops in the desert, the paper's Environment section reported last week, a war would threaten the local dugongs. 'These marine turtles are right in the frontline ... Mutant turtles are a distinct

possibility.'

"Now, it never does to mock ... but what the hell: once dugongs have mutated into turtles, maybe a second mutation would be that much easier."

PUERTO RICO

Caribbean Stranding Network Activities. - Network participants from the Puerto Rico Department of Natural Resources salvaged the bones of a badly decomposed large manatee from Levittown, Puerto Rico, in late January 1991, while Antonio Mignucci and three student volunteers necropsied a manatee that had been butchered by humans near the mouth of the Rio Loiza.

Ruby Montoya, a young manatee researcher from Colombia, began working on her four-month internship on marine mammal health at the Caribbean Aquatic Animal Health Project laboratory (University of Puerto Rico, Lajas). - (Excerpted from Summary 7 of the Marine Ecological Disturbance Information Center, UPR, Lajas, 10 Feb. 1991.)

ABSTRACT

The Ecology of Manatees in Georgia with Emphasis on Cumberland Sound (Barbara J. Zoodsma & Lynn W. Lefebvre). - Although sighting reports indicate that manatees are not uncommon in southeast Georgia, little was known about their distribution and ecology in this region, which represents the northern limit of their typical range. A 3-year radio-tracking study was conducted from the spring of 1987 through the summer of 1990 to investigate the ecology of manatees along the southeast coast of Georgia, and to evaluate the potential effects of dredging on manatees in Cumberland Sound and Kings Bay, Georgia. Fourteen manatees were radio-tracked for varying amounts of time during the study: 8 manatees were captured and radio-tagged in Fernandina Beach, Florida; 5 manatees radio-tagged in Brevard County, Florida, migrated to Georgia during the warm season; and one manatee was radio-tagged in Kings Bay, Georgia, in 1989. Weekly aerial surveys were conducted from May through September, 1988, and April through August, 1989, to determine manatee distribution in Cumberland Sound and Kings Bay. Microhistological analysis was performed on the stomach contents of 15 dead manatees which were recovered in Georgia.

Georgia salt marshes are an important manatee habitat. Some of the manatees that winter in Florida return to Georgia in repeated years during the warm season. Manatees feed primarily on Spartina alterniflora, which is only accessible to them during high tide, and the macroalgae Ulva spp. and Gracilaria spp. Manatee activity patterns are rhythmic in response to tidal cycles: manatees feed on Spartina most often at high tide, and rest or cavort at low and mid-tide in both cold and warm seasons. Manatees spend a significantly greater proportion of time resting in a man-made warm water source at low tide than at mid- or high tide in the cold season,

presumably to conserve energy. Aerial surveys as well as radio-tracking indicated that Cumberland Sound, Kings Bay Naval Submarine Base, Tiger Island Marsh, and the Fernandina Beach waterfront are some of the areas in and near Georgia which manatees frequent in the warm season. The Satilla and Altamaha rivers, north of Cumberland Sound, were also visited by several radio-tagged manatees. Potential negative effects of dredging on manatees can be minimized by providing for manatee watches on dredges, requiring support vessels to move at slow speeds, avoiding dredging in manatee feeding areas, and monitoring the effects of dredging on the salt marsh shoreline and benthic macrophytes, particularly in known manatee feeding areas. [Summary of a report to the Florida Cooperative Fish and Wildlife Research Unit.]

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