"Aquatic Mammals", Vol. 8, no. 1, June 1980.

CLINICAL OBSERVATIONS ON CAPTIVE AND FREE-RANGING WEST INDIAN MANATEES, *TRICHECHUS MANATUS*, IN FLORIDA.

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Introduction

Diagnosis and treatment of captive West Indian manatees, *Trichechus manatus*, is hampered by a paucity of clinically useful information. Clinical information is needed because manatees are an endangered species. In Florida, where the manatee population may number as few as 1000 animals (BROWNELL c.s., 1978), sick or injured wild manatees are taken to oceanaria for rehabilitation (ASPER c.s., 1978; BEUSSE c.s., 1978; CARDEILHAC c.s., 1978; ZEILLER, 1978). Successful treatment of these animals may provide valuable medical and biological information, and will contribute to sustaining the beleaguered population. The purpose of this paper is to present clinical data incidentally compiled during various field and captive studies Conducted from 9 October 1975 through 6 February 1979. The information should be useful for diagnosis and for evaluation of treatments for manatees. In particular, we will present blood and urine values, discuss skin lesions on captives, and compare weight-lenght data from captive and dead animals.

Materials and methods

A total of 21 manatees were captured in Florida by the U. S. Fish and Wildlife Service, National Fish and Wildlife Laboratory (NFWL), for tagging studies. Blood samples were collected from 13 different animals, and urine was collected from 10 of those individuals. Most of the manatees were measured, weighed, tagged, and released at the capture site, but four animals were transported to Marineland of Florida, near St. Augustine. Those taken into captivity included a 278 cm long female (No. 2), that was captured with her 181 cm long female calf (No. 3) on 5 March 1976; a 319 cm male (No. 10) captured on 26 August 1977; and a 300 cm male (No. 12) captured on 19 October 1977. Manatee No. 2 was lactating (BACHMANN c.s., 1979), but she weaned the calf during the first 8 months in captivity. Manatee No. 3 died on 27 January 1977. Manatee No. 2 was released on 16 August 1978.
At Marineland, the NFWL animals were held in a 13.4 m long by 6.7 m wide tank (181,000 l) with an adult female, "Rosie", that had been in the tank since 1968. Each manatee was fed 28-38 kg of head lettuce per day and a supplement of up to 1 kg of thread herring, *Opisthonema oglinum*, but only Rosie consistently consumed the fish.
The tank was supplied with ocean water (20 -27° C) during the warmer months. From approximately late November to late March, when the ocean water was 20°C, the tank was filled instead with 20 - 22°C artesian spring weater.

Blood and urine collection. The manatees were usually stranded on the tank bottom as the water was drained, but for some procedures the animals were individually restrained on a foam

padded platform with five to seven straps across the body. Rosie was not handled. Blood was extracted from the palmar side of either flipper (WHITE c.s., 1976) with 18 gauge, 3.8 cm long needles on 25 ml syringes. Blood was dispensed immediately into empty tubes and allowed to clot, or into tubes containing Ethylenediamine tetra-acetic acid (EDTA). Serum was separated from clotted blood and cooled on ice, or frozen if analysis within 24 h was not possible. EDTA blood was analyzed within 5 - 24 h after collection. Blood cell counts, hemoglobin concentrations, packed cell volumes, and erythrocyte indices were determined using a Coulter Counter model ZBI-6 System. Differential leukocyte counts were done on Giemsa-stained blood films by classifying 200 leukocytes. Plasma proteins were determined using a refractometer, and fibrinogen was determined by heat precipitation (SCHALM c.s., 1975). Blood sera were analyzed in SMA-12/60 or SMA 20 analyzers.

Urine was collected in a Frisbee placed under the animals' urogenital area, or in test tubes when animals urinated while on their backs. Urine levels of glucose, blood, proteins, and pH were measured with Hema-combistix; ketones were measured with Ketostix and specific gravity was measured with a total solids meter. Blood and urine osmolarity were measured with an Osmoette A osmometer.

Skin lesions. Skin lesions from manatees were examined for bacteria, fungi, and algae. Cultures were made on dermatophyte and Sabouraud media for fungi and on Lowensteins and Dorset Egg media for acid-fast organisms. Skin lesions also were cultured for anaerobes on Blood Agar Plates (BAP) and in thioglycollate medium, and for aerobes on BAP, eosin-methylene blue and Rimler-Shotts medium. Acid-fast stains were made from lung lesions, and cervical and mesenteric lymph nodes of manatee No. 3 by the above described methods, using acid-fast stains and cultures, and fungal cultures.

Weight-length measurements. Each manatee was measured to obtain tip-of-snout to tip-of-tail length. Weights were obtained on a Sampson scale (Model S-2-12; 907 kg capacity). Lenght and weight data on a manatee captured near Ft. Myers, Florida (AIR No. 1 for use in Fig. 1) were provided by D.K. Odell (personal communcation).

Results and discussion

Blood and urine studies. Values from blood obtained during our studies were similair to those reported for captives (WHITE c.s., 1976), suggesting that there is little difference between healthy captives and free ranging animals (Tables 1 and 2).

Urine values were particularly interesting because specific gravity and osmolarity differed according to salinity at the capture site. Mean urine osmolarities of manatees captured in saline habitats (1158.3 mosm/l) were significantly different ($P < 0.001$; t test) (SOKAL c.s., 1969) from values of manatees captured in fresh water (201.7 mosm/l; Table 3). These results are not conclusive because of the crude urine collection methods, but do suggest that manatees can drink salt water and concentrate their urine to help satisfy fresh water requirements. No other urine values from sirenians are available, and kidney function studies have not been conducted.

Skin lesion studies. All NFWL manatees developed multiple furuncles associated with hair follicles, primarily over the animals' dorsal and lateral surfaces. The female and calf developed lesions within three weeks after initial handling in the tank filled with fresh water, although lesions were less numerous on the calf. The two males developed no lesions until after handling in February 1978. Similar skin lesions on captive manatees have been described as furuncular dermatitis (BARTMANN, 1974), dermatomycosis (TABUCHI c.s., 1974), or due to an infection of *Mycobacterium chelonei* (BOEVER c.s., 1976). Free ranging manatees in Crystal River,

Table I. Mean blood chemistry values (International Units ± Standard Deviation) from *Trichechus manatus*.

	Wild-caught*	Captives** this study	Captives** WHITE c.s. 1976***
Glucose (mg/dl)	75.0 ± 14.8 (10)	80.0 ± 35.8 (5)	73.4 ± 11.9
Sodium (meq/l)	149.8 ± 6.4 (9)	148.4 ± 1.27 (7)	143.8 ± 1.2
Potassium (meq/l)	6.1 ± 0.5 (11)	5.7 ± 0.4 (7)	5.0 ± 0.1
Chloride (meq/l)	92.4 ± 7.2 (11)	88.4 ± 5.0 (7)	88.1 ± 2.0
Co_2 (meq/l)	31.2 ± 5.9 (10)	36.1 ± 5.9 (7)	34.4 ± 0.5
B.U.N. (mg/dl)	12.9 ± 3.7 (8)	8.3 ± 3.3 (7)	16.0 ± 2.3
Creatinine (mg/dl)	1.7 ± 0.8 (11)	1.8 ± 0.6 (7)	—
Uric Acid (mg/dl)	1.3 ± 0.4 (11)	1.2 ± 0.2 (6)	—
Calcium (mg/dl)	10.3 ± 0.4 (10)	10.3 ± 0.3 (5)	10.1 ± 0.7
Phosphorus (mg/dl)	5.2 ± 0.8 (11)	3.6 ± 1.1 (7)	
Total Protein (g/dl)	8.4 ± 0.6 (10)	7.7 ± 0.6 (7)	7.4 ± 0.7
Albumin (g/dl)	5.7 ± 0.2 (8)	—	—
Globulin (g/dl)	2.8 ± 0.3 (8)	—	—
Alkaline Phosphatase (U/l)	132.3 ± 38.6 (11)	118.3 ± 31.1 (7)	—
LDH (U/l)	375.0 ± 353.6 (11)	283.6 ± 105.3 (7)	—
SGOT (U/l)	14.6 ± 8.4 (11)	8.0 ± 7.4 (7)	22.8 ± 11.0
SGPT (U/l)	19.9 ± 9.6 (11)	6.4 ± 3.1 (7)	—
Cholesterol (mg/dl)	137.5 ± 37.8 (8)	150.5 ± 7.8 (2)	—

* ( ) = number of individuals; one sample per individual
** ( ) = number of samples from a total of four manatees
*** 15 samples from two manatees
— = not reported

Citrus County, Florida, are reported to have only "occasional pus-filled tumors" (HARTMAN, 1979).

Topical medications (furacins, iodophors, and gentian violet), that were applied to stranded animals probably were diluted when the tank was refilled with water, and were ineffective for treatment. The lesions gradually regressed after the tank was changed to salt water, but complete healing never occured. The skin condition of Nos. 2 and 3 stopped improving after the water started to cool in the fall, and the furunculosis worsened in fresh water during the winter of 1976-1977. It is uncertain how the improvement in skin condition was influenced by the change in salinity and increase in water temperature. The lesions on Nos. 10 and 12 were improved but still obvious when the animals were released six months after the condition developed.

The manatees calf (No. 3) died in January of 1977, ten month after capture. Gross necropsy and subsequent light microscopy revealed numerous 1 mm to 1 cm skin ulcers and abscesses. The skin at the edge of the flipper had become detached, exposing a confluent reddened dermal area. Numerous 3 cm diameter abscesses were noted in the lung. On histologic section, acid-fast organisms were noted in the lung lesions and in small granulomatous lymph node lesions, but cultures from lymph nodes and lungs on acid-fast media were negative. No acid-fast

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143.8 ± 1.2
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10.1 ± 0.7

7.4 ± 0.7
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22.8 ± 11.0
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Table II. Mean blood counts and red cell indices (± Standard Deviation) from *Trichechus manatus*.

	Wild-caught*	Captives**	
		this study	WHITE c.s., 1976***
RBC ($x10^6$ /ul)	3.2 ± 0.2 (7)	3.1 ± 0.3 (7)	3.6 ± 0.2
WBC (cells/ul)	6120 ± 1345 (7)	8811 ± 1280 (8)	9300 ± 1280
Hb (g/dl)	13.42 ± 1.0 (7)	12.93 ± 1.6 (8)	14.8 ± 0.7
PCV (%)	40.6 ± 1.8 (7)	39.3 ± 4.4 (8)	46.6 ± 0.5
MCV (fl)	125.9 ± 5.6 (7)	125.4 ± 6.1 (7)	129.5 ± 7.8
MCHC (%)	33.28 ± 1.3 (7)	33.7 ± 2.6 (7)	31.8 ± 1.4
MCH (pg)	41.4 ± 2.4 (7)	42.4 ± 4.4 (7)	40.9 ± 1.3
Heterophils (%)	48.3 ± 7.9 (8)	57.5 ± 18.0 (8)	56.2 ± 15.8++
Lymphocytes (%)	44.3 ± 9.8 (8)	34.1 ± 17.2 (8)	34.0 ± 16.5
Monocytes (%)	7.6 ± 3.0 (8)	8.3 ± 5.5 (8)	3.1 ± 0.3
Eosinophils (%)		—	5.2 ± 0.3
Icterus Index (units)	< 5	—	—
Plasma Protein+ (g/dl)	8.5 ± 0.4 (7)	8.8 ± 0.8 (5)	—
Fibrinogen (mg/dl)	371.4 ± 125.4 (7)	—	—

* ( ) = number of individuals sampled; one sample per individual
** ( ) = total number of samples from a total of four manatees
*** 15 samples from two manatees
\+ Due to slight hemolysis in some samples, actual levels may be lower than shown here
++ Listed by WHITE c.s. as polymorphonuclear leucocytes
— = not reported

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organisms were recovered from the skin lesions. No bacteria were isolated from aerobic and anaerobic cultures of the lymph nodes, and only *Escherichia coli* and other coliforms were isolated from lung lesions. No fungi were found in lung or lymph node tissues.

No known pathogenic strains of algae or fungi were isolated from the skin lesions on the adult manatees. However, *E. coli*, *Aeromonas hydrophilia*, three species of *Pseudomonas*, and several typical *Staphylococcus* and *Streptococcus* forms were identified in samples from manatees No.s. 10 and 12. *P. putrefaciens* and *P. florescens* were isolated together and are considered non-pathogenic, while *P. aeruginosa* was the most prominent and is considered potentially pathogenic. *P. putrefaciens* and *P. florescens* were typically isolated from non-lesion areas (i.e. skin), while *P. aeruginosa* and *A. hydrophila* were usually isolated from inside the swollen hair follicles and the open lesions.

It is our opinion that the skin lesions on the manatees resulted from trauma to the dermal tissue. When stranded, each animal occasionally rolled over on the tank bottom and struggled, causing abrasions that were then subject to secondary infections from potential pathogens either in the tank or on the animals. A similair explanation for manatee dermatitis was reported for a manatee being transported from Puerto Rico to England (MURIE, 1872). Lesions on the NFWL animals appeared nearly identical to a pothograph of lesions (BOEVER c.s., 1976), suggesting a common cause. Lesions associated with hair follicles on Rosie were not observed until after she was stranded with the NFWL animals in March 1976. Increased salinity and warm water temperatures may aid healing by bacteriostatic action (ZOBELL, 1946) or by osmotic stimulation of the skin (BARTMANN, 1974).

Table III. Mean urine values (± Standard Deviation) for *Trichechus manatus.* *

Condition	Glucose	Protein	pH	Specific Gravity	Clarity	Blood	Ketones	Osmolarity mosm/l
Wild from fresh water n = 6 manatees	N	N	7.2±0.7	1.007±0.005	clear	N	N	201.7±212.6
Wild from salt water n = 3 manatees	N	N	7.3±0.3	1.021±0.008	clear	N	N	1158.3±49.4
Captive in salt water n = 3 manatees	N	N	7.5±0.9	1.005±0.003	clear	N	N	147.5±35.7**

* Except as noted, one sample from each manatee
**n = 12 samples from a total of two manatees
N = negative

Weight-length studies. The weight-length relationships of free ranging animals (Fig. 1) are of clinical value to assist estimation of nutritional state, especially of sick or injured animals taken into captivity. The linear regression equation for the line is y(kg) = 3.98x - 651.1 (cm). Data taken from measurements of 200 - 400 cm long dead manatees (IRVINE c.s., 1978; BECK c.s., 1978) are described by the equation y(kg) = 4.45x - 821.3 cm (Fig. 1). Slopes of the regression lines were compared (analysis of covariance; KERLINGER c.s., 1973) and found to be homogeneous ($p = 0.34$). Vertical displacement of the y-intercepts was significant ($p = .02$). As has been suggested (ODELL c.s., 1978), the regression line for the salvaged manatees may be generally below that for the live animals because some of the salvaged specimens may have suffered weight loss before or after death.

Manatees No. 10, 12 and 2 lost weight in captivity (Fig. 2). Percent of capture weight lost was 10.7% in 41 days for manatee No. 10, 14.8% in 30 days for manatee No. 12, and 7.6% in 10 days for manatee No. 2. Maximum percent weight loss for manatee Nos. 10 and 12 was 13.1% and 17.6% of capture weight, respectively, but each animal regained weight in the spring. After losing 27.5% of her capture weight, manatee No. 2 generally maintained her weight for 10 months. The sharp initial decreases in weight may have been related to the animals learning to eat lettuce, developing appropriate digestive fauna, or to the nutritional value of lettuce. None of the manatees ate all of the lettuce provided for them during the first four to six weeks in captivity. The weight increase of manatee Nos. 10 and 12 coincided with the increase in tank water temperature and may indicate that the animals had been using available energy to maintain

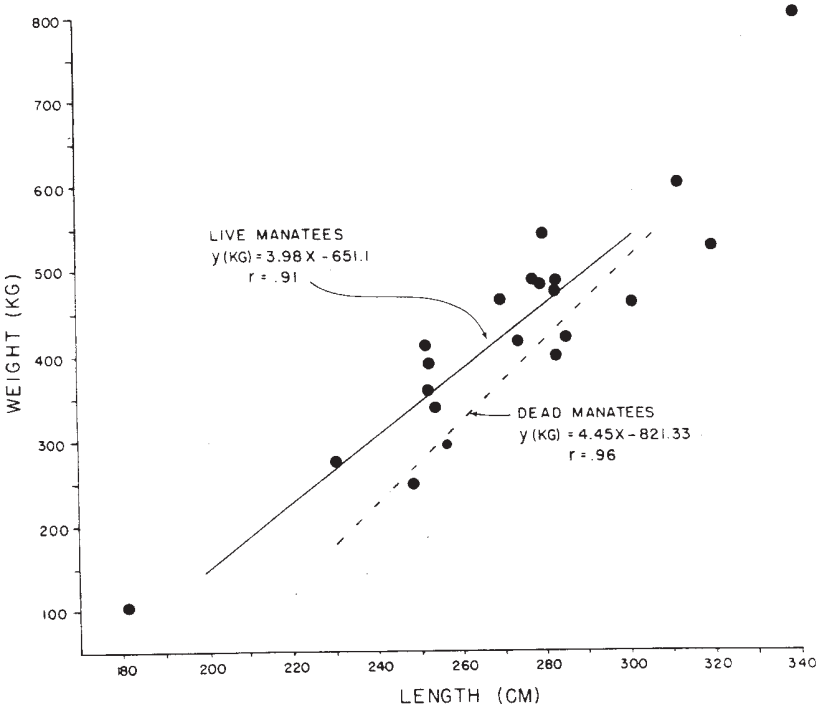

Fig. 1. Body weight of newly captured manatees plotted against length with linear regression line (solid) and data points (.) shown. Regression line (broken) from data (not included) on salvaged manatees (IRVINE c.s., 1978; BECK c.s. 1978) is provided for comparison.

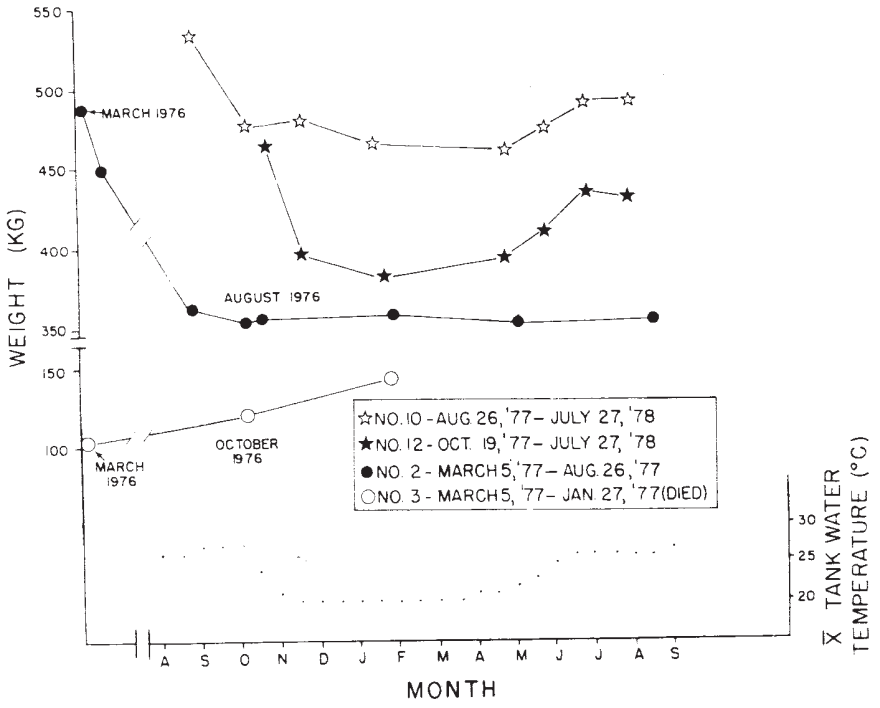

Fig. 2. Weight change of NFWL manatees while held at Marineland of Florida. Average water temperature (^{o}C) in tank during 1976 and 1977 is shown at bottom.

body temperature in 20^{o}water, but that they were able to increase body fat at higher water temperatures. Water temperatures below 20^{o}C have been reported to be unsuitable for manatees (CAMPBELL c.s., 1978).

Summary

Blood values from captive manatees were similar to values from free ranging animals. Urine osmolarity differed according to salinity of habitat, and suggested that manatees may be able to drink salt water to satisfy fresh water requirement. Skin lesions on captives may result from trauma to dermal tissue during handling. The captives lost from 13-15% of body weight but two of the captives regained weight as water temperatures increased from winter lows of 20^{o}C.

Acknowledgements

Personnel from NFWL, Blue Spring State Recreation Area, the Merrit Island National Wildlife Refuge, Sea World of Orlando, and the University of Central Florida, assisted during captures of the manatees. The captive manatees were maintained courtesy of Marineland of Florida, and animals there were handled with the assistance of individuals from NFWL, the University of Florida and the Marineland staff. The NFWL manatees were captured and held under U.S. Department of the Interior Permit PRT 2-3058. Hematology analysis was provided by Dr. J.W.

Harvey of the University of Florida College of Veterinary Medicine (UFCVM). Equipment for urine osmolarity measurements was provided by Dr. M.J. Fregley of the University of Florida, Department of Physiology. Manatee skin cultures and bacteriology was analyzed by the Jackson Veterinary Hospital, St. Augustine, Florida, the Florida Department of Agriculture, Kissimmee Diagnostic Laboratory, Kissimmee, Florida and the UFCVM. Constructive comments on the manuscript were made by Cathy Beck, Bob Bonde, David Black, Donald Forrester, John Harvey, Tom O'Shea, Galen Rathbun, Michael Scott and Robert Shields. We are indebted to all of the above organizations and individuals for their assistance.

Products mentioned in the text

Mention of product names does not imply endorsement by the U. S. Fish and Wildlife Service.
COULTER COUNTER: manufactured by Coulter Electronics Inc., Hialeah, Florida 33011, USA.
TOTAL SOLIDS METER: Model 1400, manufactured by American Optical Co., Keene, New Hampshire, 03431, USA.
SMA-12/60 or SMA 20: manufactured by Technicon Instrument Corp., Tarrytown, New York, 10591, USA.
FRISBEE: recreational-sport saucer; manufactured by Wham-O Mfg. Co., San Gabriel, California 91778, USA. The 165 g Tournament model has greatest structural strength and therefore was most useful for urine collection under the manatees.
HEMA-COMBISTIX AND KETOSTIX: indicate amounts of various substances in urine by changing color; manufactured by Miles Laboratories, Inc., Elkhart, Indiana 46514, USA.
OSMETTE A OSMOMETER: manufactured by Precision Systems Inc., Newton, Massachusetts 02158, USA.
SAMPSON SCALE: manufactured by Precision Engineering Co., Tulsa, Oklahoma, 74101, USA.

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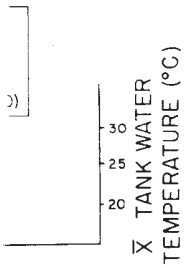

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