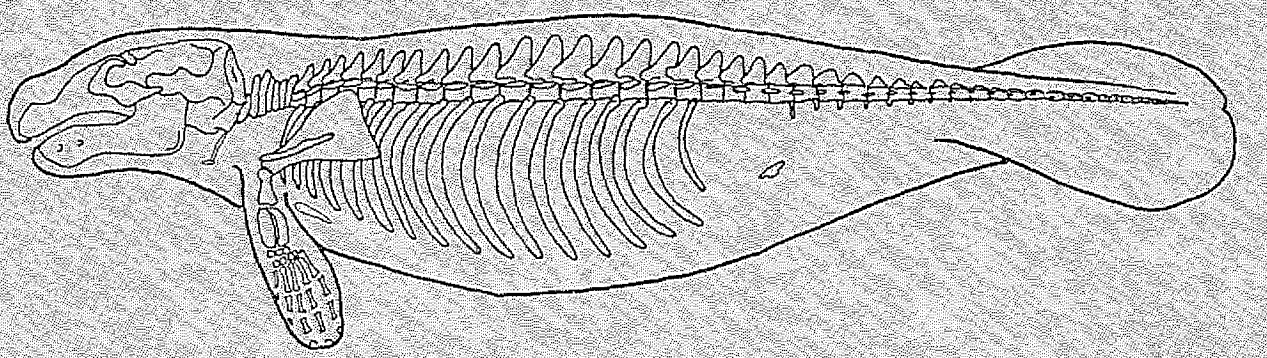
MANUAL OF PROCEDURES

FOR THE SALVAGE AND NECROPSY

OF CARCASSES OF THE

WEST INDIAN MANATEE (Trichechus manatus)



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--September 1983--

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INTRODUCTION

In 1974 the University of Miami and the U.S. Fish and Wildlife Service initiated a program for the salvage and necropsy of the West Indian manatee (Trichechus manatus) in the southeastern United States and Puerto Rico. The West Indian manatee enjoys protection under Florida statutes and the U.S. Marine Mammal Protection Act of 1972, U.S. Endangered Species Act of 1973, and subsequent amendments. These laws provide a mandate for research. The purpose of the salvage program is to determine causes of death in manatees and to collect basic biological information and material for research.

Techniques for the salvage and necropsy of manatees have become increasingly refined and detailed since the inception of the program. The purpose of this manual is to describe all techniques surrounding the program which are currently in use, to provide a standardized methodological guide for present and future technical personnel, and to establish a protocol to serve as a foundation for improvement. The manual may also be useful for the development of similar programs in other countries within the range of the West Indian manatee. In the United States its use must be limited to those with legal authority to participate in the program.

This manual is an outgrowth of techniques developed with input from R. L. Brownell, Jr., A. B. Irvine, D. K. Odell, G. B. Rathbun, numerous visiting scientists hosted by the Sirenia Project, and faculty and staff

of the University of Florida, College of Veterinary Medicine. Early manuscript drafts were substantially improved as a result of comments and discussion from D. J. Black, C. D. Buergelt, D. P. Domning, D. J. Forrester, J. G. Mead, W. Medway, D. K. Odell, G. B. Rathbun, J. E. Reynolds, III, R. K. Stroud, and A. G. Watson. Mention of product names does not imply endorsement by the U.S. Fish and Wildlife Service.

I. AGENCY RESPONSIBILITIES AND PROCEDURES FOR RECEIVING AND VERIFYING REPORTS

Telephone reports of dead or injured manatees may come from the Florida Marine Patrol (FMP) headquarters in Tallahassee (where a 24 hour toll-free manatee hotline is maintained), FMP District Offices, Florida Game and Fresh Water Fish Commission (GFWFC) Regional Offices, or other sources, including the public. Responsibilities of the principal agencies and organizations involved in the salvage program are outlined below, and an explanation of procedures for receiving a report follows. Telephone numbers and names of key personnel are listed in Table 1.

AGENCY RESPONSIBILITIES

Florida Marine Patrol

Tallahassee -- The Tallahassee office operates the 24 hour toll-free manatee hotline. Upon receiving a report of a dead or injured manatee the operator assigns a case number and immediately notifies the Denver Wildlife Research Center, Sirenia Project (DWRC), U.S. Fish and Wildlife Service (USFWS) Law Enforcement (LE), and the appropriate FMP District Office.

District Offices -- District Offices are responsible for notifying the Tallahassee office of direct reports received at their level (Fig. 1). District Offices dispatch officers to verify reports in the field, and

to tow and secure carcasses to boat ramps for retrieval by salvage crews. Officers assist the USFWS Endangered Species Field Office (ESFO) staff or USFWS refuge personnel in monitoring the locations of animals in distress. Information concerning circumstances and condition of distressed or dead manatees are relayed from District Offices to appropriate USFWS personnel.

U.S. Fish and Wildlife Service

Denver Wildlife Research Center (DWRC), Sirenia Project -- This project retrieves carcasses of dead manatees for necropsy and collection of specimens. Upon receiving reports DWRC coordinates recovery of carcasses in its retrieval area with the FMP District Offices or GFWFC Regional Offices as outlined below. The University of Miami (UM) is notified by DWRC if the carcass is located in their retrieval area, and the ESFO is notified if the case involves distressed or injured manatees.

Endangered Species Field Office, Jacksonville -- The ESFO determines the need for rescue of distressed or injured manatees and coordinates rescue operations with oceanaria and wildlife refuge staff. Injury reports from FMP are relayed through DWRC. The USFWS manatee coordinator is the contact point. Alternates are listed in Table 1.

Law Enforcement -- USFWS LE Senior Resident Agents (SRA) are notified of each case by FMP Tallahassee. DWRC and ESFO are responsible for

notifying LE if rescue or necropsy operations reveal possible violations of federal law.

University of Miami

Rosenstiel School of Marine and Atmospheric Sciences -- Dr. Dan Odell and technicians perform carcass salvage activities in Florida south of Fort Pierce on the Atlantic Coast and Port Charlotte on the Gulf Coast. UM receives reports from FMP Tallahassee through DWRC. UM notifies FMP Tallahassee and DWRC upon receiving direct reports and coordinates the recovery of carcasses with FMP District Offices and GFWFC Regional Offices as outlined below.

Florida Game and Fresh Water Fish Commission

Regional Offices -- GFWFC officers verify reports and secure carcasses in inland waterways.

PROCEDURES FOR RECEIVING AND VERIFYING REPORTS

Reports are usually received by DWRC from FMP Tallahassee, FMP District Offices, GFWFC Regional Offices, or the public. UM usually receives reports from DWRC or the above and other sources, but not from FMP Tallahassee. Procedures to follow when receiving or verifying a report from these principal sources are listed below. In all instances notification of appropriate personnel should be accomplished immediately

upon receiving a report. Verification of a carcass should be as soon as possible and the carcass should be retrieved within 24 hours of verification.

Incoming Reports from FMP Tallahassee

1. Record the FMP case number, date, and time of call.
2. Record the name, address, and phone number of the original reporting source. (Persons reporting carcasses near their residences can sometimes assist in verifying or retrieving them.)
3. Verify that USFWS LE and appropriate FMP District Offices have been notified.
4. Obtain all available information on the location and characteristics of the carcass or injury. If it is an injured or distressed manatee notify the ESFO. If it is a dead manatee notify UM if it is in their retrieval area.
5. Call the FMP District Office to confirm that FMP Tallahassee has notified them, and have the District Office call back directly with the information listed in the next section below. Call the GFWFC Regional Office and follow similar procedures if the carcass is in waters under their jurisdiction.

Incoming Reports from FMP District Offices and Coordination of Retrieval

1. Verify that FMP Tallahassee has been notified and record FMP case number if applicable. Record the date and time of call.

2. Record the name, address, and phone number of the original reporting source.

3. Ask the District Office to dispatch an officer to confirm the report and secure the carcass at a boat ramp. Emphasize the need to have it brought to a ramp. Obtain the officers estimated time of arrival (ETA) at the carcass. Ask the District Office to call back directly with locality and carcass condition information as soon as possible.

4. Obtain directions to the secured carcass and also obtain a precise description of the locality where the carcass was originally found. Give the ETA for the salvage crew to FMP and to local resident (reporting source) if applicable. Inquire if tidal stage will affect ability to retrieve the carcass. Sometimes it may be necessary to arrange to meet an officer to take the salvage crew out to secure a line for towing. If it is inaccessible to the officer, get an accurate location description and prepare to retrieve the carcass with a jon boat or canoe.

5. Inquire about the condition of the carcass: Is the black skin intact, peeling, or is the carcass white? Is it floating with the belly up? Are any cuts, holes, or internal organs visible? How large is it? If it is reported to be small, or a calf, ask if one person can lift it. Ask if other manatees are near the carcass, and how they are behaving.

6. Inquire about the kinds of human activities (flood gates or canal locks, commercial vessels, pleasure boating, dredging or blasting, for example) that may occur in the area where the carcass was found, and if live manatees commonly occur there.

Incoming Reports from Other Sources

1. Record the name, address, and phone number of the original reporting source and the date and time of call.
2. Obtain a specific description of what they see and when they first saw it. Politely try to determine if they can distinguish a manatee from a dolphin or other object.
3. Obtain information on location, carcass condition, and activities as outlined in the above section.
4. Notify FMP Tallahassee and obtain the FMP case number. Call the FMP District Office and relay information, following the procedures outlined in the above section on coordinating carcass retrieval.

II. RETRIEVING A CARCASS

Carcasses should be retrieved within 24 hours of verification. The estimated time of arrival should have been given to the FMP if an officer is needed to help or wants to be on the scene. The estimated time of arrival should also have been given to the parties involved if the manatee is located at a private residence. Leave the home base with a truck and trailer (preferably with power winches on both) and carry the items listed in Table 2. When it is certain that the carcass is a calf the trailer is not necessary. The calf can be placed in a plastic barrel and lifted manually into the back of the truck. However, be wary of size estimates reported by inexperienced observers. Ask the reporting source if the carcass can be easily lifted by one person and to compare the size with some familiar animal or object. It may be necessary to load a jon boat with a small outboard or a canoe with paddles if the FMP cannot reach a carcass in shallow water or if an on-site necropsy is required.

NOTES AND PHOTOGRAPHS

At the recovery site take notes on the carcass, its condition, and general characteristics of the area where it was found. Ask about ongoing human activities in local waters, how regularly manatees are seen in the area (daily, seldom, seasonally), if other manatees were with the carcass, and what they were doing. If the original reporting source is present, ask the exact location of the carcass when first seen (use a map if possible) and how it was originally positioned. Always respond politely to inquiries

from the public, and when possible distribute manatee educational material to interested parties.

Take the following photographs (include a reference scale) at the recovery site:

1. Overall dorsal, ventral, and lateral aspects. This may be the only opportunity to thoroughly examine and photograph the back on the entire carcass because the manatee is in the water and can be easily rolled. External photographs taken on site are also generally superior because the carcass is in better condition than it will be by the time it reaches the necropsy facility.
2. Closeups of any unusual marks, scrapes, scars, wounds, or natural features, as detailed in Section IV.
3. Photographs of the habitat where the manatee was found.

LOADING THE CARCASS

Ideally, the manatee will be secured at a boat ramp and can be easily loaded onto a flatbed trailer. Unplug the trailer lights before backing the trailer down the boat ramp into the water. Put on the emergency brake, leave the truck in a forward gear or park, and place blocks or bricks behind the tires. A manual or power winch attached to the trailer tongue is necessary to pull the manatee from the water onto the trailer; be familiar with operator requirements for particular winch and vehicle

combinations. Make sure the winch clutch is engaged properly for feeding the cable in or out.

Place a noose with a free looped end around the peduncle (tail stock) of the manatee and hook the winch cable through the looped end. Winch the animal in with the ventral side up and fluke (tail) first, centered on the trailer. Manually lift the fluke over the back edge of the trailer. Once this is done the carcass will then usually slide onto the trailer easily. Rarely the trailer may need to be tilted by removing pins at the tongue before the carcass can be loaded. Pull the truck and trailer out of the water once the manatee is centered and secure. Cover the carcass with a tarpaulin and secure it firmly with ropes and tie-down straps. Retrieve the blocks and plug in the trailer lights.

If the manatee has not been left at a boat ramp but is accessible, try to arrange in advance to be met by an officer and assist the officer in securing the carcass and towing it to a ramp. Occasionally a carcass will be in shallow water and may be reached either by wading to it from the FMP boat with a towline, or directly by the salvage jon boat or canoe. In any of the above cases the information on special circumstances should have been obtained in advance and adequate preparation made.

Occasionally a carcass may be in a remote area inaccessible by boat, or may be so badly decomposed as to make transport impossible. Under these circumstances a necropsy may have to be performed on site. Once a carcass has been opened it is impossible to contain all the body fluids and tissue;

for sanitary reasons, therefore, an on-site necropsy should never be a regular practice and should only be done if the site is far from homes or recreational areas.

RETURNING WITH A CARCASS

Always call back to the home base before leaving the recovery site in case there is a report of another manatee salvage in the area. Give them an estimated time of return and the size, sex, and condition of the carcass being brought in. Alert them to prepare for an immediate necropsy if the carcass is fresh. Obtain ice to put around fresh carcasses to slow the rate of decomposition, especially during hot weather. Carcasses of calves can be placed in a plastic barrel or trash can filled with ice.

Try to obtain a weight at a weigh station en route for every intact carcass that is not very badly decomposed. Truck weigh stations along main highways will weigh the loaded trailer if they are not busy. Try to consistently use the same weigh stations for which a tare weight for the trailer has previously been obtained. Pull onto the platform scale so that only the loaded trailer will be weighed and disengage it from the truck. Calves can be weighed by more convenient means, including accurate bathroom scales.

III. PHOTOGRAPHS AND RECORD KEEPING

PHOTOGRAPHS

Multiple external and internal photographs are necessary for documentation of each case. Individually distinct external features on carcasses are especially important as these can be matched with existing photographs of previously living animals. Photographs should be taken of dorsal, ventral, and both lateral aspects of each carcass, including dorsal and ventral aspects of the fluke. Photographs should be taken of any unusual marks, scrapes, scars, wounds, skin lesions, or natural external features. A white plastic background behind the subject enhances contrast and is especially good for details of fluke margins. A ruler or scale of known size should be present in every photograph. A "data-back" which imprints the date on each slide as it is exposed should be used. A 28 mm wide-angle lens is necessary for overall specimen photographs and a 50 mm macro lens is important for closeups. Extra batteries, flash attachment, and extra film (Ektachrome 200 is suitable) should always be carried. Each developed slide should be labeled with the specimen number, sex, species, photographer's roll and exposure number, date, location, and a brief description of the subject depicted. Slides should be stored in organized catalogs in a cool, dry place.

RECORD KEEPING

Accurate record keeping is accomplished through the consistent use of standardized forms. A chalkboard or tape recorder are often useful and recommended for taking notes during the necropsy examination. Currently four forms (Appendix I) are used during manatee carcass salvage operations in Florida. The Manatee Data and Morphometric Sheet is used to record species, field number, sex, total length, weight, dates of reporting, recovery and necropsy, and persons involved, photographs taken, materials collected, stranding location, cause of death, and carcass condition. Field numbers are assigned to manatee carcasses in Florida using two different systems, exclusive of each other. Carcasses recovered by UM are assigned numbers prefixed by M, the year of collection, and numbered consecutively (M-82-25, for example, is specimen 25 collected in 1982). Manatees recovered by DWRC are prefixed M and numbered consecutively. Manatees that are verified but never recovered are assigned a lost manatee prefix including year. Lost carcasses reported by UM are identified as LM-82-1, for example, whereas those reported by DWRC are identified as DWRC-82-1, for example.

Carcass condition refers to state of decomposition and is based on subjective, qualitative criteria. In general, fresh carcasses usually show little or no bloating due to general tissue decomposition, the skin does not slough, flippers are not stiffened vertically, and internally all organs are intact with material generally suitable for histopathology. Moderately decomposed carcasses may show slight bloating and some skin

sloughing or stiffening of flippers. However, all internal organs including the liver show integrity, although autolysis and decomposition may render the tissue matrix unsuitable for standard histopathology. Badly decomposed carcasses usually are bloated, missing patches of black skin, with flippers stiffened vertically, and internal organs, particularly the liver, showing loss of integrity or complete disintegration. In some carcasses bloating may not be evident due to very advanced decomposition or release of gas through wounds. Dried carcass or bones are cases advanced to the point where little remains of the carcass other than the skeleton or hide.

A series of standardized measurements are also recorded on the Manatee Data and Morphometric Sheet (Appendix I). These are illustrated on the form. Other than girths and the distance from eye to eye over the forehead all are straight line measurements taken above the body and are not taken over the body contours. All weights and measurements should be metric; if original units are in English (truck scale weights, for example) metric conversions should follow original units in parentheses. Weights and measurements subject to distortion (especially girths) should not be taken on badly decomposed specimens. Skin and blubber thickness measurements are made during internal phases of the necropsy. Tooth counts are taken during internal examination of the head and neck.

Scar measurements are recorded on a separate form (Appendix I). A single pattern generally refers to a series of scars representing one strike by a boat propeller. Sketches are made on the data sheet in appropriate places

and measurements of scars within patterns recorded as illustrated. Separate sheets are used for each pattern if more than one are present. Fresh wounds are open, usually with recent bleeding. Recent wounds show signs of healing. Healing scars are completely covered by yellow-white scar tissue and healed scars are generally covered by dark-pigmented scar tissue. Each wound should be sketched and documented photographically, including a scale of measurement.

The Manatee Salvage Program Necropsy Report (Appendix I) is used to record notes taken during necropsy. History refers to conditions and observations surrounding the death or recovery of the animal. Points to note under each organ system are detailed in following sections of this manual. The diagnosis section is provisional unless signed by qualified professionals, but otherwise should represent a summary list of pathological features noted by prosectors. Cause of death refers to the broad categories of boat/barge collision, gate/lock crushing, other human-related, dependent calf, natural, or undetermined with a note on the specific pathology involved, if any. Guidelines for categorization appear in Section V of this manual. The Manatee Fat Deposition Comment Sheet (Appendix I) is a trial form used to describe the color, consistency, and amount of fat, with accompanying photographs, in key areas of the carcass during necropsy.

IV. NECROPSY

Performing a good necropsy requires consistent procedures, keeping of detailed notes and photographic records, proper equipment, and experience. This section provides specific guidelines for gross examination of all major organ systems in a manatee carcass. Consistent use of these guidelines when applicable should result in a relatively thorough necropsy, although it is acknowledged that advanced decomposition may often preclude detailed examination of some organ systems. Other sections provide information to aid in keeping records, preserving material, and classifying the cause of death. Table 3 gives lists of equipment necessary for a proper necropsy.

The necropsy should be performed in an area that has restricted public access, as well as shelter from rain, direct sun, and flying insects. Access to running water, as well as electricity for refrigerators, freezers, bone saws, and other equipment, is also important. Efforts should be made to contain fluids and tissue waste and to keep the work area as clean as possible during the necropsy. Adequate protective clothing, gloves, and disinfectants (such as Betadine for skin and Roccal-D for tools and work surfaces) should be used and care taken not to expose the eyes, nose, mouth, and skin to contamination. Following necropsy, waste tissue should be contained and immediately incinerated or buried in a location where human and wildlife contact will be minimal, in compliance with local standards and ordinances. The work area and equipment should be scrubbed down with disinfectant detergents. Personnel should wash thoroughly and launder clothing as soon after the necropsy as possible.

EXTERNAL EXAMINATION AND INITIAL INCISIONS

The carcass will usually be presented on its back (dorsal recumbancy) and preliminary examination of the dorsal surfaces should have taken place in the field before loading on the trailer (as noted in Section II). The ventral and lateral aspects should be examined externally with comments made on the presence, absence, location, and appearance of wounds, scars, coloration, barnacles, barnacle scars, algae, abrasions, lesions, abscesses, deformities, emaciation, bloating, and other unique characteristics. Barnacles should be collected and fixed for 24 hours in 10% neutral buffered (n.b.) formalin, then stored in 70% ethanol (Appendix II). Algae collected from the skin should be preserved in 5% n.b. formalin. Prominent features should be measured, sketched, and photographed.

Use the terminology and methods listed in Section II for measuring propeller wounds and scars. Note if scrapes, cuts or other wounds are superficial or deep, the amount of reddening in surrounding tissue, and if the wounds appear to have been inflicted either ante- or post-mortem (Section V). Carefully examine the epidermis for focal lesions, sloughing, or patches of wrinkling. Take culture swabs of any infected areas (Section VI). Avoid contact with suppurative lesions and abscesses; pathogens infective to humans may be present. Note presence or absence of large uneven swellings, asymmetry in body contours, or abnormal stiffness or curvature to the axial skeleton.

Examine the head for evidence of trauma. Inspect the mouth and lips for the presence of foreign objects, vegetation, inflammation, or lesions. Collect vegetation from animals recovered in fresh water in 5% formalin and from animals recovered in salt water in 5% formalin made with saline or sea water (Appendix II). Note if the nostrils are free of obstruction, note the nature of any nasal discharge, and collect nasal flukes (Cochleotrema cochleotrema) in 10% n.b. formalin (Appendix II). If still alive, they should be relaxed in cold water for 1 to 4 hours, then fixed in AFA. Examine the eyes for notable features and preserve frozen or in 10% n.b. formalin if not badly decomposed. The external auditory meatus should be located for examination and as a reference point in morphometrics (Appendix I). On some specimens the meatus may be difficult to locate. It is found at about the same distance caudal to the eye as the eye is from the tip of the snout. A slice through the dermis at the meatus will reveal a 1-2 mm diameter canal filled with a black waxy paste, in contrast with whitish, unfilled hair follicles. Note if the mandible may be moved with ease or if stiff. Leave a more detailed examination of the head and neck for a later stage in the necropsy.

Examine each flipper for freedom of movement, inflammatory lesions, healed wounds or other abnormalities. Count the number of nails on each flipper and record on a data sheet. Measure teat size in females; palpate the teat working up towards the nipple, and note the presence or absence of milk, pus, blood, or other material. Note if both teats are of normal and approximately equal size, or if there is any apparent shrinkage or

swelling. Detailed examination of mammary tissue is performed during examination of the thoracic cavity.

Examine the umbilicus for abnormalities or infections, particularly in calves. Examine the urogenital aperture for discharges or abnormalities. In recently parturient or near-term females the vaginal canal is enlarged and supple, and the prosector's protected forearm can pass through to the uterus. Females in late pregnancy will also show a bulge with a prominent curve cranial to the urogenital opening and may exude mucus. Note the texture and characteristics of vaginal fluids, and collect samples if warranted, checking for sperm if recent copulation is suspected. Note if semen is exuding from the external genitalia of males. Examine the anus for blockage, and note the presence or absence of feces or other discharges, describing texture, color and consistency. Photograph any abnormalities of the fluke, including a reference scale.

Carefully obtain the measurement data detailed in Appendix I. These include five head measurements, three flipper measurements, two fluke measurements, five longitudinal measurements, and four girth measurements. Girths should be obtained only on animals that have not been distended by bloating.

Using a knife, begin the first incision (Incision A; Fig. 2) mid-ventrally at a point just caudal to the sternum and cut caudally down the midline. Move to the right of the genital aperture and continue to the right of the midline to a point just cranial to the anus (Fig. 2). (Throughout the

text of this manual right refers to the animal's right, left to the animal's left.) Cut through the dermis, outer blubber, cutaneus trunci muscle, inner blubber and rectus abdominis muscle layers (Fig. 3) up to but not through the fascia of the parietal peritoneum. Be extremely delicate at the latter point to prevent a sudden, unexpected release of gas and fluids. Once the length of the incision has been made, cautiously make a small cut in the parietal peritoneum at the mid-abdomen using bandage scissors (blunt point directed internally), gradually lengthening the cut as the internal pressure is reduced. The parietal peritoneum can then be cut the length of incision A (Fig. 2), taking care not to nick underlying organs. Make a second large incision with a knife (B in Fig. 2) from the sternum laterally to a point just ventral to the distal tips of the right ribs. Follow the line of the rib cage caudally, rejoining incision A just cranial to the anus. Remove the entire right slab and put it to the side. Remove a mirror-image left slab (Fig. 2) by cutting down the midline just to the left of the genital aperture to a point cranial to the anus, and by making a lateral cut from the sternum to a point just ventral to the distal tips of the left ribs, proceeding caudally as in Figure 2. The genitalia should remain with the carcass. Be careful not to disturb the underlying organs during removal of these slabs.

Take a sample for culture of body fluids in the abdominal cavity immediately upon opening the carcass to prevent contamination.

Photograph all exposed organs <u>in situ</u> (Fig. 4), including a reference scale. Photograph the two slabs, placed over the abdomen in their original

orientation but with their internal surfaces exposed outward. Give a qualitative estimate (very heavy, heavy, moderate, light or none) of the amount of fat on the parietal surfaces of the slabs and describe the color and texture of the fat. Take measurements of dermis and outer and inner blubber layer thicknesses at the mid-ventral and mid-lateral exposed, layer cake-like surfaces from the left slab (Fig. 3). Take a cube of about 10 x 10 cm from the mid-line edge of the left slab and photograph the layers with a reference scale included. Describe the quantity, color and texture of the blubber. Collect a minimum sample of 10 g each from the outer blubber and outer muscle (cutaneous trunci) layers for environmental contaminant residue analysis following instructions detailed in Section VI. Collect similar blubber and muscle samples from an adjacent portion of the slab and freeze separately for fat content and electrophoretic analyses. Remark on the general appearance of the abdominal cavity. Note the presence of fluids, if any, and their color and consistency. Note the color and consistency of fat deposits. Remark on peculiar odors, the presence or absence of gas and ingesta, displacement of organs, ruptures, adhesions or hemorrhage. Examine the gastrointestinal mesenteries for discoloration or hemorrhage, and mesenteric lymph nodes for size and color. Take culture swabs and collect tissue samples for histopathology if appropriate.

GASTROINTESTINAL TRACT

The gastrointestinal tract and associated structures of the digestive system are removed for examination following *in situ* inspection of the

exposed serosal surfaces and mesenteries for hemorrhage, cysts, tears, abscesses or other lesions. Begin by locating the junction of the descending colon and the rectum. Free this segment by cutting the mesentery (mesocolon), and tie the rectum off with string in two places a few cm apart just dorsal to the urinary bladder. Sever the descending colon between the strings and start to cut the mesocolon cranially to begin removal of the entire tract. The diaphragm is on a dorsal plane (Fig. 4), and each half is referred to as a hemidiaphragm. The descending mesocolon is attached to the left hemidiaphragm, near the left kidney. In an adult animal the descending colon turns abruptly after about 1 meter and runs transversely (transverse colon) for approximately 1 meter (Fig. 5). The mesocolon should be cut and the color, texture, and quantity of fat described for the transverse colon and adjoining mesenteries. Photograph the transverse colon showing fat deposits. Tie a string at the center of the transverse colon to mark its location for future reference.

The coiled ascending colon is approximately 15-17 meters long in an adult animal and is attached to the parietal peritoneum at the vertebral column. Continue dissections to free the ascending colon. The cecum, approximately 20 cm in diameter, with two "rabbit-ears" diverticula, marks the junction of the large and small intestines (Fig. 6). It is located to the left of the vertebral column. Cut the peritoneum joining the dorsal surface of the cecum to the vertebral column and hemidiaphragm while lifting the cecum. Continue to apply tension and remove the loops of the ileum and jejunum. At this point the celiac and cranial mesenteric

arteries are severed (Fig. 7). The aorta and caudal (inferior) vena cava are left attached to the hemidiaphragm (Fig. 7).

Complete the removal of the gastrointestinal tract by cutting between the duodenum and hemidiaphragm until the pylorus of the stomach is reached. Do not cut the hemidiaphragm. Then stop and move cranially to where the esophagus enters the stomach (Fig. 6). Sever the esophagus about 5 cm cranial to the stomach and continue to cut between the stomach and hemidiaphragm, dissecting through the lesser omentum, hepatic artery, and the bile duct. Clamp the bile duct with a hemostat before severing. Cut the bile duct caudal to the hemostat. The entire gastrointestinal tract may be removed from the abdominal cavity once the stomach attachments are freed. Place the tract on a flat, clean surface for detailed examination (Fig. 8).

After the gastrointestinal tract has been removed but prior to detailed examination, the prosector should inspect the peritoneal lining and the abdominal cavity. Note the presence or absence of areas of edema, adhesions, abscesses, growths, ruptures of the diaphragm or body wall, or other peculiarities. If not contaminated by foreign material, note the amount (by removal with a graduated container) and characteristics (color, consistency, presence of fibrin strands, etc.) of fluids. If clotted blood is present, measure the amount.

Locate the adrenal glands. These are small glands 3-4 cm long and 1 cm in diameter found along each medial edge of the vertebral column 15 to 20 cm

cranial to the kidneys (Fig. 7). They are best located by palpation of the region. In some specimens the right adrenal gland may be located in the mesentery more lateral to the vertebral column than the left adrenal gland. If the adrenal glands cannot be located they may have inadvertently been removed with the gastrointestinal tract. Once the adrenals are located and removed, they should be examined for cysts or swellings, weighed and measured, and sliced like bread at thicknesses no greater than 0.5 cm for examination and best penetration of formalin. Preserve in 10% n.b. formalin.

The gastrointestinal tract should have been placed on a large clean working area so that it can be spread out for examination. Begin by cutting the jejunum and ileum free of the mesentery and carefully examining all serosal surfaces for hemorrhages. Clamp off any areas inadvertently nicked during removal. Once the serosal surfaces have been examined and described, the spleen and pancreas should be collected and the lumen and mucosa of the stomach examined.

The spleen is located on the greater curvature of the stomach just caudal to the cardiac gland (Fig. 8). It is generally dark colored and small, about 3-5 cm in diameter and 2-3 cm thick in an adult animal. Photograph, measure, and weigh the spleen. Note if the spleen is in one piece or fragmented, and if fragments of accessory spleens or old ruptures are discernible. Comment on the overall appearance, size, presence of fatty growths, polyps, and texture of the organ. Thinly slice the spleen and note the nature of any fluids which might ooze from it. Preserve in 10% n.b. formalin.

The pancreas is a large, pale, relatively diffuse glandular organ found dorsal to where the duodenal ampulla narrows (Fig. 8). The single pancreatic duct opens into the narrow end of the duodenal ampulla, 5-10 cm distal to the opening of the bile duct. The pancreas is about 10 cm in length and 7-8 cm wide in an adult. The pancreas is subject to rapid decomposition. In fresh carcasses it should be removed, photographed, measured, weighed entirely, examined for abnormalities, sliced for penetration, and preserved in 10% n.b. formalin.

Open the stomach by making an incision about 15 cm long through its ventral surface (Fig. 9). Note if the stomach is excessively gassy or if peculiar odors occur. Look for foreign objects or impactions, or for swallowed blood near the gastro-esophageal junction. Note the consistency, color, quantity and odor of stomach contents, mucus, or fluids. Note the presence or absence of sand, mud, or other sediment. If abundant, estimate or measure the amount present and collect all or some fraction of the sediment, estimating the proportion of the total present that has been preserved. Examine contents for parasites and, if present, estimate degree of infection. The nematode (Heterocheilus tunicatus) is common and is sometimes embedded in the mucosa. Collect specimens in 70% ethanol or 70% glycerine ethanol (Appendix II) if available, estimating the proportion of the total present that has been preserved. If possible, living nematodes should first be placed in a shallow dish containing a small amount of GAA (Appendix II), for a few minutes only, then transferred to the ethanol solution for storage. Collect samples of vegetation from near the center of the food mass in 5% formalin for food habits studies. A second sample

should be frozen if enterotoxemia due to a Clostridium infection is suspected (Section V). Remove remaining stomach contents but do not discard if contents weights are desired.

Examine the mucosal surface of the stomach for cysts, inflammation, ulcers, or hemorrhages. Note if the muscular wall of the stomach appears normal in thickness or if it is thickened, edematous or inflamed (reddened). (Occasionally animals are found which have ingested a non-harmful marine algae (Gracillaria) which imparts a bright, deep pink stained mucosa.) Cut through the cardiac gland and examine for abnormalities. Photograph the stomach and collect tissue samples of any abnormalities in 10% n.b. formalin.

Following examination of the stomach, begin to examine the intestines. Throughout the gastrointestinal tract certain features should be characteristically noted. These include the presence or absence of intestinal contents, noting their color and consistency, and presence or absence of excessive flecks, sheets, or aggregations of mucus; discolorations of the mucosa or patches of hemorrhages; dilatations, thickenings, ulcers, stenosis (severe constrictions) or intussusceptions (an ensheathing or telescoping of the intestine within itself); hyperplasia or necrosis of lymphoid tissue; obstructions, sediment, or foreign objects.

Make an incision about 10 cm long on the ventral surface of the duodenum (Fig. 10) and note the quantity, color, consistency, and odor of contents. Contents are typically watery throughout the small intestine beyond the

duodenal ampulla and care should be taken to avoid inadvertent spillage. Examine contents and make notations on the presence and characteristics of vegetation, parasites, or foreign objects. Collect nematodes as previously described. Remove contents and carefully examine the mucosa for inflammation, cysts, ulcerations, hemorrhages, or other lesions. Locate the duodenal papilla and probe the exit of the bile duct for patency.

Continue cutting through the jejunum and ileum, examining and remarking upon the mucosal surfaces and contents. Examine the remnant of the vitelline diverticulum (Fig. 11). The presence of this structure is an anatomical peculiarity found in manatees and therefore should be described for each specimen. It is located at about 15 cm proximal to the ileocecal junction. Note the presence or absence of the diverticulum and its lateral mesenteric fold. Photograph the diverticulum and measure the length of the fold and its distance from the ileocecal junction. Examine the lymph nodes in this region noting the size, shape, and color, preserving a thinly sliced section in 10% n.b. formalin. Save the small intestine contents if a total gastrointestinal tract contents weight is desired.

Make an incision ventrally along the length of the cecum. Note the consistency, color, odor, and quantity of contents. Ingesta are normally firmer than those found in the small intestine and finer in consistency than those found in the stomach. Collect ingesta from the center of the food mass and parasite samples. Trematodes (Chiorchis fabaceus) are the most commonly seen parasites in the cecum and colon and should be preserved

in 10% n.b. formalin. If still alive, they should be relaxed in cold water for 1 to 4 hours, then fixed in AFA.

Examine and remark upon the mucosa of the cecum. Cut through the cecal horns to expose contents and parasites.

The remainder of the colon should be examined by opening the organ along its entire length with scissors. Continue to make notes on the consistency, color, odor, and amount of ingesta and examine for foreign objects or unusual items. Weigh the entire gastrointestinal tract contents when the tract is full and contents are normal in appearance and consistency. These weights are useful indicators of the mass of food manatees ingest. Distinguish between ingesta and meconium in calves. Meconium is a dark green rubbery, mucilaginous material in the intestinal tract of full-term fetuses and neonates. Carefully examine the mucosa for hemorrhages, cysts, lesions, fibrin strands, obstructions, stenosis, or other lesions. Take culture swabs if enteritis is suspected. Cultures should be taken immediately upon opening any given discrete area. Collect tissue samples for histopathology in 10% n.b. formalin. Collect parasites, noting location in intestines, and give an estimate of the degree of infection (light, moderate, heavy, very heavy), proportion collected, and approximate total present. Collect a sample of ingesta in 5% n.b. formalin from the mid-large intestine for food habits studies. Examine the section of transverse colon that had previously been tied off and cut it into a 0.5 m long section centered at the string. Remove and weigh the fat and accompanying mesenteries. Remove the contents by washing and weigh the

empty and fat-free 0.5 m segment of colon. A ratio of the amount of fat to the colon mass is used as a relative fat index.

LIVER AND GALL BLADDER

The liver and gall bladder are situated in the cranial quadrant of the abdominal cavity, just dorsal and cranial to the stomach. Four lobes of the liver can be distinguished: right, left, quadrate, and caudate (Fig. 12). The bile duct should have been clamped with a hemostat near its confluence with the digestive tract during the removal of the stomach and intestines and severed at that time.

Remove the liver and gall bladder by cutting at the cranially situated connection between the cranial border of the liver and the diaphragm, where it is fused with the pericardium, severing the cranial ligaments of the liver. Continue the dissection caudally cutting the ligaments between the liver and diaphragm. At the caudal border of the liver sever the hepatic portal vein (Fig. 12). Remove the entire liver and gall bladder and photograph. Avoid contaminating the surfaces if samples are to be taken for environmental contaminant residue analysis.

Examine the gall bladder. Note if it is swollen or abnormally distended. Remove the hemostat and determine if the bile duct is patent (allows free flow of bile). Note the quantity, color, clarity and consistency of the bile. Cut along the bile duct. Search for obstructions if the bile was not free-flowing; examine the mucosa of the bile duct and the gall bladder

for inflammation, cysts, unusual thickness, stones, parasites, or other abnormal features. Describe the color and luster of the mucosa. In the normal organ the coloration is mustard yellow, and the mucosa is dotted with numerous 1-2 mm diameter round, raised secretory bodies.

Examine the surface of the liver. Note the color, degree of rounding of the edges (normally angular), presence or absence of pigmentation, discoloration, "nutmeg" condition, tubercles, cysts, abscesses, spots (foci), nodules, fibrosis or scarring. If the coloration is yellowish, note if there is also a greenish tinge. Obtain an entire organ weight and volume determination. Remove a sample from the caudal tip of the right-hand lobe for environmental contaminant residue determination prior to immersing the entire organ in water for a volume determination by displacement. Add an estimate of the volume of the sample removed for contaminant residue determination to the total volume. Make transverse cuts through remaining portions of the liver. On the cut surface, determine if the tissue within the membrane bows outward from the plane of the cut (indication of a swollen liver). Describe any exuding fluids. Examine for parasites. Remove a small piece of liver and determine if it sinks or floats in water. Preserve a small slice in 10% n.b. formalin. The sample should be taken from a location away from major bile ducts, areas of bile spillage, or bile stained areas of tissue.

PERICARDIAL CAVITY, HEART, AND MAJOR BLOOD VESSELS

The pericardial cavity is separated from the abdominal cavity by the diaphragm. The caudal aspect of the pericardium is fused to the diaphragm and this thin combined membrane separates the pericardial cavity from the abdominal cavity (Fig. 4). The pericardial cavity is encased by the sternum ventrally. Dorsally it is bordered by two landmarks; caudally by the cranial edge of the diaphragm and cranially by the first three thoracic vertebrae and ribs. The pericardial cavity houses the thymus, heart, and associated vessels. In an adult manatee the heart is approximately 2.0 kg in weight and 20 cm in diameter.

To reach the pericardial cavity incisions are made along the ventral midline from the xiphoid process of the sternum to the chin (Incision C; Fig. 2), from the chin posteriolaterally to each axilla, and from each axilla caudally to the open abdominal cavity (Incision D; Fig. 2). This creates two slabs of tissue. Remove the skin over each area and examine the underlying musculature for signs of trauma. Examine the mammary tissue in females for lactation, cysts, hemorrhage, inflammation, or other abnormalities (Fig. 19). Note the presence and nature of any fluids present when cut (blood, milk, pus), the color of the underlying mammary tissue, and the presence or absence of fibrous tissue, lumps or abscesses. Remove the superficial musculature ventral to the sternum, cut the cartilaginous tissue around the sternum, and lift it free. Examine the thymus, located along the cranial wall of the pericardial cavity (Fig. 19). The thymus is pinkish to dark gray in color and about 2-3 cm in

width and 10-15 cm or smaller in length. It is most prominent in younger, smaller manatees. Describe its color and consistency.

Examine the pericardial membranes for lesions, including hemorrhage, and fibrin deposition. Determine if fluid is present in the pericardial sac, and note its color, consistency, clarity, and amount. Take a sample of the fluid for microbiological culture. Photograph the heart *in situ*, including the fat overlying the ventral surface and in the interventricular groove. Describe the amount, color, and texture of the fat. Note any abnormalities in the position or appearance of the heart, including the relative size of the right and left ventricles and the profile of the ventral border. Note if any congenital anomalies are apparent on external examination.

Begin removal of the heart (Fig. 13) by cutting the pericardium down to the diaphragm, and then cut the right hemidiaphragm lateral to the right ventricle. Cut the right pulmonary artery and vein, and then the caudal vena cava, as distal to the heart as possible. Cranially, locate the major branches of the aortic arch. These are, from right to left, the brachiocephalic trunk, left common carotid and left subclavian arteries (Fig. 13). Cut the right common carotid and right subclavian arteries approximately 5 cm distal to their common junction with the brachiocephalic trunk. Cut the left common carotid approximately 5 cm distal to its junction with the aorta. Isolate the left subclavian from as much of the surrounding connective tissue as possible, and then cut. Once the major arteries are free, cut the left hemidiaphragm lateral to

the left ventricle as deeply as possible, severing the left pulmonary artery and vein. From the right side cut between the dorsal surface of the heart and the right bronchus, cutting the aorta, which passes dorsal to the left bronchus, as far distal as possible. Remove the heart.

Examine the heart externally. Note if the muscular wall of the heart is firm or flabby, if either of the ventricles show abnormally rounded bulging (dilatation), or if there is any evidence of hypertrophy. Examine the external surface for the presence of scars, abscesses, hemorrhage, or other unusual features.

Examine the heart internally by cutting through the ventral surface of the right atrium to the right ventricle (follow arrow; Fig. 14). A sample of blood (minimum 10 cc) from the heart should be frozen if botulism is suspected. Examine the endocardium, chordae tendineae, and papillary muscles for inflammation, scars, tears, hemorrhage, plaque, or other abnormalities. Examine the three cusps of the right atrioventricular valve for inflammation, thickness, hardening, growths, or other abnormalities. Continue the incision from the right ventricle through the pulmonary trunk, examining the three cusps of the pulmonary semilunar valve. Turn the heart over and from the dorsal aspect make a new incision from the left atrium to the left ventricle, examining the left atrioventricular valve and interior as on the right side. Make a third incision in the dorsal side of the heart from the left ventricle through the ascending aorta. Examine the three cusps of the aortic semilunar valve for growths, hardness, wear, holes, and other features. Examine the

wall of the aorta and the coronary arteries for plaque buildup, emboli or thrombi, noting color, size, thickness, and texture. Note if the interventricular and interatrial septa are complete. Examine the heart for evidence of coarctation or aneurysms. Note if blood is present in the left ventricle, and if so if it is clotted or unclotted. Tissue samples for histology should be taken from both right and left ventricles in 10% n.b. formalin.

Note the color of blood and the sheen or luster of the internal lining of the heart. Note the presence or absence of chicken-fat clots, or if there is no evidence of clotting. Postmortem clots can be distinguished from thrombi in that they are uniform in color, smooth and shiny, uniform in texture, and unattached but molded to the vessel in which they are formed. Antemortem thrombi are often a layered mixture of red and gray, friable, dull, roughened, stringy, and attach to the walls of blood vessels.

The heart should also be examined for evidence of congenital anomalies, particularly in young animals. Examine the ductus arteriosus between the pulmonary artery and the aorta with a probe to determine if it is patent or has closed, as is normal in larger, older animals, remaining as the ligamentum arteriosum. Examine the pulmonary artery for stenosis or constriction. Collect and preserve the whole heart or any abnormalities in 10% n.b. formalin.

Major blood vessels should be inspected routinely during examination of the organ systems they supply. In calves particular attention should be paid to the umbilical vessels for necrosis or abscesses.

RESPIRATORY SYSTEM

Each right and left lung is undivided and located in the dorsal part of the thoracic cavity. The lungs are separated from the abdominal cavity on either side of the vertebral column by the right and left muscular hemidiaphragms (Fig. 15). Pleural cavities extend from the first to the sixteenth thoracic vertebrae. Lungs are long (1 meter or more in adults), wide (20 cm) and thin (5 cm or less).

Examine each hemidiaphragm for tears. Carefully cut and remove the diaphragm beginning at the cranial and lateral edges and ending down the midline, ensuring that no fluid remains in the abdominal cavity to run into the pleural spaces. Note the amount, color, and consistency of fluid in each pleural cavity. Note if pus or fibrin is present. Obtain a culture sample if appropriate (Sec. VI).

Examine the lungs in place for adhesions or punctures by passing the hand completely around the lungs. Begin removal of each lung by severing the primary bronchus and carefully cutting through the pulmonary ligament along most of the length of the lung between its medial edge and the vertebral column. Remove and weigh each lung; then place on a flat surface for further examination. Photograph the dorsal and ventral surfaces of the lungs.

Describe the external appearance (color, luster, consistency and texture), and examine the pleural surfaces for fibrinous inflammation, verrucous

growths, discolored patches, abscesses, adhesions, cysts, spicules, or other unusual features. Poke the lung with a finger and describe the response of the tissue: note if it remains depressed or retains its shape, if it is well-rounded, or if it collapses. Examine the lungs for areas of hepatization, in which the tissue has about the same degree of firmness as liver. A hepatized lung is incompressible, and when cut with a knife a watery fluid will run out. A collapsed lung (atelectasis) is similar to liver in consistency but will be depressed and shrunken rather than swollen, and no fluid can be squeezed from its cut surface. If the lung tissue seems distended and firm in consistency, cut through a lobe and squeeze the edges: if a watery fluid emerges, perhaps a little tinged with blood, the lung is edematous; if the fluid is definitely bloody the lung is congested; if there are drops of pus it is pneumonic. Photograph unusual features.

Using scissors, open the bronchi from the ventral surface working towards the caudal end of the lung. Cut the ramifications of the bronchioles as far as possible and note the presence and quantity of mucus, blood, froth, ingesta (through terminal aspiration), obstructions, fibrin, inflammation, or pus. Occasionally nasal flukes (Cochleotrema cochleotrema) may be present; if so, note their numbers and position, and collect as previously described. Take culture samples and tissues for histology when appropriate. Collect flukes in 10% n.b. formalin or AFA. Obtain weights of each lung. Cut a piece of lung tissue and place it in water. Note if it sinks or floats. Photograph unusual features.

Returning to the body cavity, examine the parietal pleura for punctures, inflammation, abscesses, growths, hemorrhages, fibrin or tissue tags, or other lesions. Examine ventral surfaces of ribs for evidence of fractures or exostoses (bony outgrowths) and intercostal spaces for hemorrhaging.

URINARY TRACT

The kidneys are located in the caudal quadrant of the abdominal cavity, attached to the ventral surface of each hemidiaphragm. Kidneys are lobulated (Fig. 16), and in adults are approximately 20-25 cm in length and 15 cm wide.

Note relative size, shape, and position of each kidney. Make an incision along the length of each renal capsule, exposing the outer surface of the kidney. Photograph and describe the presence (if any), amount, coloration, and consistency of fat overlying the kidney. Locate ureters and clamp with hemostat and sever cranially. Remove both kidneys and determine weights and volumes of each after removing their encapsulating membrane and adhering tissue. Remove a sample from the caudal tip of the right kidney for environmental contaminant residue analysis prior to volume determination. Add an estimate of the volume of the sample removed to the total volume. Examine the remaining kidney, making transverse slices. Describe the color and presence or absence of necrotic areas. Examine each kidney internally, and note the definition between the cortex and medulla (Fig. 16), the presence or absence of petechiae, cysts or abscesses, and the nature of any fluids. Collect samples in 10% n.b. formalin for routine histology.

Follow the ureter to the urinary bladder and note the degree of distension. Carefully puncture the bladder and collect a urine sample with a sterile syringe. Measure the amount of urine present, and its consistency, clarity, and coloration. Freeze urine samples not intended for culture, particularly if starvation or emaciation is suspected and ketone determinations are desired. Samples may also be frozen for osmolality studies. Examine the ureter, urinary bladder, and urethra for obstructions, inflammation of the mucosa, cysts, stones, tumors, thickenings, folds, or hemorrhages. (Dissection of the urinary tract may be reserved until after dissection and removal of the reproductive tract.)

FEMALE REPRODUCTIVE SYSTEM

The female reproductive system (Fig. 17) is located in the caudal quadrant of the abdominal cavity. Locate the ovaries and oviducts by tracing the uterine horns to the abdominal wall. A single ovary in an adult female is about 10 cm long and 7 cm wide. The ovaries are attached to the parietal peritoneum, ventro-lateral to the kidneys, and ventro-lateral to the hemidiaphragms. The dorso-lateral aspect of each ovary shares a common wall with the peritoneum. Examine and photograph the entire reproductive tract *in situ* and describe any unusual or abnormal features, including hemorrhages, inflammation, or abscesses. Cut the membrane encapsulating the ovaries and dissect each entire ovary free but leave the uterine horn attached. Inspect each ovary and note the size, shape, color, presence, and quantity of ovarian follicles, corpora lutea, and corpora albicantia. Ovarian follicles are about 1 cm in diameter, blister-shaped with clear or

translucent jelly-like contents. Corpora lutea are similar, but filled with solid, creamy colored glandular tissue. Corpora albicantia are smaller, with a small brown spot on the center of the surface. Remove and weigh each ovary and measure its greatest length and width. Tie a string around the right ovary as a marker.

Examine the uterine horns and associated fascia for deposits of fat. Describe the amount, consistency, and color. Photograph the fat-laden areas. Tie a string around the right horn of the uterus. Dissect both uterine horns free up to the body of the uterus. Slice longitudinally along each horn into the lumen and examine the endometrium for hemorrhage, placental scars, or banding. If the animal is pregnant remove the entire embryo or fetus and preserve whole in 10% n.b. formalin or freeze.

Check the uterus and vagina for mucus or seminal fluid. Make a smear on a glass slide if seminal fluid is suspected and examine as outlined for sperm in the male reproductive tract. Note any anomalies and preserve in 10% n.b. formalin.

If the entire female reproductive tract is desired, dissect around the urogenital aperture, deep into the constrictor vulvae muscle to the abdominal cavity. (Collect the vestigeal pelvic bones on each side of the urogenital opening, lying deep to the cutaneus trunci muscle.) Dissect free and remove the entire vagina, urinary bladder, uterus, uterine horns, and ovaries. Examine, photograph, and slice with a scalpel to insure proper penetration of preservative and store in 10% n.b. formalin.

If the entire tract cannot be preserved intact, separate it between the uterus and vagina at the fornix of the vagina, just proximal to the cervix. Preserve the attached cervix, uterus, uterine horns and ovaries in 10% n.b. formalin after slicing for thorough penetration of preservative.

MALE REPRODUCTIVE SYSTEM

The male reproductive system (Fig. 18) is located in the caudal section of the abdominal cavity. The testes are attached to the peritoneum overlying the ventro-lateral surface of the kidney. A single testis in an adult male can be as large as 15 x 10 cm. Examine the testes. Locate the head of the epididymis and follow it to the seminal vesicles by way of the ductus deferens. The seminal vesicles are bilateral and located on the dorsal aspect of the urinary bladder. (The urinary bladder is just cranial to the anus and located at the proximal end of the body of the penis.) Examine and photograph the entire reproductive tract in situ and describe any unusual or abnormal features, including hemorrhages, inflammation, or abscesses. Note the color and quantity of fat deposits on the ductus deferens. Cut the membrane surrounding the right and left testes. Dissect free each testis with epididymis and ductus deferens attached. Tie a string on the right side as a marker. Free the right and left ductus deferentes to the base of the seminal vesicles. Remove the entire reproductive tract severing ventral to the urinary bladder. Measure the greatest length and width of each seminal vesicle and examine internally. Separate testes from epididymides (tie a string around the right testis) and take weights and measurements (greatest length x width) of each testis

within its capsule. Cut the caudal end of the epididymis and dab a small amount of fluid on a slide, smear over the surface, and allow to dry. Presence of mature sperm can be verified at low magnification (200X is suitable) of a microscope. The dry smear can be stained with Harris hematoxylin or other stains and stored.

If the entire male reproductive tract is desired, dissect around the bulbocavernosus muscle, freeing the entire penis, urinary bladder, and seminal vesicles with testes, epididymides, and ductus deferentes attached. (Remove and save the right and left vestigial pelvic bones on each side of the bulbocavernosus muscle at the base of the penis.) Examine, photograph, and slice several times with scalpel to insure proper penetration of preservative and place in 10% n.b. formalin.

If the entire tract cannot be collected, separate it between the root of the penis and the urinary bladder, preserving the testes and epididymides with seminal vesicles and urinary bladder attached in 10% n.b. formalin after slicing several times for proper penetration.

HEAD AND NECK REGION

Remove the ventral skin mass from the pectoral area up to the chin (Figs. 19 and 20). Examine the underlying muscle for trauma, hemorrhage, abscesses, cysts, or other abnormalities. Cut free and remove the muscles (right and left sphincter colli profundus muscles) which run parallel to the long axis of the body, ventral to the trachea at the median. Note the

large (about 20 x 25 cm in an adult) parotid salivary glands just lateral to each muscle (Fig. 19). Slice through and examine the glandular tissues. Note their color, size, and shape, and examine for hemorrhage or other abnormalities. Examine the lymph nodes in this region, noting size, shape and color, preserving a thinly sliced sample in 10% n.b. formalin. Take a culture sample if desired.

Just dorsal to the sphincter colli profundus muscles are the right and left sternohyoideus muscles. Dissect and remove these muscles, avoiding damage to the underlying thyroid. The thyroid is a bilobed gland usually joined by a thin isthmus, lying on both sides of the trachea just posterior to the larynx (Fig. 19). Its color may vary from amber or gold to a dark brown and it is very variable in size. Remove the thyroid, examine and describe, weigh, and preserve in 10% n.b. formalin after slicing to insure proper penetration of preservative.

Slice open the trachea and examine the lumen for parasites, obstructions, mucus, froth, blood, foreign matter or other abnormalities. Note if the mucosa shows reddening or inflammation. Remove the trachea and examine the esophagus (dorsal to the trachea) internally for obstructions, irritation, inflammation, or other unusual features. Remove the hyoid bones and examine the base of the oral cavity. Dissect the tongue free and examine. Examine the middle ear chambers for fluid or solid material, noting the color, quantity, and clarity of contents. The middle ear chamber is examined by slicing through the membrane between the basioccipital bone and tympanoperiotic bone.

The head can be removed from the neck by cutting between the occipital condyles and the atlas (located at the level of the humero-scapular joint). By cutting through the joint here, the head should separate easily. Cut through the overlying dorsal musculature and skin to remove the entire head.

Examine the dorsal aspect of the head and the lips. Make sagittal slices through each nostril and examine the nasal cavities for parasites, fluids, other material, or foreign objects. Remove the skin from the dorsal and lateral aspects of the head, examining the underlying tissue for signs of trauma, hemorrhage, or splintered bone. Remove the eyes using curved tip scissors to sever the muscle attachments. Preserve frozen or in 10% n.b. formalin. Open the mouth and count the number of erupted teeth on each tooth row, recording the information on the appropriate standardized form.

Brains, generally intact only on relatively fresh carcasses, may be removed by making a series of cuts on the dorsal, caudal aspect of the skull (Fig. 21) using a Stryker or hack saw. The bone is dense and the job is tedious: caution should be taken not to damage the underlying tissue. Carefully pry the cut section of skull away from the cranium. Gently remove the brain, cutting major cranial nerves as it is lifted out; carefully try to remove the pituitary gland, located on the mid-ventral surface, intact with the entire brain. Describe the color of the brain and the presence or absence of surface lesions or edema. Weigh the entire brain. Examine the cranial cavity for fluid, hemorrhage, or discoloration. If toxic chemicals are suspected as a cause of death but histology is

still desired make a sagittal cut dividing the brain in two symmetric halves, freezing one-half and preserving the second half entire in 10% n.b. formalin. Otherwise preserve the brain entire as desired.

FLENSING THE SKELETON

Remove the right and left flippers by cutting between the head of the humerus and the glenoid fossa of the scapula. Remove as much flesh as possible and carefully slice the skin from the rest of the flipper. Remove the scapula. Flense away as much soft tissue as possible from the sides, carefully examining for trauma, hemorrhage, abscesses, or other abnormalities. The carcass can be rolled at a convenient point and the skin and blubber layer measurements taken from the mid-dorsal line at mid-body. Continue flensing the dorsal skin and musculature. On large specimens the axial skeleton can be cut in halves or thirds for ease of handling. If two pieces are desirable a cut can be made between the last thoracic and first lumbar vertebrae (Fig. 22). Make an additional segment if desired by cutting between the eighth and ninth thoracic vertebrae. The vertebral column is best severed by cutting from the ventral aspect with a sharp knife. Cut between the dorsally situated articular processes of the vertebrae at a direction angled towards the fluke while applying pressure by draping one section of the body over the end of the work table or trailer.

Broken or disarticulated bones and ribs should be noted and photographed. Describe which bones are broken, numbering ribs consecutively from cranial to caudal. Describe any bony overgrowth if the wound is not recent. If the fracture is a recent, acute break note its location (tip or distal, middle, or proximal third in the case of ribs) and whether it is a hairline crack, simple break, or comminuted (shattered in pieces) fracture. Describe the edges and angles of the breaks.

Label the skull with a lead tag marked with the correct field number of the specimen. Skeletons should be placed in large metal drums with small drain holes at the bottom. Skulls should be placed in the barrels dorsal side down to prevent the teeth from falling out. Mandibles should be disarticulated from the cranium and set next to the skull, dorsal side up. Flippers should be placed flat on the bottom and far enough apart so that carpal bones and digits of separate limbs do not intermingle as the remaining flesh disintegrates. Each barrel should be labeled with a lead tag. Cover the drum with a securely fastened hardware cloth or chicken-wire lid. Care should be taken to prevent smaller bones from being lost or separated from the specimen.

The complete axial skeleton (Fig. 22) should consist of the cranium and 2 fused mandibles; 3 hyoid bones; 6 cervical, 17-19 thoracic, and 23-29 lumbocaudal vertebrae; 17-19 paired ribs, usually 3 of which are true ribs, 13 false ribs, and 1 a floating rib; the sternum; and 7-9 pairs of chevron bones attached by cartilage to the posterior end of each ventral surface of the first 7-9 caudal vertebrae. The appendicular skeleton

consists of 2 vestigial pelvic bones, and 2 flipper assemblies each consisting of a scapula, humerus, radius, ulna, 7-8 carpal bones, and 5 digits with a phalangeal formula of I:2, II:3, III:3, IV:3, V:2-3. In young animals sutures may not be fused in the skull, vertebral processes, or epiphyses of flipper bones, and the hyoid and pelvic bones may be incompletely ossified.

V. AIDS TO ASSIGNING A CASE TO A CAUSE-OF-DEATH CATEGORY

Each specimen should be assigned to one of six probable cause-of-death categories following completion of the necropsy. Criteria used to make these assessments are listed below.

COLLISION WITH A BOAT OR BARGE

Death due to collisions with vessels is often acute but may also be a result of a chronic long-term debilitation. Fresh, open propeller wounds or skeg marks provide obvious clues. Manatees can be killed by impact alone or by crushing between the hull and the substrate leaving no such propeller marks. External features which can sometimes provide clues include extensive scrape marks and asymmetry or twists along the main axis of the body. Superficial muscle layers, particularly on the top of the head and the back, may show signs of massive trauma such as bruising and/or hemorrhage. These usually are in well-demarcated blood-tinged patterns that can be distinguished from autolysis in all but the most badly decomposed carcasses. Broken bones, particularly recent fractures of ribs or shattered scapulae, are also frequently encountered. Massive trauma to internal organs may also be seen and large amounts of coagulated blood are sometimes found in the body cavities if major blood vessels are ruptured. Broken bones may perforate lungs or major blood vessels, the heart may rupture, and the kidneys may appear paler, softer, and larger than normal with loss of blood. Pulmonary perfusion may occur, causing the lungs to be heavy and saturated with blood, with an absence of frothy fluid in the

bronchi. Other signs associated with an agonal death or shock may also be present. Correlates of a boat-barge collision can include anuria, petechial hemorrhage in mesenteries and blood-tinged fluid in the pericardial sac.

External propeller wounds can be minor and superficial but can be associated with massive internal trauma as described above. Major, severe wounds which penetrate the dermis and enter the flesh causing serious organ damage can also occur. The possibility of a propeller cut being post-mortem can be investigated using several clues. Post-mortem propeller cuts show no signs of trauma to internal organs or musculature. If the wound is cut through with a knife and examined in cross-section and shows reddening around the edges, fibrin and pus infiltration, or scar tissue, it was inflicted ante-mortem. Location of the propeller wound also provides a clue. Dead manatees always float with the ventral aspect exposed and ante-mortem wounds on this aspect are rare. Wounds responsible for death are usually located on the dorsal aspects. Floating dead manatees are probably also more easily seen and avoided by boat pilots. Post-mortem propeller cuts have very rarely been encountered.

Chronic debilitation due to a boat-induced injury usually involves infection. Even a minor, externally healed propeller wound may be associated with large purulent internal abscesses, septicemia, organ adhesions, or other signs of infection. Chronic osteolytic lesions from broken ribs can also lead to massive internal infections and subsequent

death. As these infections are a secondary result of a collision with a vessel, the cause of death is categorized as such.

CRUSHED OR DROWNED IN A FLOOD GATE OR CANAL LOCK

External scrapes and impressions, internal damage, and a history of proximity of the carcass to one of these structures provide clues used in assigning a case to this category. Minor scrapes and abrasions can occur anywhere on the body, particularly if concrete walls, bottoms, or sills are present. Distinct impressions of gate edges are sometimes evident. Broken bones and/or disarticulated ribs are often found (with clean, sharp breaks where fractures are involved). Other lesions as described for boat-barge collisions may also occur, but in some cases drowning (asphyxiation) may take place and massive areas of hemorrhage are not encountered because the heart had stopped pumping blood. Location of the carcass, records of gate operation schedules, and reports of lock-tenders or other witnesses usually provide convincing circumstantial evidence to place a case involving signs described above into this probable cause of death category.

OTHER HUMAN-RELATED

Previously encountered cases assigned to this category include deaths due to vandalism, poaching, entrapment in nets or pipes, and complications due to entanglement or ingestion of fishing gear. Indicative lesions and circumstances surrounding these causes of death are usually evident.

Toxicosis from environmental contaminants has not previously been determined, but such deaths would also be included in this category.

Gunshot wounds leave small entry holes on the external surface, which must be examined for carefully during necropsy. Buckshot or other foreign objects resulting from nonlethal vandalism may be encountered while removing skin or flesh, for example, in the snout region. If possible, a radiograph of the suspected area should be taken to determine the location of a bullet. If bullets are found they should be saved for law enforcement personnel. Animals that have been killed for meat usually have large pieces of flesh missing from the carcass. Poaching, vandalism, and other human-related causes of death should be reported to USFWS LE agents as soon as they become apparent.

Small calves have been found drowned in fisherman's hoop nets, and manatees have also been entangled and drowned in nets of shrimp trawlers. Reports of witnesses, proximity of carcasses to netting operations, and other non-pathological clues provide important circumstantial evidence for inclusion in this category. Manatees may also become trapped and die in large diameter pipes, or become entangled in wires, lines, or ropes. Ropes and line may wrap around flippers and cause necrosis and subsequent septicemia eventually causing death.

DEPENDENT CALF

This category is arbitrarily defined to include all animals less than 150 cm in total length which were not determined to have died due to human-related causes. Small fetuses are not included. Calf deaths due to disease or congenital anomalies are included in this category. However, proximate causes of death are frequently unknown. Near-term fetuses as large as 152 cm have been recorded and some calves as large as 260 cm in length may continue to nurse from females. Hence most cases of dead calves less than 150 cm probably involve perinatal and early juvenile mortality, which is useful to distinguish from the undetermined category used for larger animals dead from unknown causes. Carcasses slightly greater than 150 cm that are obviously perinatal (based on digestive tract contents, umbilical characteristics, lack of inflation of the lungs, fetal folds, and other features) may also be classified in this category.

Signs of starvation or anorexia are sometimes encountered in small calves, indicating prolonged separation from mothers. Carcasses show emaciation, and fat undergoes serous atrophy, leaving a clear or jell-like appearance of remaining deposits. This is most prominent around the ventral surfaces and interventricular groove of the heart. The gastrointestinal tract is often empty and the gall bladder distended with bright yellow bile. Animals in this condition may also have infections. These may include multiple purulent abscesses in the dermis, musculature, umbilical vessels, and kidneys.

Calves which die at or soon after birth can be distinguished by the presence of meconium in the digestive tract (but no milk or vegetation), an unhealed (a non-involuted) umbilicus, and clotted blood in the umbilical artery. A slice of lung from a calf that has not lived long enough to breathe will not float. Morphological abnormalities or birth defects may contribute to an early death, particularly deformities of the heart. Patent ductus arteriosus, however, is a common condition that persists in young manatees to lengths greater than 150 cm and may not be considered to be a pathologic condition.

NATURAL

This category includes deaths due to infectious and non-infectious disease and natural catastrophies, such as severe weather or poisoning due to exposure to biological toxins. Small aborted fetuses are also placed in this category. Diagnosis of disease generally requires corroboration by qualified professional pathologists with supporting evidence from histopathology and microbiology. The necropsy section of this manual has been written with an eye towards identifying possible naturally caused pathology in each organ system. Samples should be taken to pathologists and other specialists for verification.

Previously encountered cases included in the natural category include hemorrhagic enteritis, lung infections (pneumonia), dermatosis, and encephalitis. In hemorrhagic enteritis the serosal surfaces of affected segments of the gastrointestinal tract show reddening due to hemorrhage

(which should be distinguished from physiologic hyperemia or congestion, and autolysis), the mucosal surfaces are inflamed and sloughing, and the contents may be watery or bloody. Respiratory pathology has included thromboembolic pneumonia, distinguished by the presence of large multiple abscesses, vascular thrombi, and areas of focal necrosis, terminal aspiration pneumonia caused by inhalation of foreign material, and verminous pneumonia as a result of a severe infection of nasal flukes. Dermatosis has involved multiple ulcerative lesions over much of the skin, with related internal sepsis. Encephalitis due to infection by Toxoplasma gondii has been diagnosed by histological examination.

An incompletely understood syndrome included in the natural category has been identified in association with prolonged cold winter weather. These animals are usually emaciated and in a general state of cachexia. Fat deposits are reduced and serous atrophy of fat is sometimes apparent. The stomach and small intestines are usually empty and material in the colon often forms small, hard, dehydrated boluses. These boluses are indicative of a lack of feeding or intestinal atony, thus causing prolonged retention in the colon where fluids are continually resorbed by the colonic mucosa (constipation). Deaths are predominant among animals larger than calves but of a subadult size range. The actual etiologic or physiologic cause of death is not known. In the past many similar cases were placed in the undetermined category.

Poisoning due to exposure to dinoflagellate toxins (red tide), probably through ingestion of toxin-accumulating ascidians, caused deaths of at

least 37 manatees in Lee County in the spring of 1982. No gross pathology other than occasional instances of hemorrhages in brains was evident, but overwhelming circumstantial evidence implicated dinoflagellate toxins and subsequent classification in the natural category.

UNDETERMINED

Cases are classified as undetermined if no cause of death is apparent following necropsy.

VI. SPECIMEN COLLECTION, PRESERVATION, PREPARATION, AND SHIPMENT

FIXATIVES AND PRESERVATIVES

This section outlines the use of fixatives and preservatives employed routinely in the manatee salvage program. Components required for the preparation of these solutions are listed in Appendix II. Other solutions may occasionally be required for more specialized techniques or cooperators requirements. Crushing, stretching, scraping, or otherwise damaging specimens should be avoided. All samples should be secured in durable containers with appropriate tags (Fig. 23) as well as external labels.

10% neutral buffered formalin. The most widely used fixative for wet tissue samples is 10% neutral buffered (n.b.) formalin. For histopathology, samples should be relatively fresh and cut into small (1 x 1 x 0.5 cm) pieces and placed in at least 10 volumes of formalin per volume of sample. Larger samples and entire organs may also be preserved in formalin, but these should be cut adequately or infused with formalin using a needle and syringe to insure maximum penetration. Fixation should be complete in 1 to 2 weeks. Samples must be checked routinely during storage to avoid loss of fluid.

5% formalin. Freshwater vegetation from manatee digestive tracts is preserved in this solution. Saltwater vegetation is preserved in this solution made with saline or saltwater (Appendix II).

Buffered glutaraldehyde. Glutaraldehyde requires refrigeration. Buffering should be done within a day of intended use and specimens processed as soon as possible (48 hours or less). It is generally used only with extremely fresh samples to be examined by electron microscopy. Precise instructions on its use should be obtained from the appropriate cooperator.

Bouins fluid. A few cooperators may request the use of Bouins fluid but it is generally not used for routine histological samples due to picric acid staining. Fixation occurs in less than 24 hours. Samples are routinely stored in 70% ethanol after fixation. Material left in Bouins fluid for longer than 24 hours becomes very firm, brittle, and difficult to section.

AFA. This solution is used for fixation of living trematodes as it tends to relax the musculature. If parasites are dead at collection other preservatives are appropriate.

Ethanol. A solution of 70% ethanol is used for preservation of nematodes, trematodes, and barnacles after fixation. It is not recommended as a fixative for other parasites or tissue samples because it can dehydrate and damage tissue.

SPECIMEN COLLECTION

Tissue samples should be routinely collected from all organ systems for histopathology if a carcass is fresh. Particular attention should be

given to samples from areas with gross lesions. Histologic samples should include the interface between normal and diseased tissue. Routine sampling should include but is not limited to the adrenals, brain, cecum, heart muscle, kidneys, liver, lungs, lymph nodes, pancreas, reproductive organs, spleen, and stomach. In addition, bone, colon, eyes, heart valves, muscle, small intestine, thymus, thyroid, trachea, and urinary bladder may also be collected. Neutral buffered formalin (10%) is a suitable fixative for general purposes, although some special stains require other fixatives. For histopathology, samples should be relatively fresh and cut into small (1 x 1 x 0.5 cm) pieces and placed in at least 10 volumes of fixative per volume of sample.

Some cooperators request that materials be frozen. Samples may include: blood or urine; portions of organs and tissues such as blubber, brain, kidney, liver, or muscle; entire organs and structures such as brain, eye, flipper, head, larynx, skin, or spleen. Entire calves may also be preserved frozen. Instructions for selected samples are outlined below.

Ingesta. Samples of gastrointestinal tract contents for food habits studies are sampled from most carcasses regardless of stage of decomposition. Contents of animals from freshwater areas should be preserved in 5% formalin; samples from saltwater areas should be preserved in 5% formalin made with saline. About 100 ml of material should be collected from each region of the digestive tract and diluted with an equal volume of preservative. Regions sampled should include the stomach, duodenum, mid-small intestine, cecum, and mid-large intestine.

Parasites and commensals. Nematodes from the stomach and duodenum should be preserved in 70% ethanol or 70% glycerine ethanol, after fixing in GAA when possible. Trematodes are fixed in 10% n.b. formalin, then preserved in 70% ethanol. Living trematodes are relaxed in cold water, then fixed in AFA. Barnacles should be fixed in formalin and stored in 70% ethanol.

Tissues for electrophoresis. Cooperators generally request that samples of muscle, liver, and kidney be taken using clean dissection instruments. Samples should be about 25 g in size and frozen in clean jars or whirlpak plastic bags. Material should be collected from fresh or slightly decomposed carcasses only.

Heavy metal and organochlorine residue surveys. Liver, kidney, muscle, blubber, and brain tissues are collected separately in samples of 10 g or more. The following precautions apply particularly to blubber, brain, and muscle samples for organochlorine analysis but are equally applicable to liver, kidney, and muscle samples to be submitted for heavy metal analysis. Samples should be stored frozen in glass jars pre-rinsed in acetone, hexane, and dilute nitric acid. Jar lids should be lined with aluminum foil or Teflon. Stainless steel dissection tools should be clean, and rinsed frequently in acetone and hexane, in that order, during dissections. Samples should not be handled or exposed to plastics, soaps or oils; excised tissue should be placed only on aluminum foil or directly in the jars following removal from the carcass. Tools should be thoroughly cleaned in acetone and hexane before changing from one tissue to another and the leanest tissues should be collected first. Jars should be

pre-weighed to the nearest 0.1 g and then weighed with contents. Weights should be recorded on the label and the lid sealed to the glass with adhesive tape.

Topographic location of samples should be consistent. Liver samples are taken from the caudal tip of the right lobe, kidney samples from the caudal portion of the right kidney, blubber samples from the outermost layer at the mid-ventrum just to the right of the mid-body incision, and muscle samples from the layer immediately beneath the blubber sample. A frozen right sagittal half of the brain is a suitable minimum sample for analysis if histology is also desired on this organ.

Urine and hemolyzed blood. Urine can be collected from the urinary bladder of relatively fresh carcasses with a sterile syringe. If the bladder is not distended it may be desirable to slit the bladder to remove the urine with a syringe. Urine can be refrigerated but it should be submitted for culturing or clinical pathology as soon as possible after collecting. Samples can otherwise be frozen for later determination of osmolality and other urine values. Hemolyzed blood from very fresh carcasses can be collected from the heart and stored frozen.

Microbiological cultures. Culture swabs (Culturettes) should be removed from their sterile wrapping, brushed against the lesion or fluid requiring sampling, and replaced in their tubes as swiftly as possible to avoid contamination. The ampule containing culture medium at the end of the tube should be crushed immediately to allow the media to contact the

swab. The Culturette should then be labeled, refrigerated, and submitted to a microbiology laboratory within 72 hours. Separate swabs should be taken from areas where the presence of pathogens is suspected. Routine sampling of the pleural surface of the lungs, bronchi, stomach mucosa, perineal fluid, fluid in the pericardial sac, brain surfaces, abscesses, or infected areas is recommended for relatively fresh carcasses.

BONE PREPARATION

Bones are removed from barrels once they are thoroughly cleaned by dermestid beetles. The bottom of the barrel and remaining soft debris should be examined for small bones and bone fragments. Flippers and other small bones can be placed in nylon stockings to keep them together during cleaning. Place the skeleton in a 30 gallon plastic barrel, fill with water, and add about 2 liters of 30% ammonium hydroxide concentrate (handle with care to avoid dangerous chemical burns). If relatively clean the fluid can be reused on another specimen. For effective cleaning, some specimens may require soaking in water for several days prior to soaking in ammonia, but water should be changed at least every 48 hours to prevent algal staining of the bones. Following ammonia soaking each bone should be brushed clean with a wire brush, rinsed with water, and dried on a wire rack for at least 48 hours. Once dry, bones should be labeled by field identification number in permanent ink. Skeletons should be stored separately in labeled containers (cardboard boxes are suitable) containing moth balls (napthalene) and placed in a cool dry place.

SHIPPING OF SPECIMENS

All samples sent to cooperators should be well packaged in heavy duty containers. Addresses should be clearly marked. The inside of the container should contain a duplicate address, a loan form (Appendix III) specifying the material enclosed and nature of the shipment, and a copy of the Federal Wildlife Permit under which authority the specimen was collected. Export permits obtained from the U.S. Fish and Wildlife Service Permit Office and CITES import permits from the destination country are necessary for foreign shipments. Osteological specimens can be wrapped in matting material and packed in styrofoam chips.

Frozen samples must be shipped in very sturdy ice chests that will not break in transit. Include a self-addressed prepaid postage label for return of the empty container. A substantial quantity of dry ice should be included. Arrangements must be made with the receiver prior to shipping so that someone will be present to promptly handle the package and remove the contents at the destination. Courier service and air freight are acceptable. In the latter case choose flights with a minimum number of connections, preferably at cooler times of the day. A certificate of contents for hazardous materials may be required for dry ice shipments of certain weights. Verify this prior to packaging and shipping. Inform the recipient of the airbill or other identification number by telephone at the time of shipping for tracing at the destination should the shipment be lost. Save all receipts.

Fluid-fixed specimens should be prepared and packaged for shipment by employing the following procedure:

1. Rinse the specimen with tap water.
2. Wrap the specimen in enough cheese cloth or cotton gauze to cover all exposed surfaces of the tissue.
3. Place the wrapped specimen in a plastic bag, including a complete specimen tag (Fig. 23). Smaller samples can be immersed directly in a small amount of preservative without being wrapped.
4. Add just enough of the preservative to thoroughly wet the wrapping material.
5. Seal the plastic bag and nest it in two or more additional sealed plastic bags. Heat-sealed bags are ideal. Zip-lock bags are suitable.
6. Package the bags in sturdy containers for shipping, including packing material, loan forms, copy of the Federal Fish and Wildlife Permit, and duplicate address label. Address the container.

Table 1. Important telephone numbers and key personnel for manatee carcass salvage in Florida, 1983.

FLORIDA MARINE PATROL

Tallahassee Manatee Hotline 800-342-1821

District Offices

1.	Panama City	904-763-3080	7.	Titusville	305-267-4021
2.	Carrabelle	904-697-3741		after 1700 h	305-269-8280
3.	Crystal River	904-628-6196	8.	Jacksonville	904-359-6580
4.	Tampa	813-272-2516	9.	Marathon	305-743-6542
5.	Ft. Myers	813-334-8963	10.	Jupiter	305-747-2033
6.	Miami	305-325-3346	11.	Pensacola	904-438-4903
	after 1700 h	305-325-3347			

U.S. FISH AND WILDLIFE SERVICE

Denver Wildlife Research Center, Sirenia Project

24 h message recorder	904-372-2571	Cathy Beck, residence	904-377-1520
Office	904-372-2572	Bob Bonde, residence	904-377-1520
FTS	946-7284, 7239	Tom O'Shea, residence	904-375-7205
R. Kipp Frohlich	813-693-2786	Galen Rathbun, residence	904-495-9073

Endangered Species Field Office, Jacksonville

Office	904-791-2580	Earl Possardt	904-791-2580
FTS	946-2850, 2580	Don Palmer (alternate), residence	904-246-2805

Law Enforcement

Senior Resident Agent, Tallahassee

24 h message recorder	904-681-7456
Bob Prather, residence	904-385-8600

Special Agent, Gainesville

Office	904-378-0201
Charles Bazemore, residence	904-375-1253

Senior Resident Agent, Miami Springs

Dick Endress	305-526-2916

Special Agent, Orlando (including Brevard Co.)

Dispatcher	305-295-9123
Vance Eaddy, office	305-699-0550

UNIVERSITY OF MIAMI

24 h message recorder	305-361-4166
Cetacean/turtle stranding hotline	800-432-6404
Dan Odell, residence	305-233-0563
Doug Burn, residence	305-665-7140

FLORIDA GAME AND FRESH WATER FISH COMMISSION

Panama City	800-342-1676	Ocala	800-342-9620
Lake City	800-342-8105	John Moran, residence	305-295-9123
Barry Cook, residence	904-466-3810	Lakeland	800-282-8002
West Palm Beach	800-432-2046		

Use space below for changes and additions:

Table 2. Items which should be taken routinely when retrieving a carcass.

1.	Federal permits for manatee salvage.
2.	Photographic equipment: 35mm SLR camera, preferably with wide-angle lens and data back; ruler or scale for a size reference; extra film; miscellaneous accessories.
3.	Collecting materials: Assorted jars and plastic bags, formalin, alcohol, labels, indelible ink pens, dissection tools.
4.	Assorted hand tools, knives, measuring tape, flashlight, large plastic bags, stiff brush, shovel, large and small barrels and buckets, blocks or bricks.
5.	Field notebook, copies of blank data sheets (see appendix), indelible ink pens and pencils.
6.	Material for covering and securing the carcass: tarpaulin, straps, line.
7.	Rubber gloves, boots, and waders.
8.	First aid kit.
9.	Water, disinfectant, soap, and towels.
10.	Map of recovery area.
11.	Manatee pamphlets and bumper stickers for interested parties.
12.	Cash for tolls, telephone calls, truck scales, ice, meals, and emergencies.

Table 3. Equipment that should be available at necropsy.

Use	Item
Clothing	Rubber boots, heavy rubber gloves, plastic gloves, aprons, smocks, coveralls.
Dissection	Knives, whetstones and steel sharpeners; scalpels and no. 22 blades; assorted scissors, forceps and probes; clamps, retractors, handhooks; Stryker saw or hack saw.
Specimen collection	Balances (for weights of small samples of a few grams and for whole organs of several kilograms); jars, vials, and plastic bags of several sizes; metric ruler; strings, tags, and labels; large amounts of preservatives (10% neutral buffered formalin, 5% formalin, 5% formalin in saline, 70% ethanol, and others as in Section V); refrigerator or cooler, freezer; syringes and needles; collection and storage tubes; sterile swabs and transport media (Culturettes); aluminum foil, contaminant-free jars and dissecting tools (scalpels, blades, forceps, and scissors), adhesive tape, acetone, and hexane as in Section V.

Table 3. Continued.

Use	Item
Documentation, measurement and labeling	Camera, wide-angle and macro lenses, data-back, film, flash unit, batteries, pointers, plastic background sheet, and scale; metric tape measure, rulers, balances, volumetrically graduated containers (1 liter or more, for fluid quantity estimates); notebook, standardized forms, blackboard and chalk, file cards, pencils, permanent felt tip markers, permanent ink pens; wire, wire cutters, lead tags, letter and number punch set, hole punch, and hammer.
Cleanup and disposal	Plastic barrels, large, heavy-duty plastic bags, shovels; metal drums (55 gal) with wire lids and drain holes for skeletons; brushes, sponges, buckets, detergent, ammonia, disinfectant solution; hand soap and paper towels.

FIGURES

Figure 1. Florida Marine Patrol District boundaries.

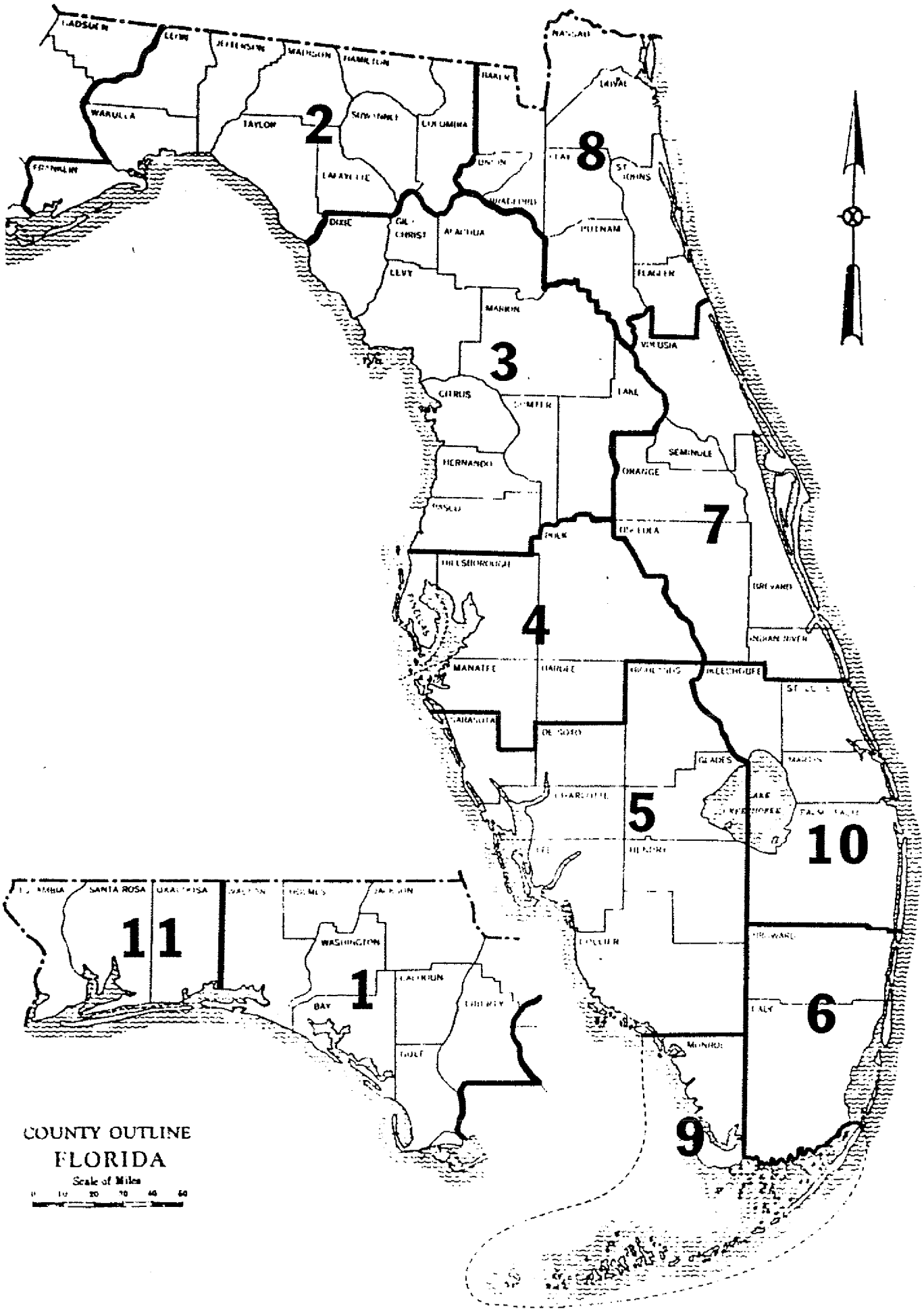

2
8
3
7
4
5
10
11
1
6
9
COUNTY OUTLINE
FLORIDA
Scale of Miles

Figure 2. Incisions required for entering the abdominal cavity from the ventral surface.

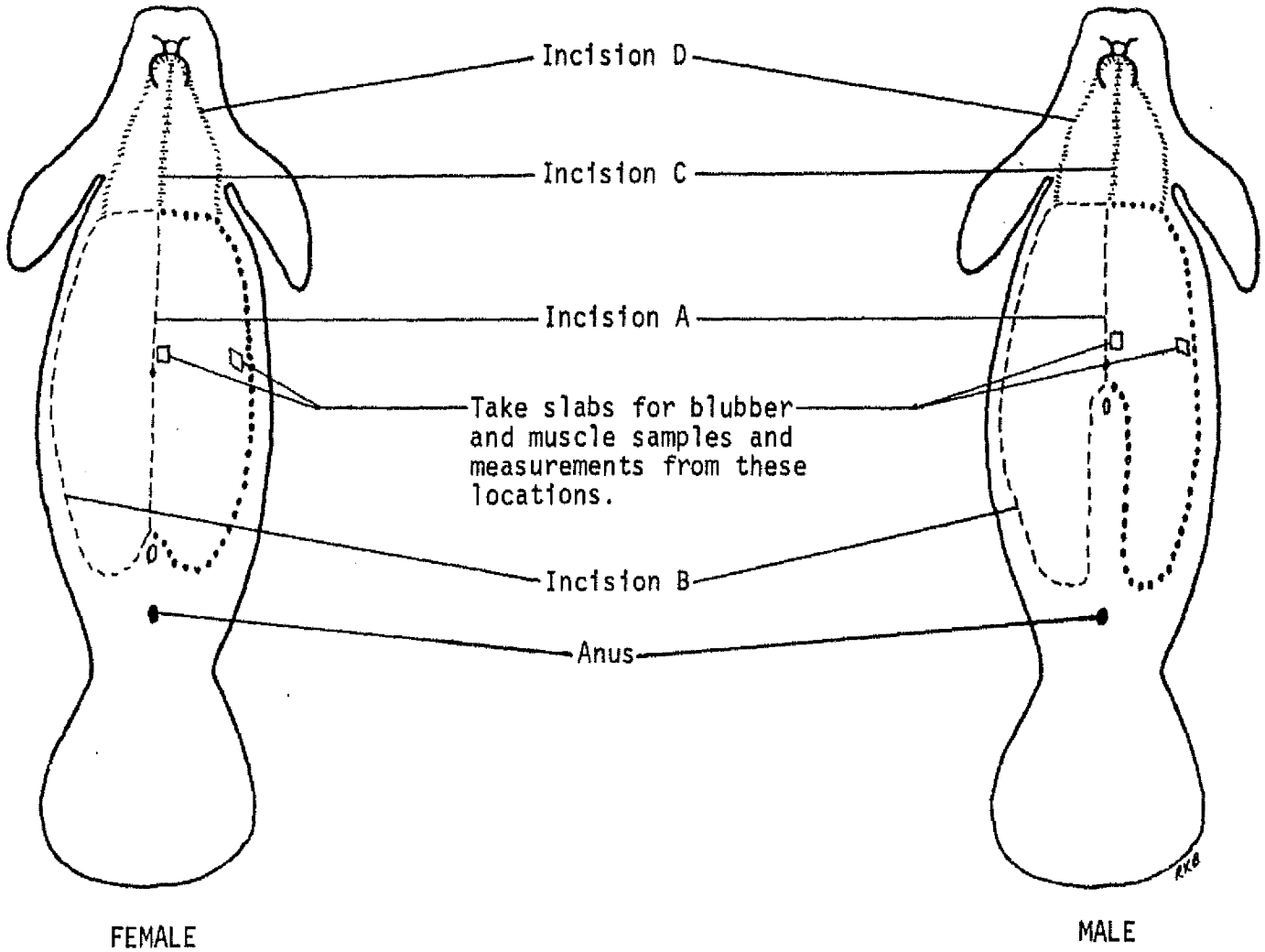

Incision D
Incision C
Incision A
Take slabs for blubber and muscle samples and measurements from these locations.
Incision B
Anus
FEMALE
MALE

Figure 3. Cross-section of tissue layers near the ventral mid-line.

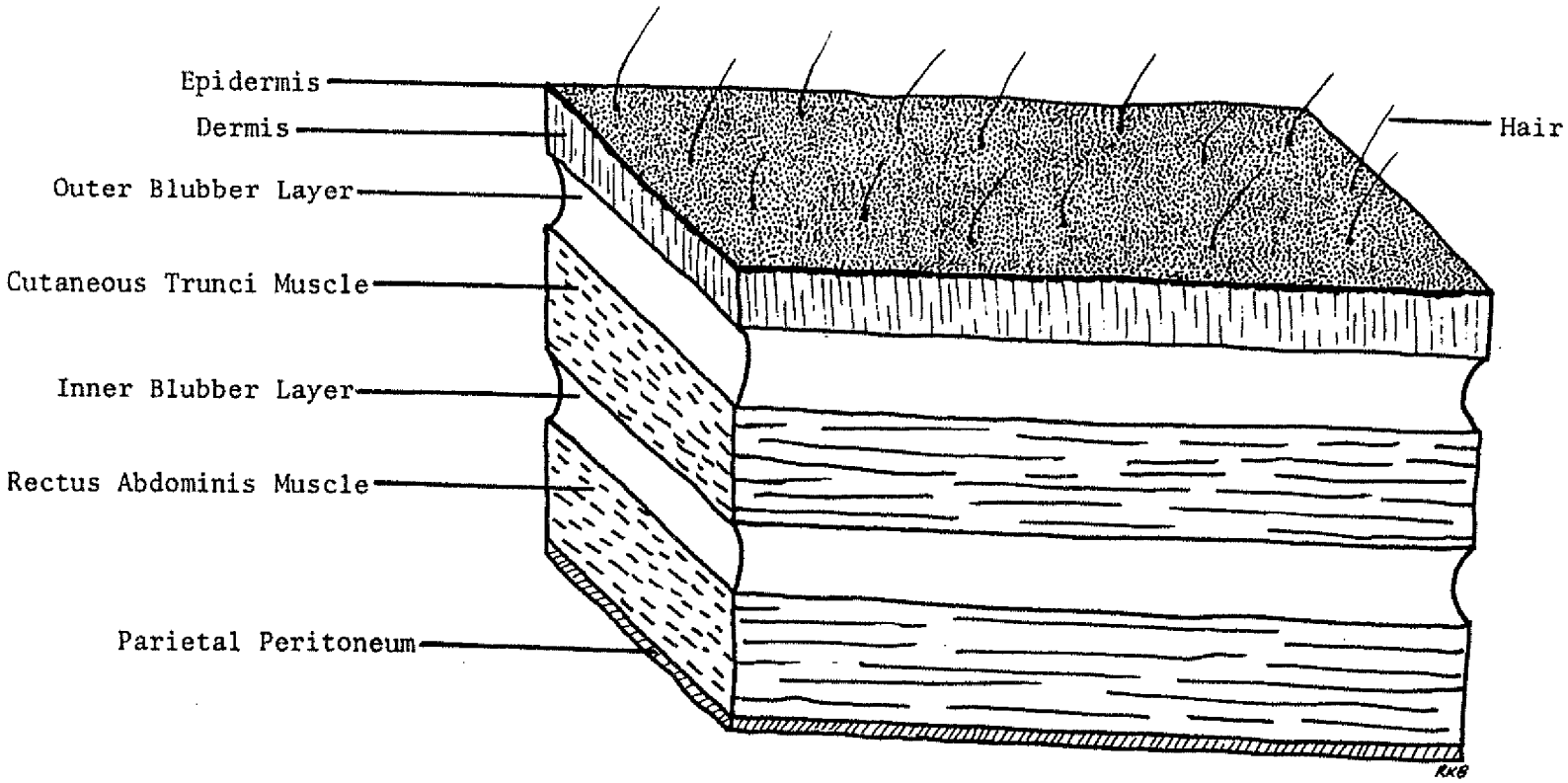

Epidermis
Dermis
Outer Blubber Layer
Cutaneous Trunci Muscle
Inner Blubber Layer
Rectus Abdominis Muscle
Parietal Peritoneum
Hair
RKB

Figure 4. Major organs of the manatee (lateral view).

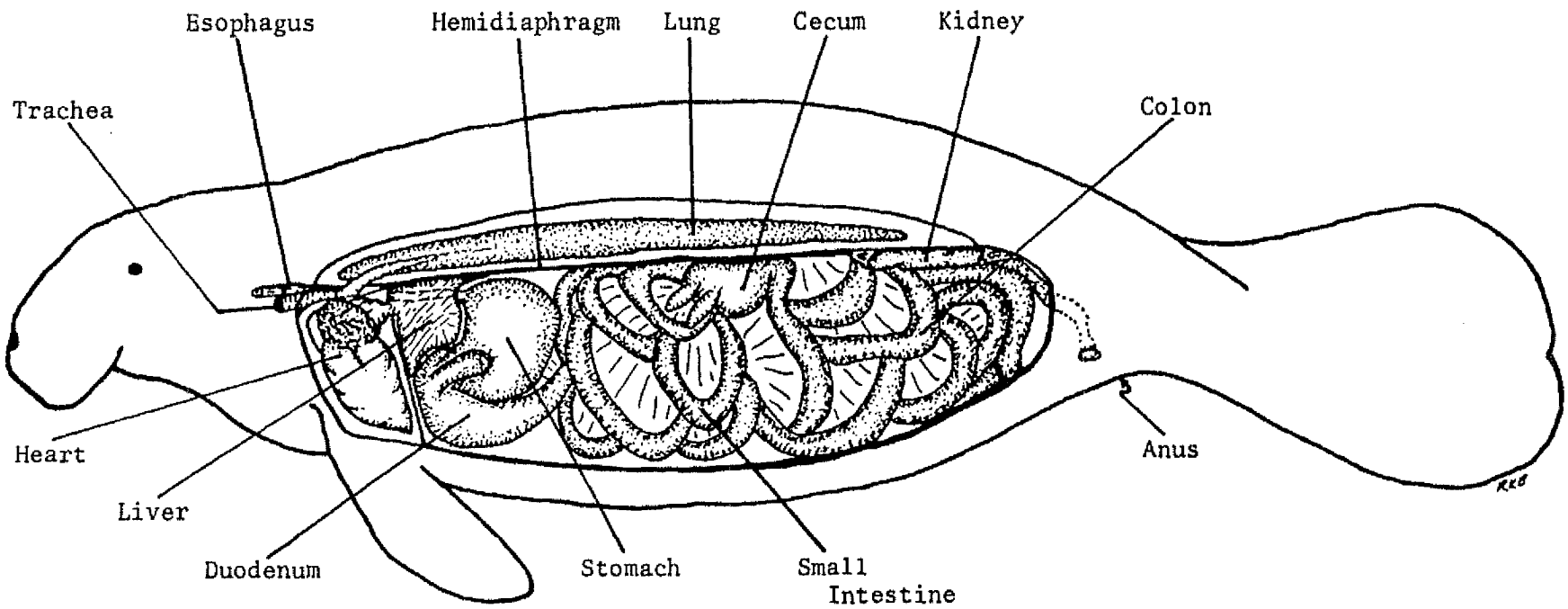

Esophagus
Hemidiaphragm
Lung
Cecum
Kidney
Trachea
Colon
Heart
Liver
Duodenum
Stomach
Small
Intestine
Anus

Figure 5. Exposed organs *in situ* following removal of ventral slabs (ventral view).

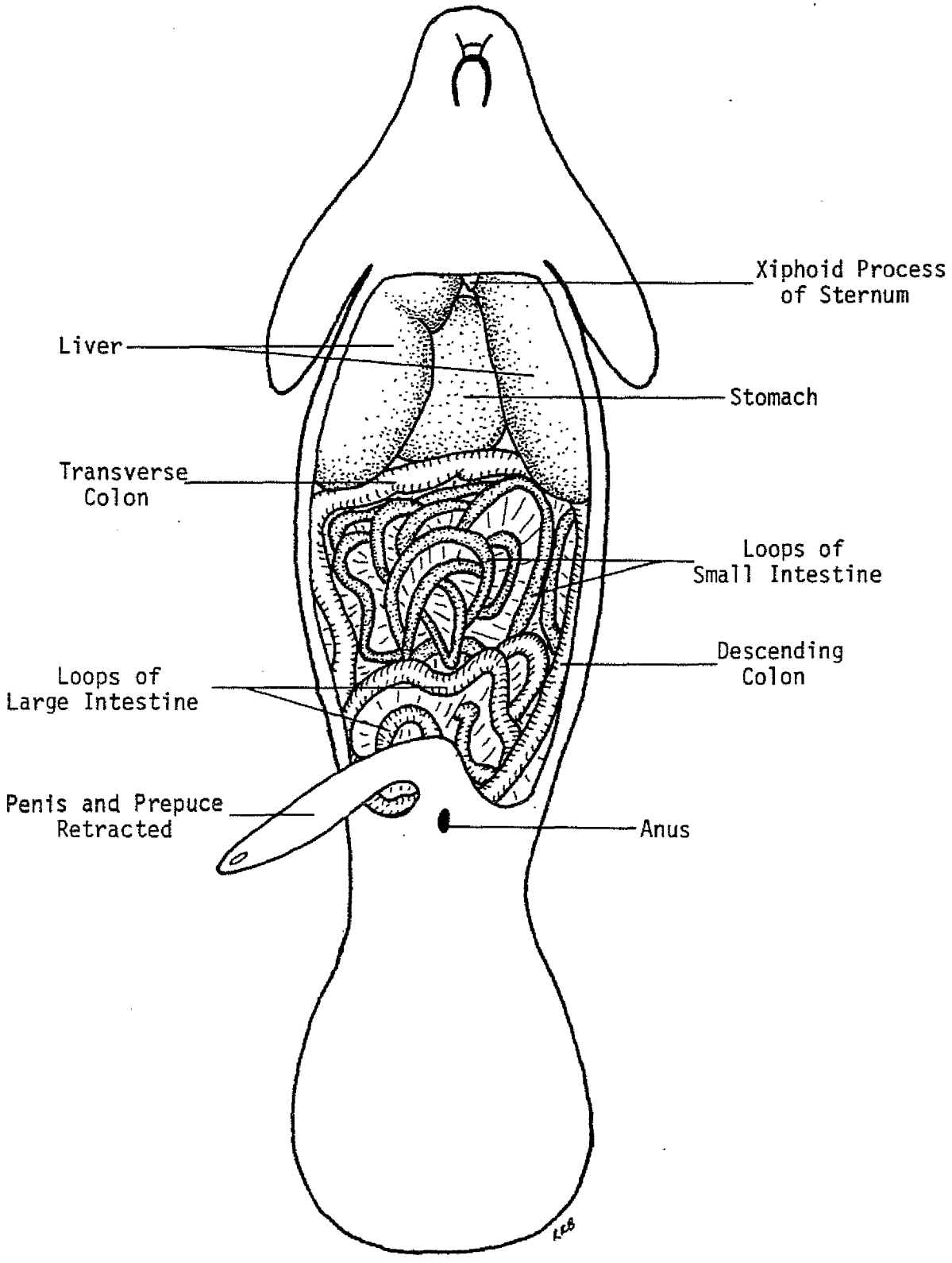

Xiphoid Process
of Sternum
Liver
Stomach
Transverse
Colon
Loops of
Small Intestine
Descending
Colon
Loops of
Large Intestine
Penis and Prepuce
Retracted
Anus

Figure 6. Major organs *in situ* after removal of loops of small and large intestines; loop with cecum and vitelline diverticulum left intact (ventral view).

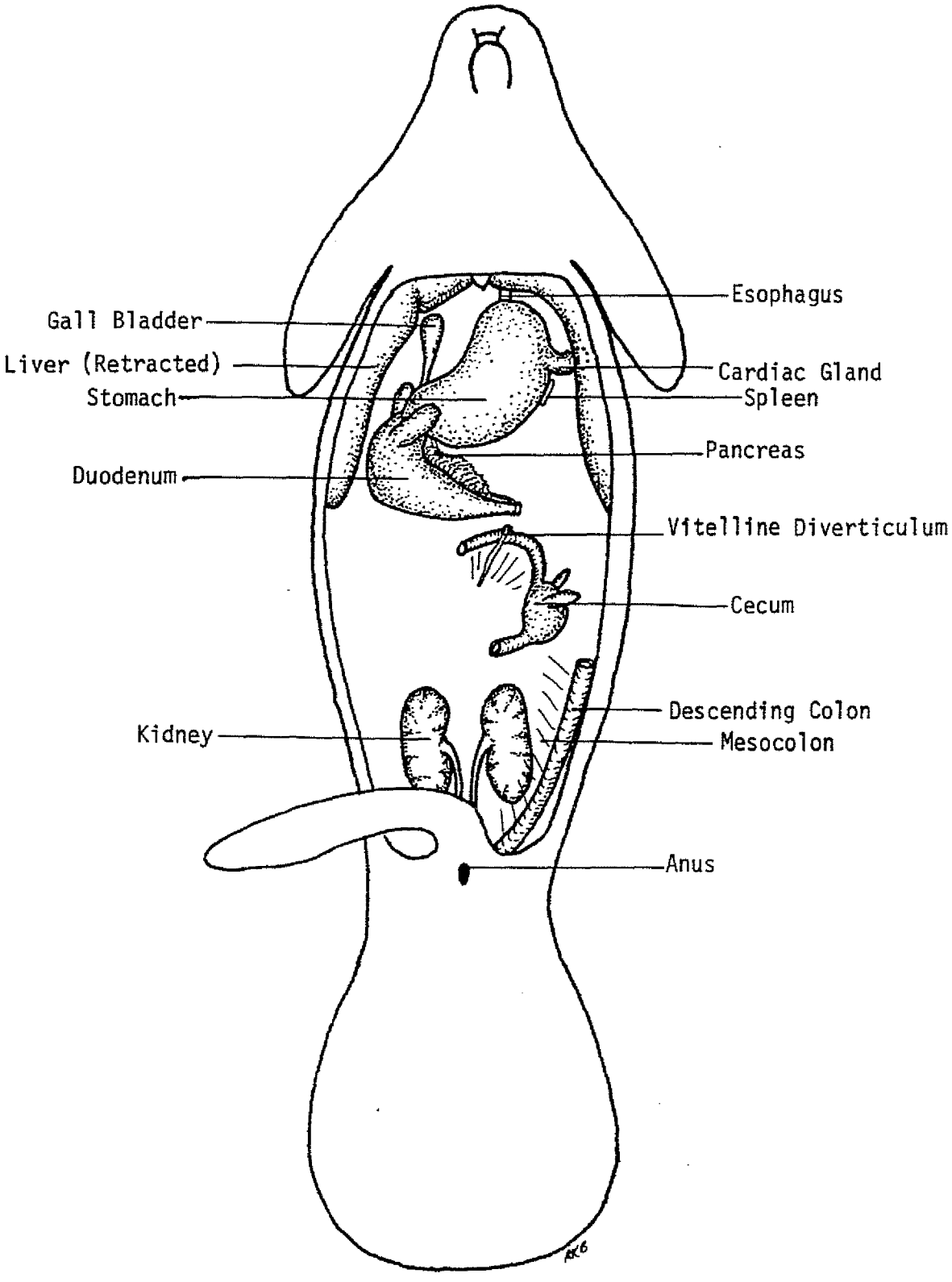

Esophagus
Gall Bladder
Liver (Retracted)
Cardiac Gland
Stomach
Spleen
Pancreas
Duodenum
Vitelline Diverticulum
Cecum
Descending Colon
Kidney
Mesocolon
Anus

Figure 7. Major structures *in situ* along mid-body line (ventral view). Parts of the diaphragm are shown cut away to expose underlying structures.

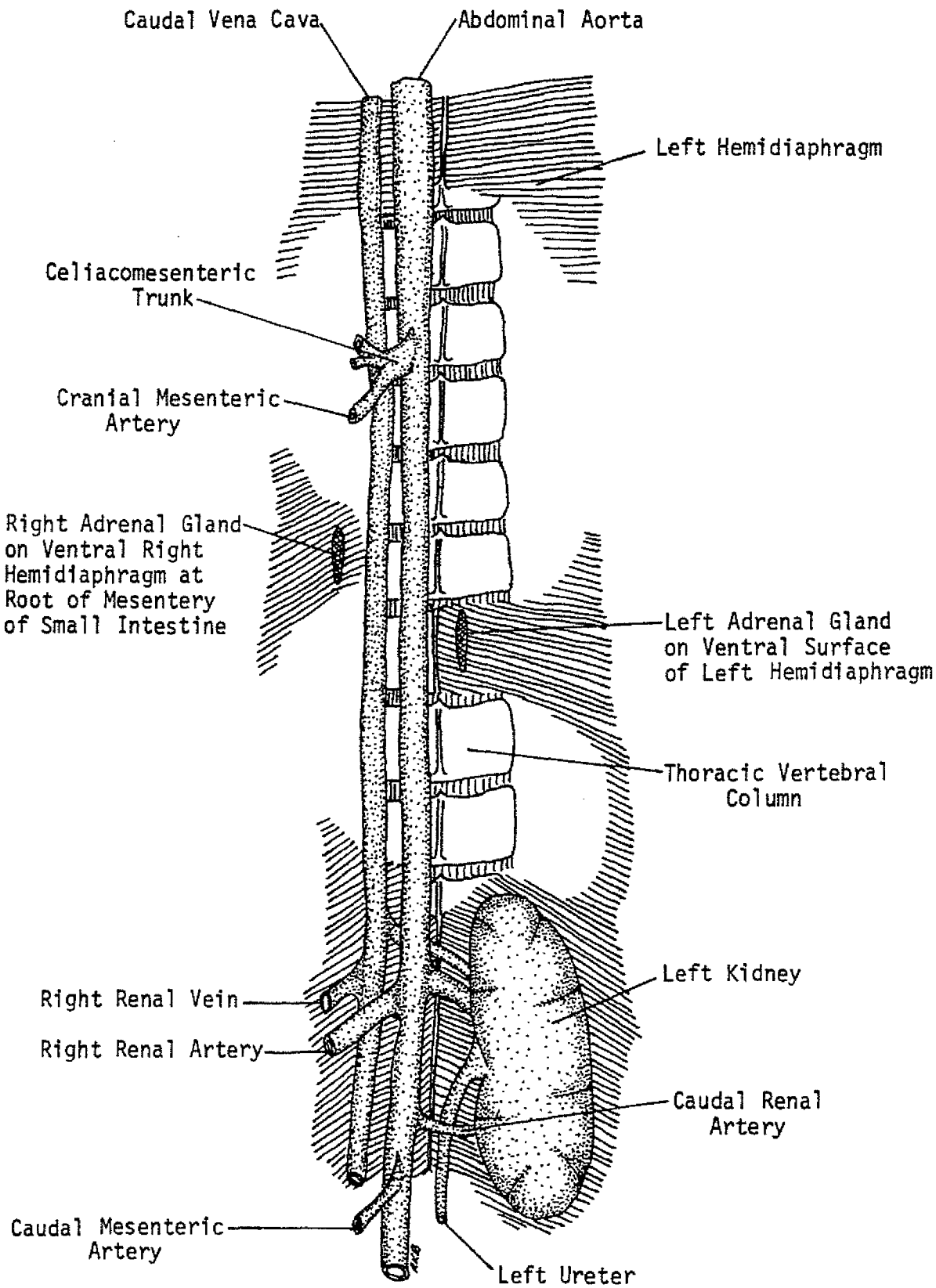

Caudal Vena Cava
Abdominal Aorta
Left Hemidiaphragm
Celiacomesenteric Trunk
Cranial Mesenteric Artery
Right Adrenal Gland on Ventral Right Hemidiaphragm at Root of Mesentery of Small Intestine
Left Adrenal Gland on Ventral Surface of Left Hemidiaphragm
Thoracic Vertebral Column
Left Kidney
Right Renal Vein
Right Renal Artery
Caudal Renal Artery
Caudal Mesenteric Artery
Left Ureter

Figure 8. Abdominal portion of digestive system (schematic).

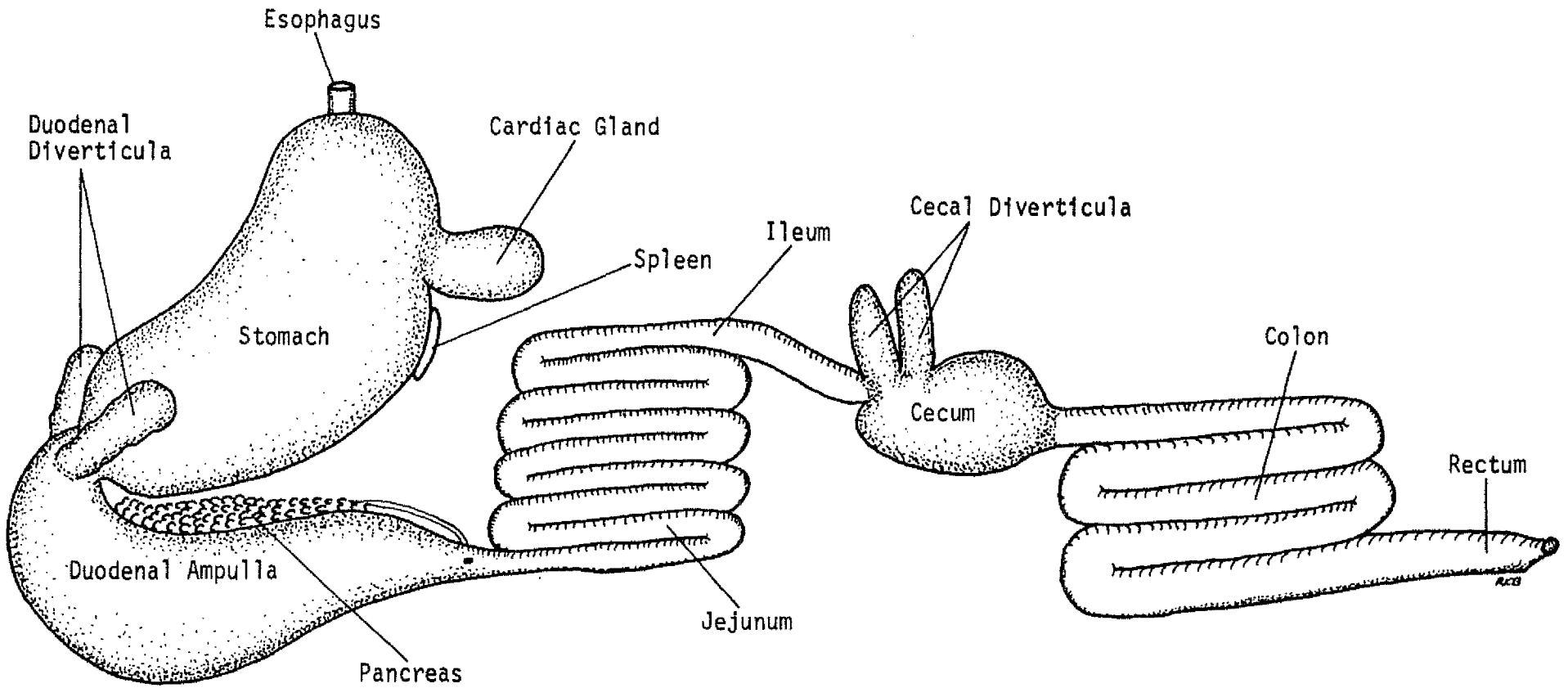

Esophagus
Duodenal Diverticula
Cardiac Gland
Cecal Diverticula
Ileum
Spleen
Stomach
Colon
Cecum
Rectum
Duodenal Ampulla
Jejunum
Pancreas

Figure 9. Stomach with cut away section (ventral view).

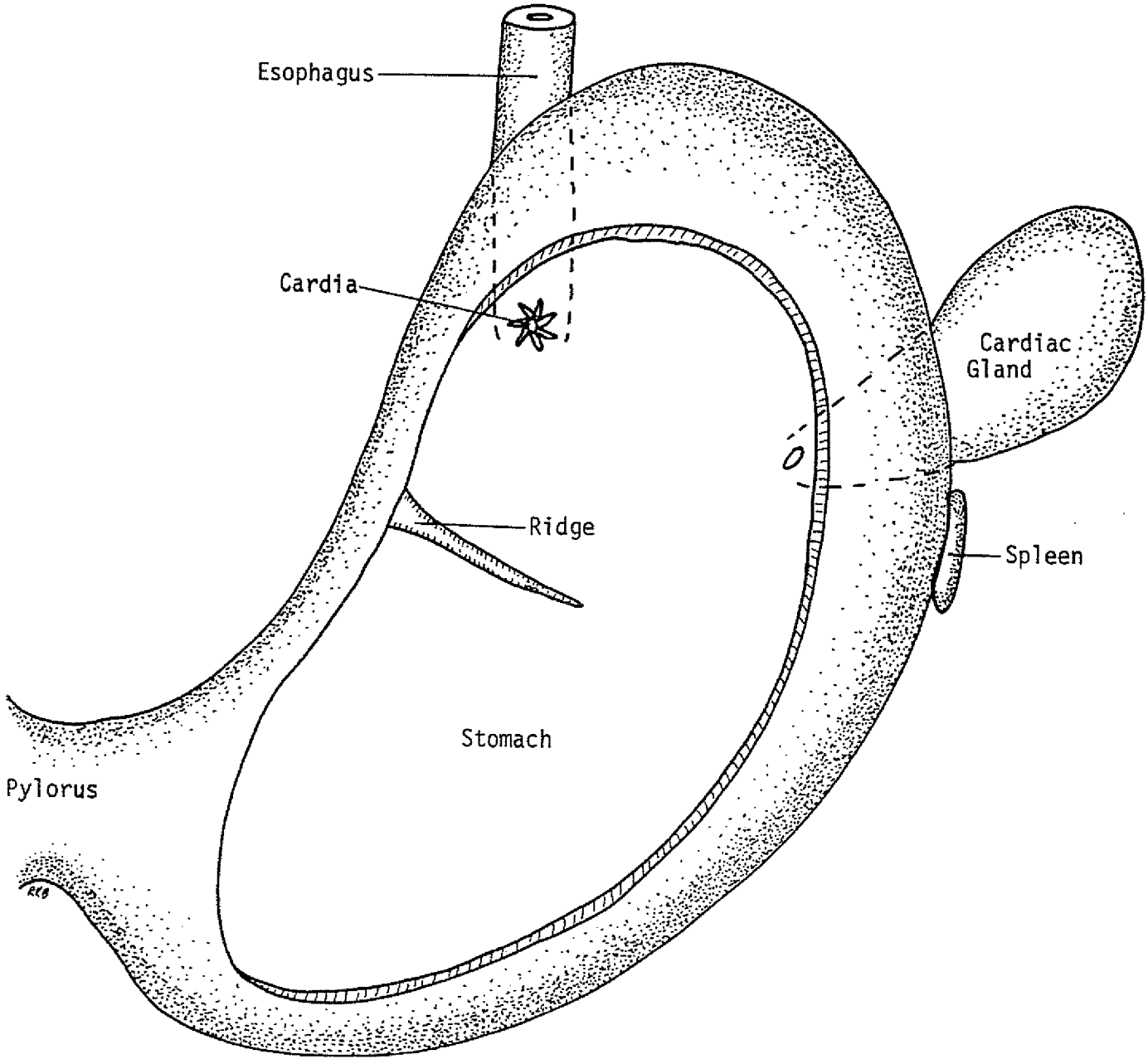

Esophagus
Cardia
Cardiac
Gland
Ridge
Spleen
Stomach
Pylorus

Figure 10. Duodenum (lateral view).

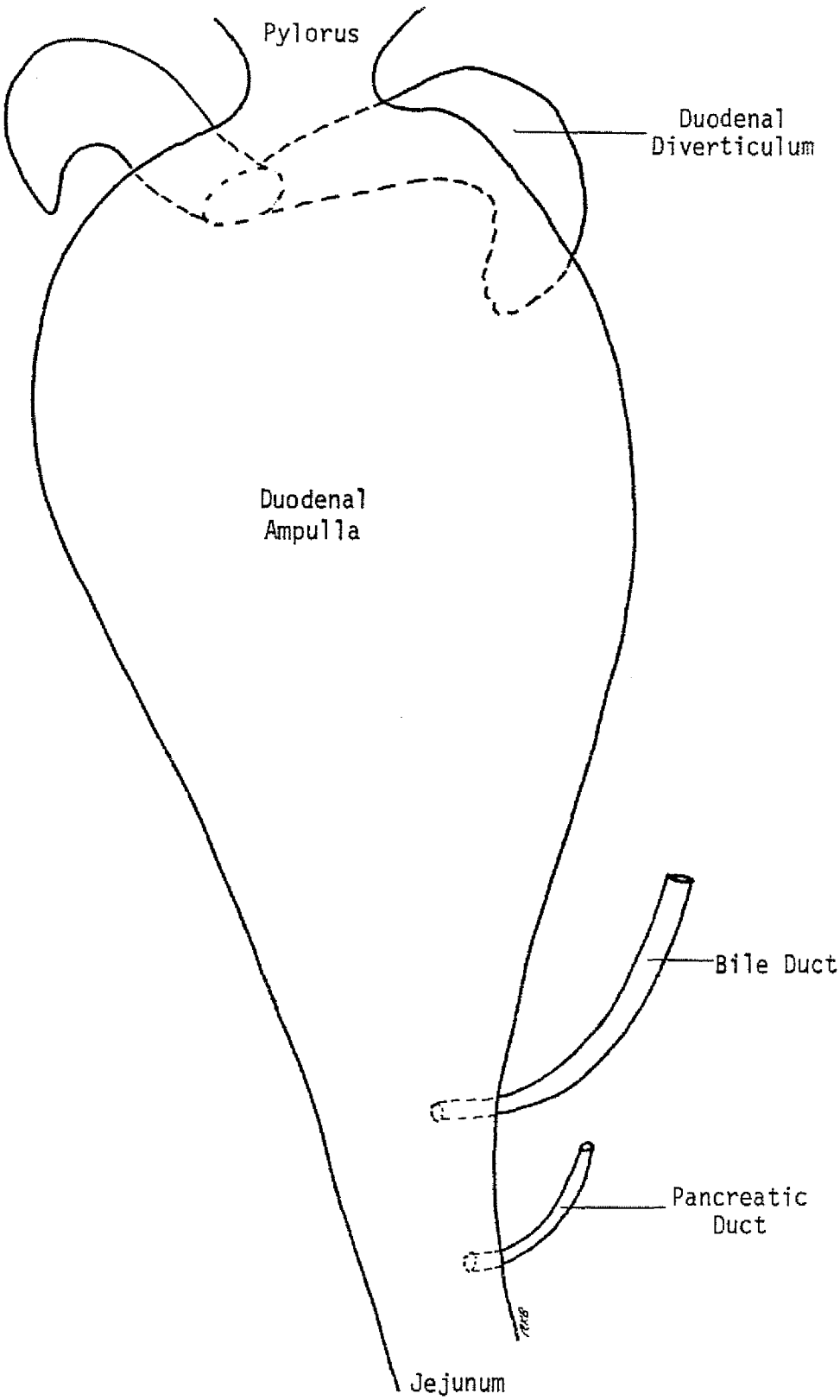

Pylorus
Duodenal Diverticulum
Duodenal Ampulla
Bile Duct
Pancreatic Duct
Jejunum

Figure 11. Cecum and adjoining structures (lateral view).

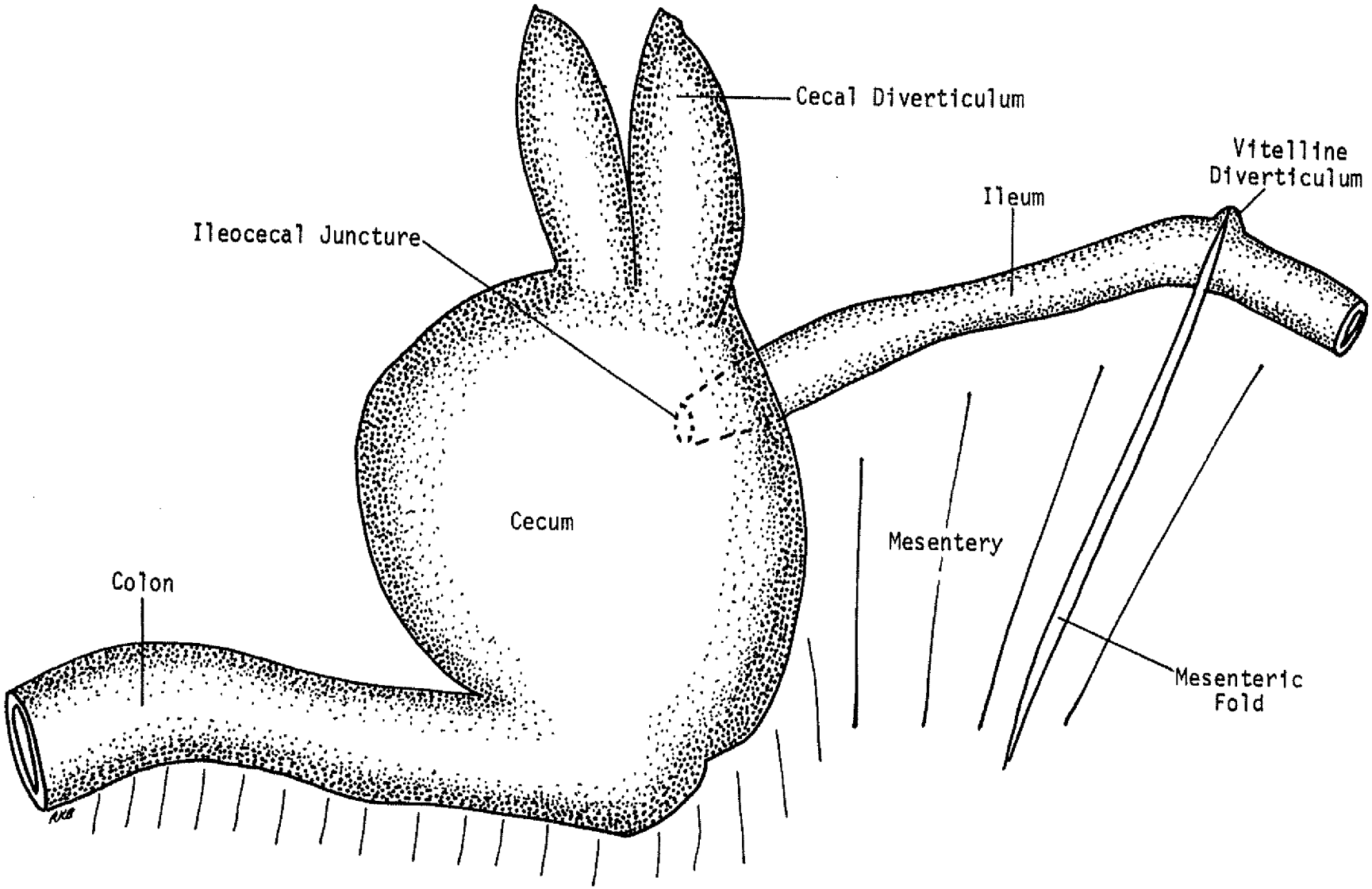

Cecal Diverticulum
Vitelline Diverticulum
Ileum
Ileocecal Juncture
Cecum
Mesentery
Colon
Mesenteric Fold

Figure 12. Liver and adjoining structures (ventral view).

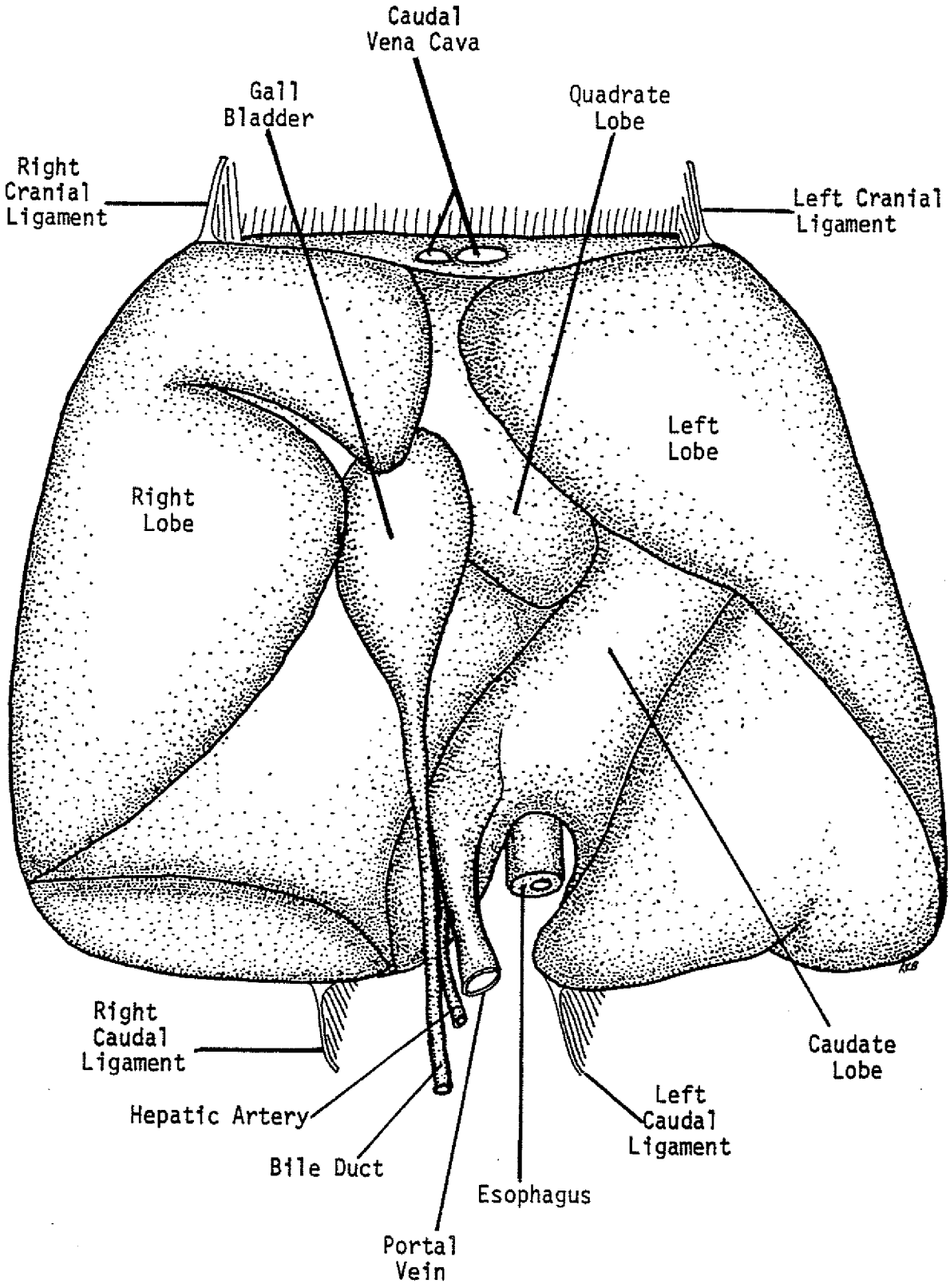

Caudal
Vena Cava
Gall
Bladder
Quadrate
Lobe
Right
Cranial
Ligament
Left Cranial
Ligament
Left
Lobe
Right
Lobe
Right
Caudal
Ligament
Caudate
Lobe
Left
Caudal
Ligament
Hepatic Artery
Bile Duct
Esophagus
Portal
Vein

Figure 13. Heart and major arteries (ventral view).

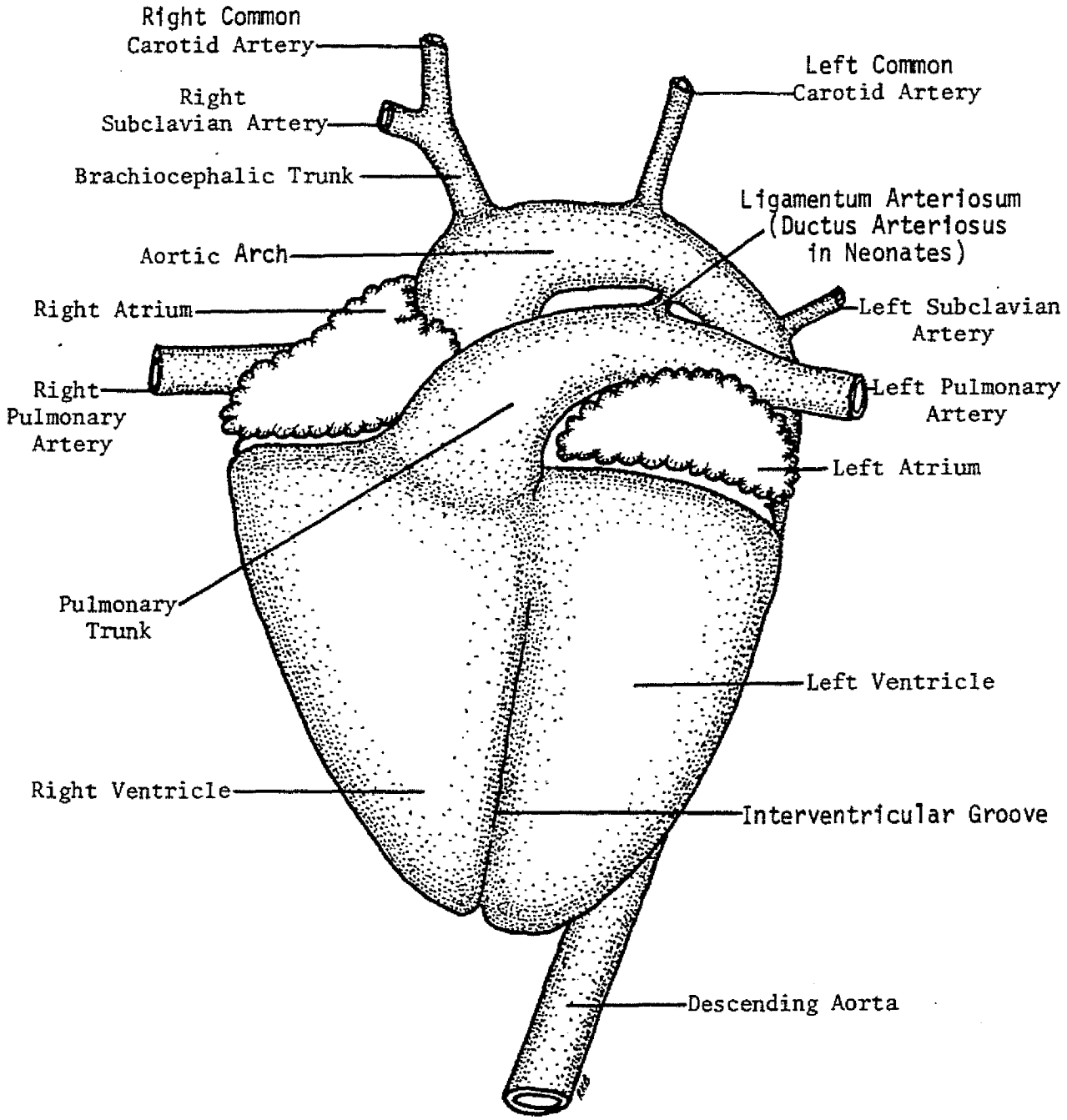
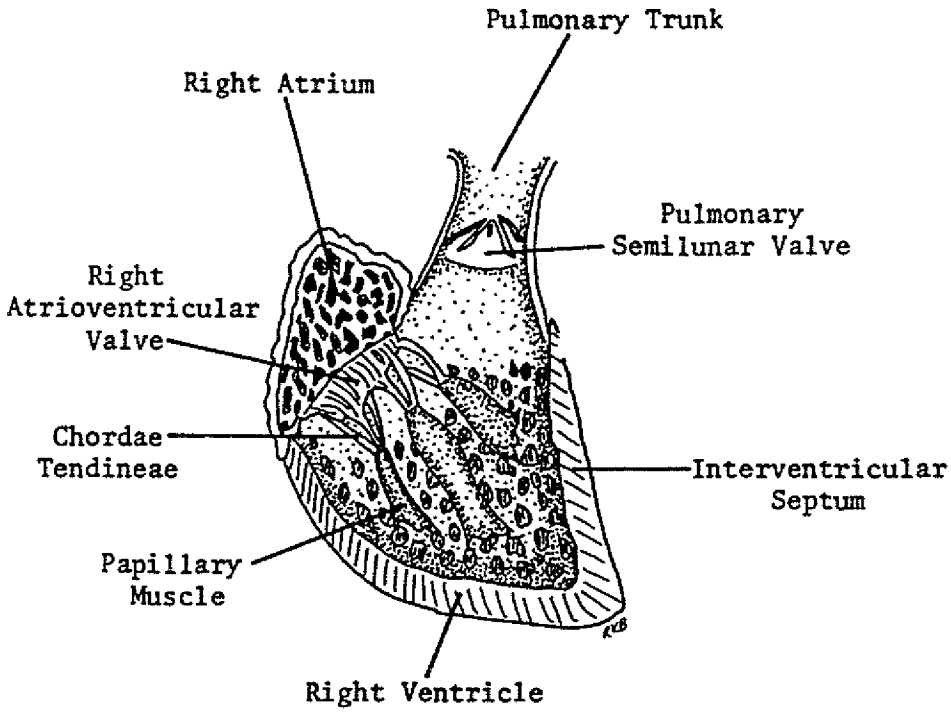
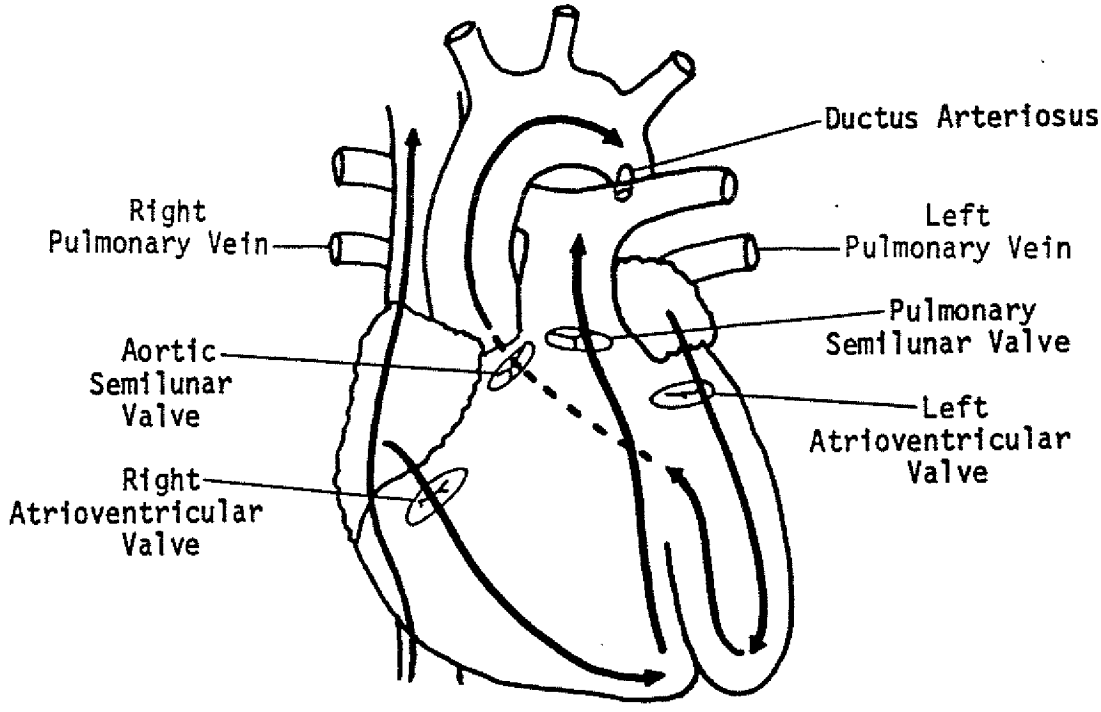

Right Common Carotid Artery
Left Common Carotid Artery
Right Subclavian Artery
Brachiocephalic Trunk
Ligamentum Arteriosum (Ductus Arteriosus in Neonates)
Aortic Arch
Right Atrium
Left Subclavian Artery
Right Pulmonary Artery
Left Pulmonary Artery
Left Atrium
Pulmonary Trunk
Left Ventricle
Right Ventricle
Interventricular Groove
Descending Aorta

Figure 14. Internal aspects of the heart (ventral view). Arrows indicate pathway recommended for dissection.





Ventral aspect of manatee heart

Figure 15. Pleural cavity and lungs (ventral view).

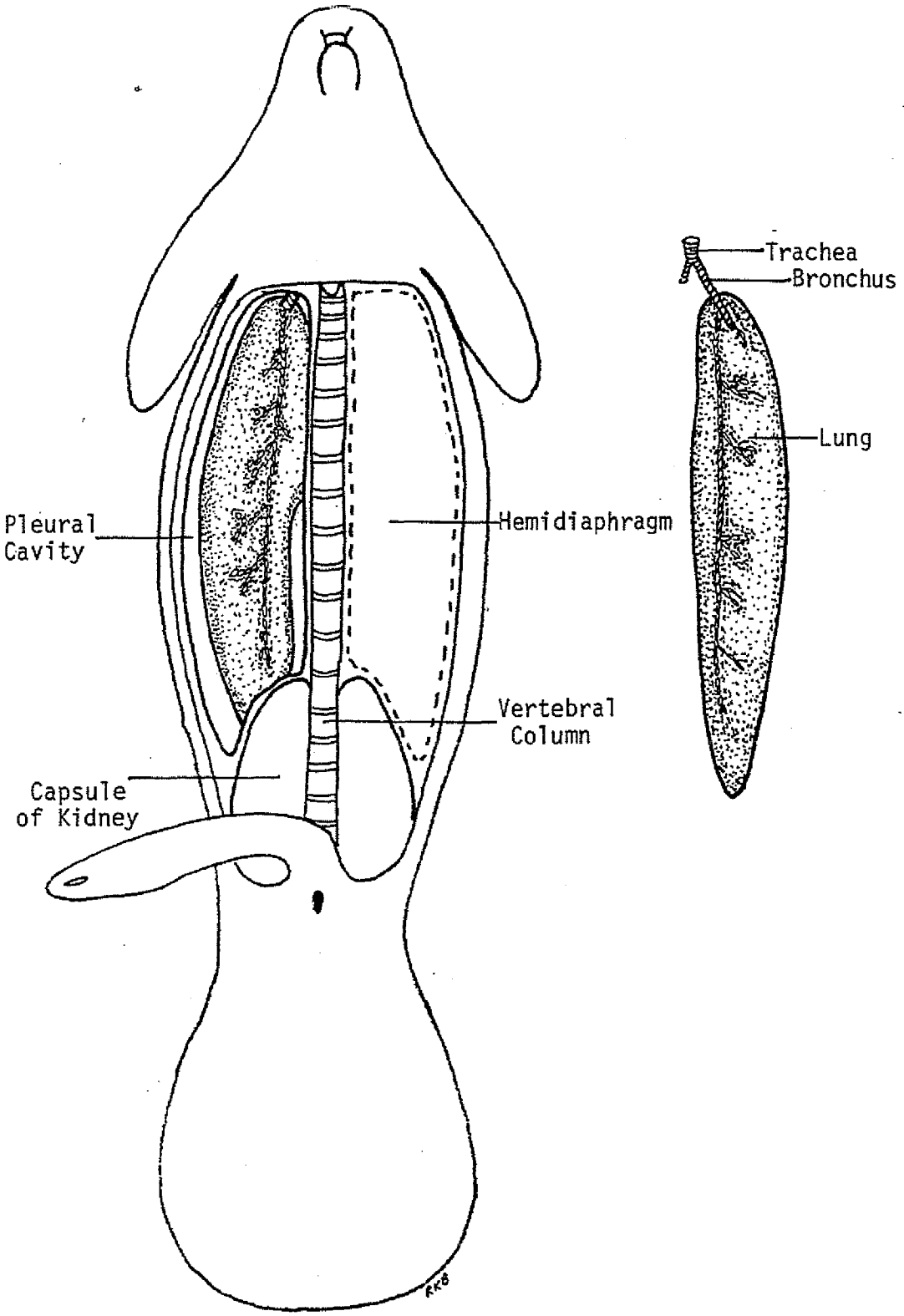

Trachea
Bronchus
Lung
Pleural Cavity
Hemidiaphragm
Vertebral Column
Capsule of Kidney

Figure 16. Left kidney and adjoining structures (ventral view).

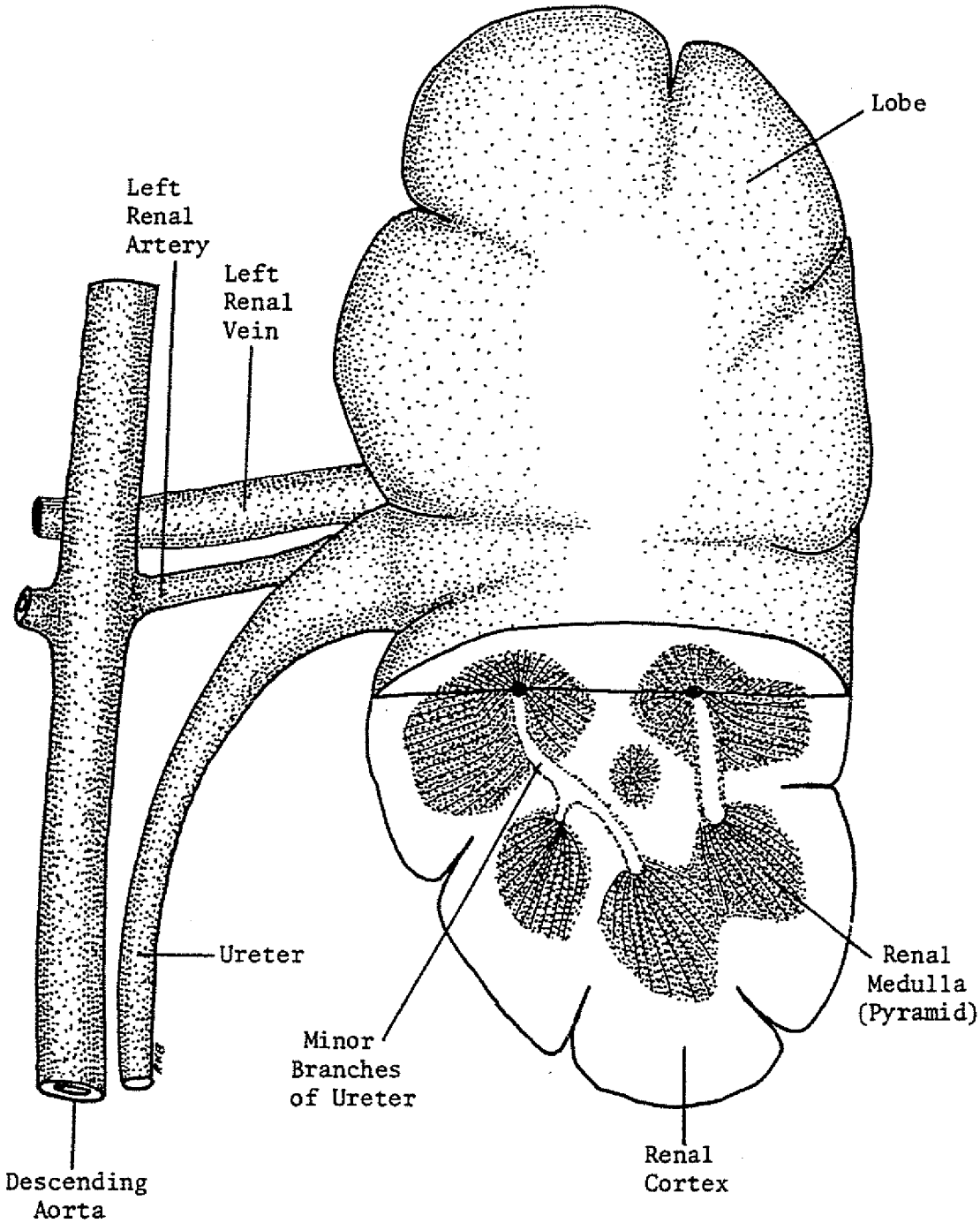
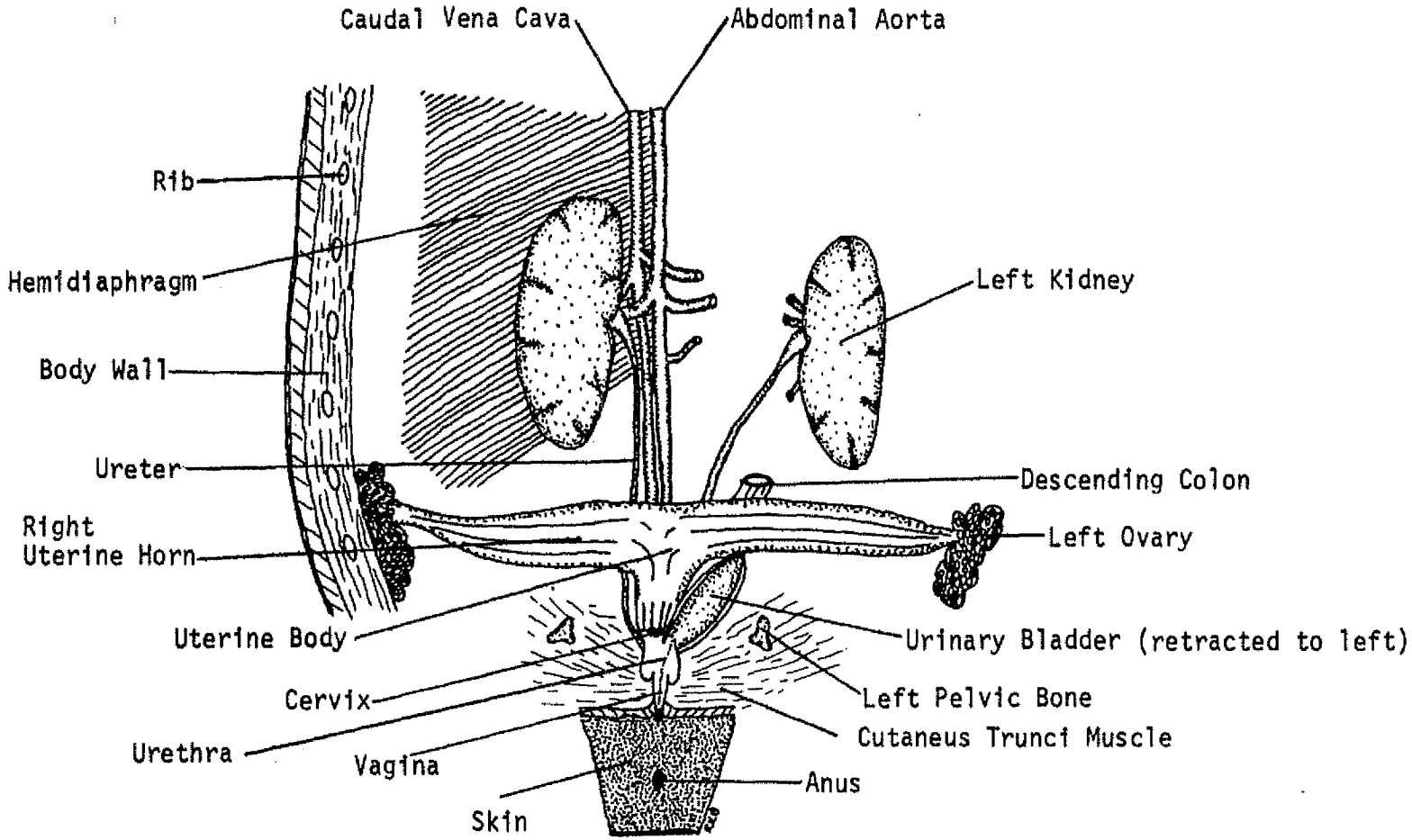

Lobe
Left
Renal
Artery
Left
Renal
Vein
Ureter
Minor
Branches
of Ureter
Renal
Medulla
(Pyramid)
Renal
Cortex
Descending
Aorta

Figure 17. Female reproductive system (ventral view).


Caudal Vena Cava
Abdominal Aorta
Rib
Hemidiaphragm
Body Wall
Left Kidney
Ureter
Descending Colon
Right
Uterine Horn
Left Ovary
Uterine Body
Urinary Bladder (retracted to left)
Cervix
Left Pelvic Bone
Urethra
Cutaneus Trunci Muscle
Vagina
Anus
Skin

FEMALE

Figure 18. Male reproductive system (ventral view).

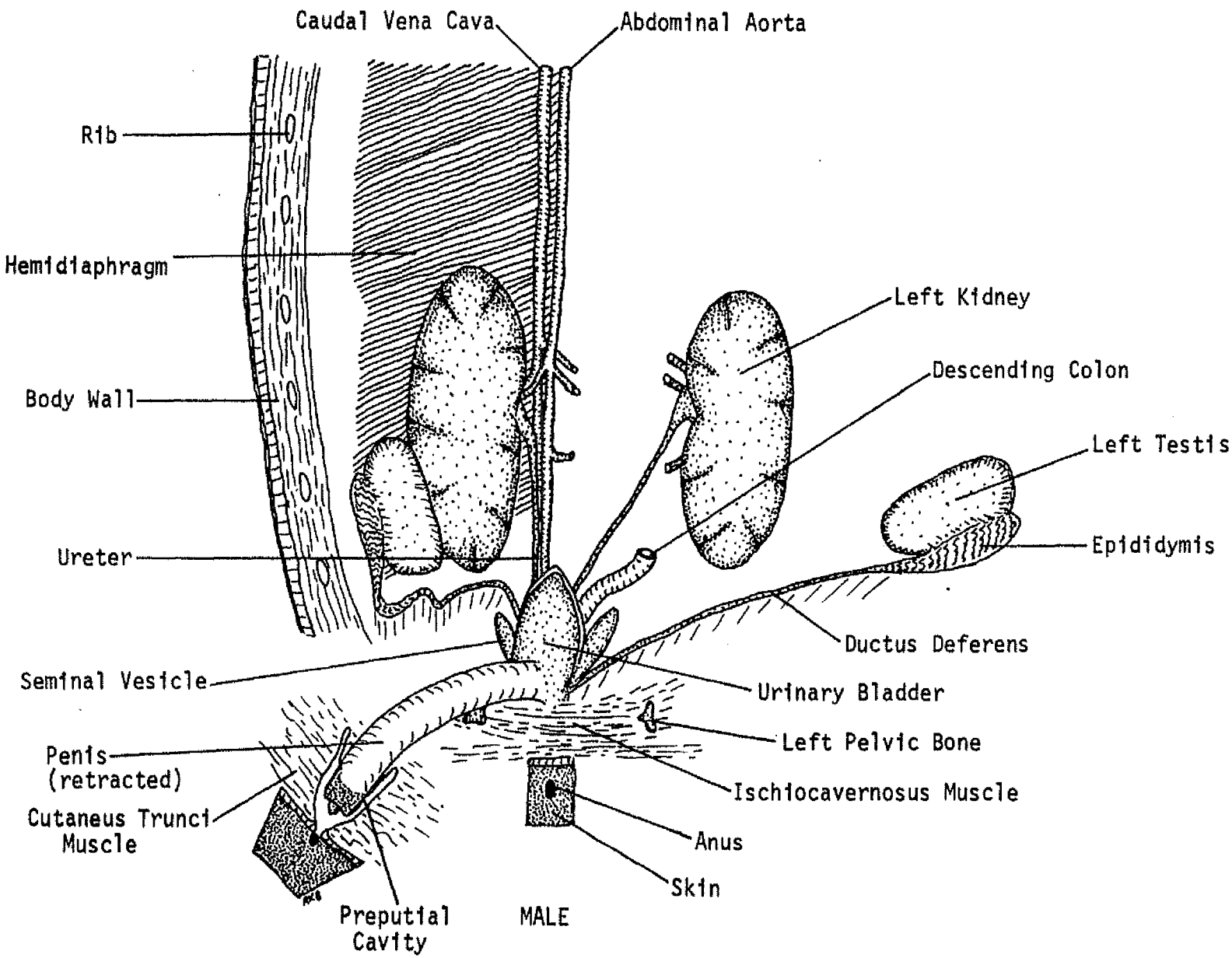

Caudal Vena Cava
Abdominal Aorta
Rib
Hemidiaphragm
Body Wall
Ureter
Left Kidney
Descending Colon
Left Testis
Epididymis
Ductus Deferens
Seminal Vesicle
Urinary Bladder
Left Pelvic Bone
Penis
(retracted)
Cutaneus Trunci
Muscle
Ischiocavernosus Muscle
Anus
Skin
Preputial
Cavity
MALE

Figure 19. Major structures of the head and neck region (ventral view). Redrawn from J. Murie 1872 (Trans. Zool. Soc. Lond. 8:127-202).

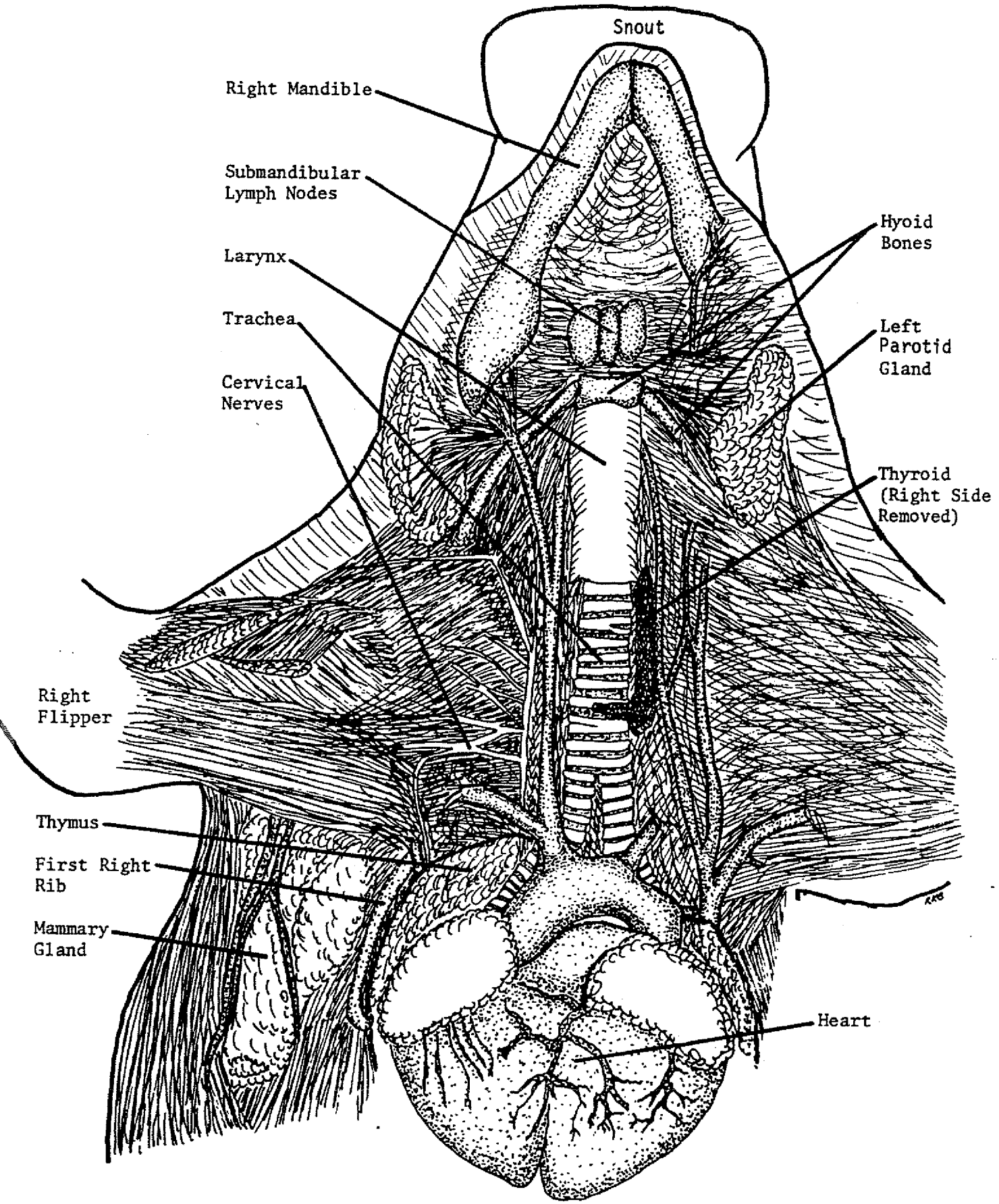

Snout
Right Mandible
Submandibular Lymph Nodes
Larynx
Trachea
Cervical Nerves
Hyoid Bones
Left Parotid Gland
Thyroid (Right Side Removed)
Right Flipper
Thymus
First Right Rib
Mammary Gland
Heart

Figure 20. Major muscles and blood vessels of the head and neck region (ventral view). Redrawn from J. Murie 1872 (Trans. Zool. Soc. Lond. 8:127-202).

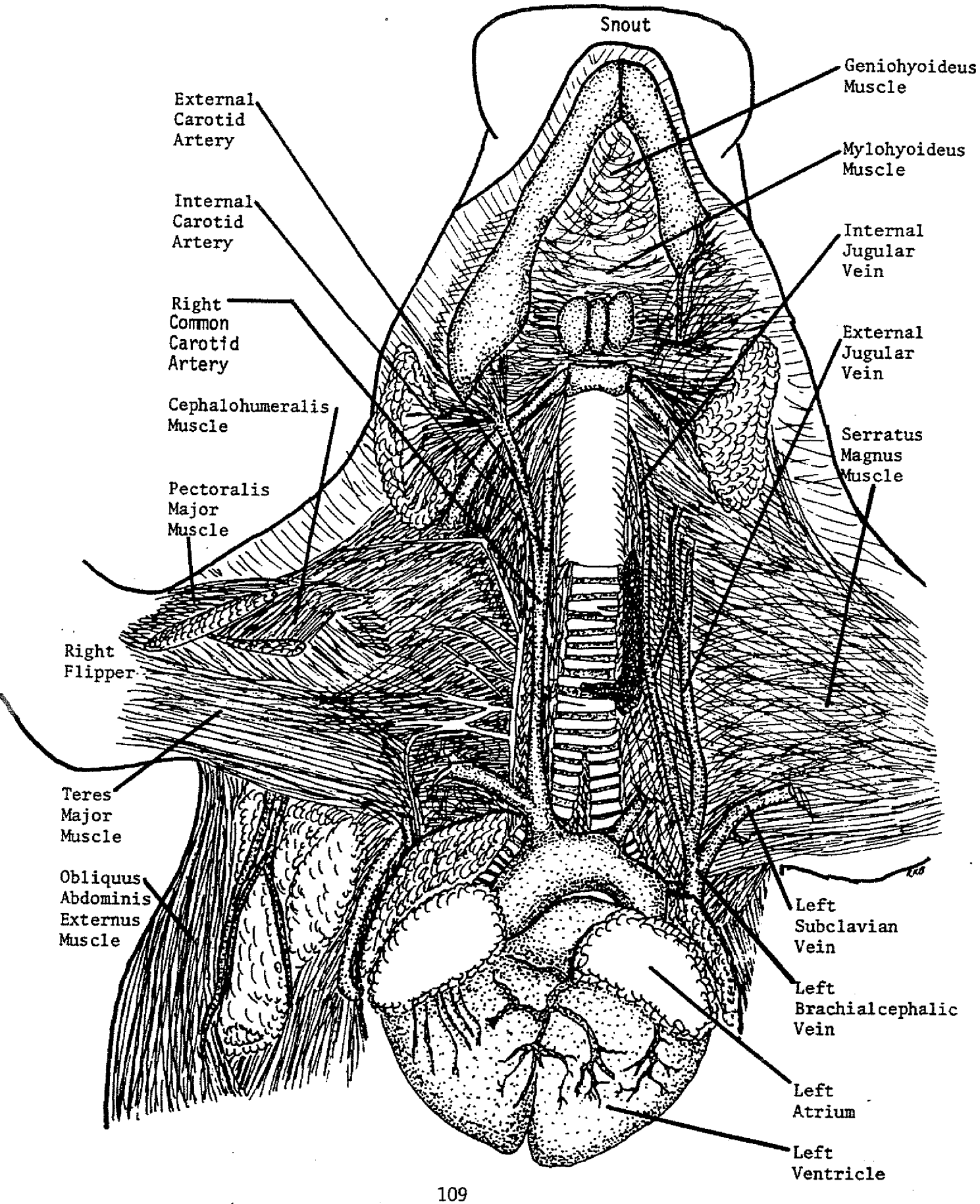

Snout
Geniohyoideus Muscle
Mylohyoideus Muscle
External Carotid Artery
Internal Carotid Artery
Right Common Carotid Artery
Cephalohumeralis Muscle
Pectoralis Major Muscle
Right Flipper
Teres Major Muscle
Obliquus Abdominis Externus Muscle
Internal Jugular Vein
External Jugular Vein
Serratus Magnus Muscle
Left Subclavian Vein
Left Brachialcephalic Vein
Left Atrium
Left Ventricle

Figure 21. Brain and cranial view of the skull.

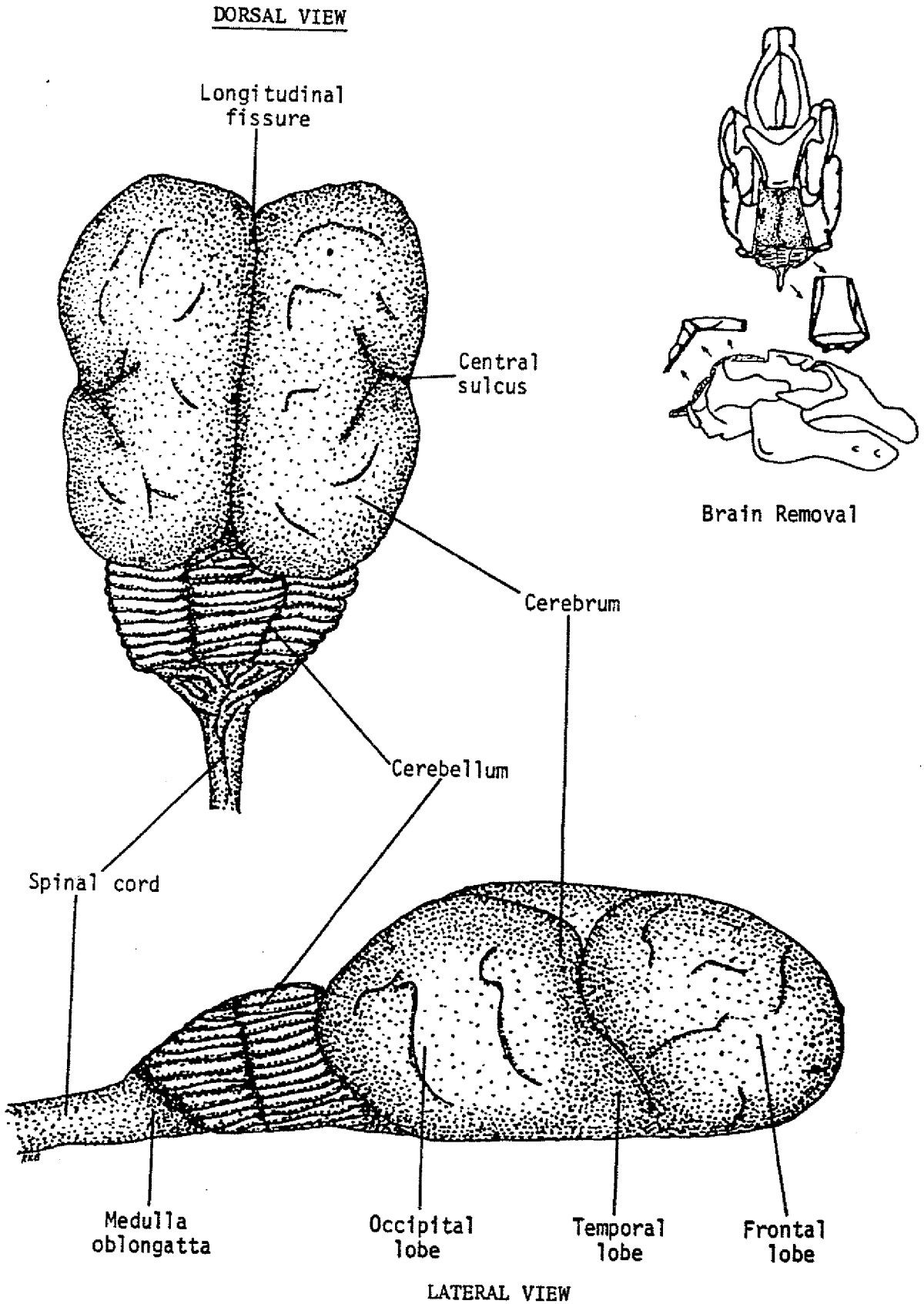

DORSAL VIEW
Longitudinal fissure
Central sulcus
Cerebrum
Cerebellum
Spinal cord
Medulla oblongatta
Occipital lobe
Temporal lobe
Frontal lobe
LATERAL VIEW
Brain Removal

Figure 22. Lateral view of the skeleton.

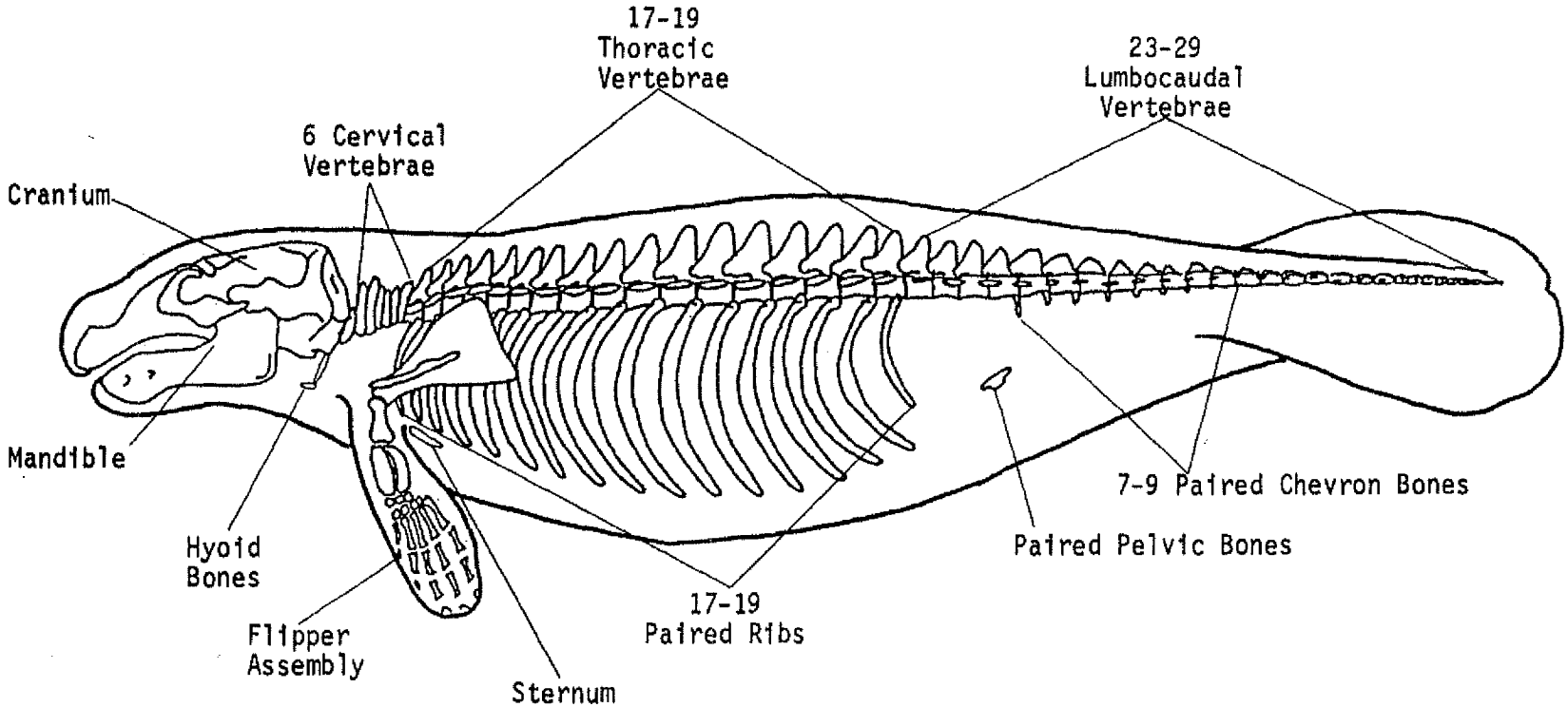
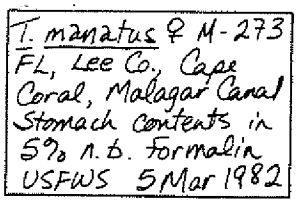
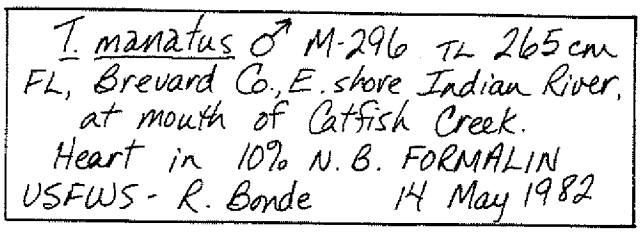

17-19
Thoracic
Vertebrae
23-29
Lumbocaudal
Vertebrae
6 Cervical
Vertebrae
Cranium
Mandible
Hyoid
Bones
Flipper
Assembly
Sternum
17-19
Paired Ribs
Paired Pelvic Bones
7-9 Paired Chevron Bones

Figure 23. Properly labeled specimen tag.



Tag placed in jar with specimen. Data should be on both sides, written in indelible ink on rag paper.



Label placed on outside of jar.

APPENDIX I. Blank and completed data recording forms.

Manatee Data and Morphometric Sheets

Manatee Scar Measurement Sheets

Manatee Salvage Program Necropsy Reports

Manatee Fat Deposition Comment Sheets

NOTES:

MANATEE DATA SHEET

U.S. Fish and Wildlife Service
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601

UNDER PERMIT: PRT 2-8430

Species _____

Field/Specimen No. _____

Accession No. _____

Sex _____

Length _____

Weight _____

Date Reported _____

by: _____

_____

Date Collected _____

Collector _____

Necropsy Date _____

by: _____

List photographs taken:

_____

_____

_____

Materials Collected:

☐ Skull only

☐ Complete skeleton

☐ Partial skeleton

☐ Other _____

Stranding Location (state, co., city, specific locality) _____

_____

_____

Lat./Long. _____

Nature of Occurrence _____

Condition:

1) ☐ Alive
2) ☐ Fresh
3) ☐ Moderately Decomposed
4) ☐ Badly Decomposed
5) ☐ Dried carcass/bones

Probable Cause of Death:

1) ☐ Boat/Barge Collision
2) ☐ Crushed/Drowned in flood gate/canal lock
3) ☐ Other human-related cause
4) ☐ Dependent calf (length less than 150 cm)
5) ☐ Undetermined
6) ☐ Natural

Explain: _____

_____

Disposition of Materials: _____

_____

_____

MORPHOMETRICS

All measurements are straight-line, point to point, unless indicated by an asterisk (*); these are direct, point to point over or around the body surface. Record girths and flipper lengths on fresh animals only. The numbers on the plane view coincide with the numbers of the measurement description. USE METRIC SYSTEM.

1. Tip of snout to tip of fluke _____
2. Tip of snout to center of anal opening _____
3. Tip of snout to center of genital aperture _____
4. Tip of snout to center of umbilicus _____
5. Tip of snout to anterior origin of flipper _____
6. Tip of snout to center of eye _____
7. Tip of snout to center of external auditory meatus _____
8. Center of eye to center of external auditory meatus _____
9. *Distance eye to eye, over forehead _____
10. Center of eye to center of nasal opening (same side) _____
11. Flipper length, anterior insertion to tip _____
12. Flipper length, axilla to tip _____
13. Maximum width of flipper _____
14. Perpendicular length of teat: R _____ L _____
15. Base of fluke to posterior tip _____

NOTES:

16. Maximum width of fluke _____

17. *Girth at fluke base _____

18. *Girth at anus _____

19. *Girth at umbilicus _____

20. *Girth at axillae _____

21. Thickness of skin: (medially)

a) Dorsal _____ b) Lateral _____ c) Ventral _____ (off midline)

Thickness of blubber layers: (medially)

Outer: a) D _____ b) L _____ c) V _____ (off midline)

Inner: a) D _____ b) L _____ c) V _____ (off midline)

22. Tooth row count: (erupted)

UR _____ UL _____

LR _____ LL _____

23. List materials collected, including parasites, tissue samples, stomach contents, etc., along with any organ weights and lengths:

_____

_____

_____

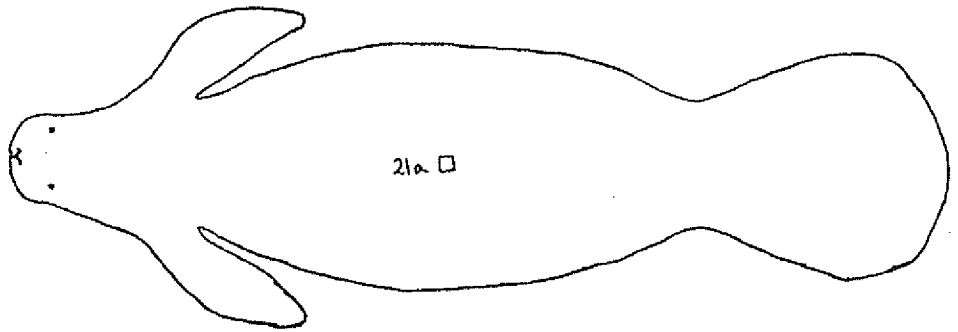
_____

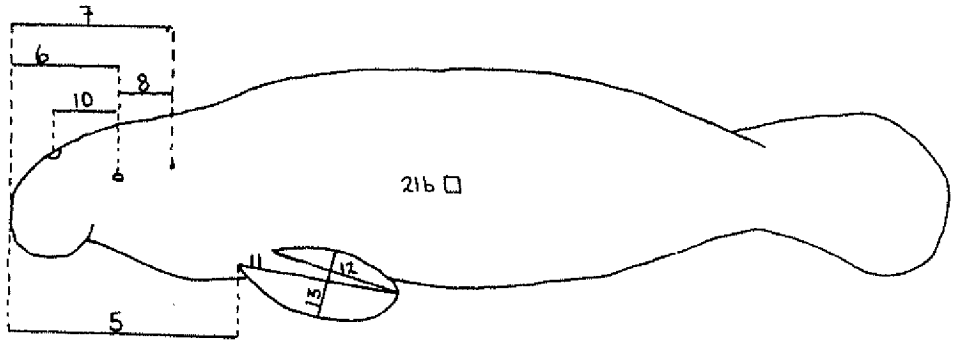
24. Comments: _____

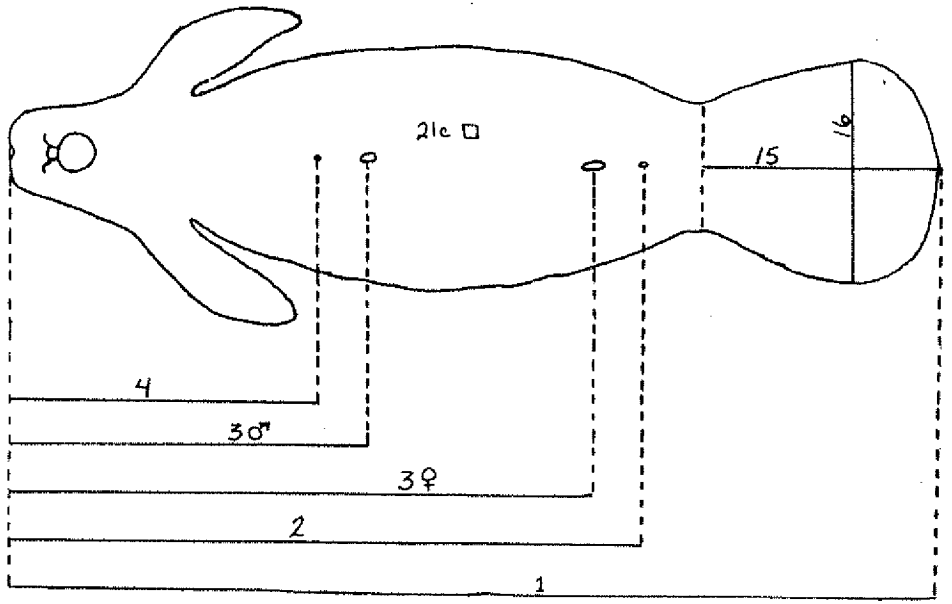
_____

_____

Draw in and measure any scars or external markings (include photographs)







NOTES:

MANATEE DATA SHEET

U.S. Fish and Wildlife Service
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601

UNDER PERMIT: PRT 2-8430

Species *T. manatus*

Field/Specimen No. *M-307*

Accession No. _____

Sex *Female*

Length *300 cm*

Weight *1200 lbs (544 kg)*

Date Reported *17 Aug 1982*

by: *Fisherman to Chuck Cowman - GA DNR*

Date Collected *17 Aug 1982*

Collector *R. Bonde, L. Hurst*

Necropsy Date *18 Aug 1982*

by: *Bonde, Beck, O'Shea Hermanson, Hurst*

List photographs taken:

_____

_____

_____

Materials Collected:

- ☐ Skull only
- ☒ Complete skeleton
- ☐ Partial skeleton
- ☐ Other _____

Stranding Location (state, co., city, specific locality) *Georgia. Glynn County, Saint Simons Sound, ½ mile E of N tip of Jekyll Island.*

Lat./Long. *31°06'N, 81°23'W*

Nature of Occurrence *Single*

Condition:

- 1) ☐ Alive
- 2) ☒ Fresh
- 3) ☐ Moderately Decomposed
- 4) ☐ Badly Decomposed
- 5) ☐ Dried carcass/bones

Probable Cause of Death:

- 1) ☐ Boat/Barge Collision
- 2) ☐ Crushed/Drowned in flood gate/canal lock
- 3) ☒ Other human-related cause
- 4) ☐ Dependent calf (length less than 150 cm)
- 5) ☐ Undetermined
- 6) ☐ Natural

Explain: *Drowned in shrimp trawler's net.*

Disposition of Materials: _____

_____

_____

MORPHOMETRICS

All measurements are straight-line, point to point, unless indicated by an asterisk (*); these are direct, point to point over or around the body surface. Record girths and flipper lengths on fresh animals only. The numbers on the plane view coincide with the numbers of the measurement description. USE METRIC SYSTEM.

1. Tip of snout to tip of fluke *300. cm*
2. Tip of snout to center of anal opening *200. cm*
3. Tip of snout to center of genital aperture *182. cm*
4. Tip of snout to center of umbilicus *110. cm*
5. Tip of snout to anterior origin of flipper *53. cm*
6. Tip of snout to center of eye *18. cm*
7. Tip of snout to center of external auditory meatus *34. cm*
8. Center of eye to center of external auditory meatus *18. cm*
9. *Distance eye to eye, over forehead *24. cm*
10. Center of eye to center of nasal opening (same side) *14. cm*
11. Flipper length, anterior insertion to tip *41. cm*
12. Flipper length, axilla to tip *40. cm*
13. Maximum width of flipper *18. cm*
14. Perpendicular length of teat: R *4.0 cm* L *3.0 cm*
15. Base of fluke to posterior tip *80. cm*

NOTES:

16. Maximum width of fluke 74.cm

17. *Girth at fluke base 107. cm

18. *Girth at anus 140. cm

19. *Girth at umbilicus 218. cm

20. *Girth at axillae 176. cm

21. Thickness of skin: (medially)

a) Dorsal 2.0cm b) Lateral 1.2cm c) Ventral 1.0 cm (off midline)

Thickness of blubber layers: (medially)

Outer: a) D 0.8cm b) L 1.2cm c) V 2.2 cm (off midline)

Inner: a) D — b) L 1.0cm c) V 1.0 cm (off midline)

22. Tooth row count: (erupted)

UR 6 UL 6

LR 5 LL 5

23. List materials collected, including parasites, tissue samples, stomach contents, etc., along with any organ weights and lengths:

Nasal flukes - 10% NBF, Chlorchis (2), Contents: Stomach, rectum, caecum, LI - 5% NBF. Urine, bile, liver, muscle, 1 adrenal, kidney & fat samples frozen.

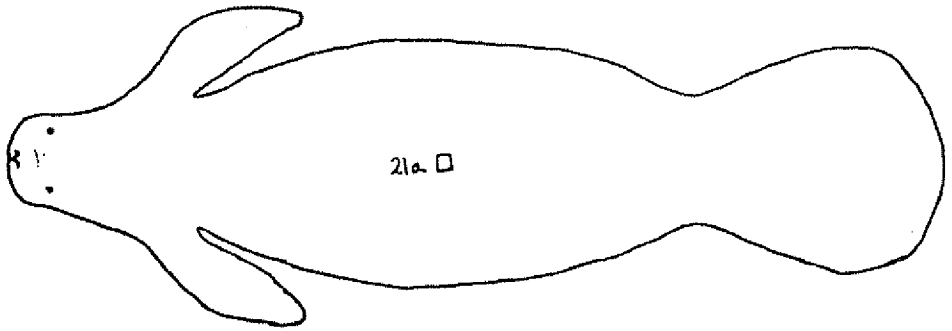
liver, lung, & kidney samples - 80% EtOH.

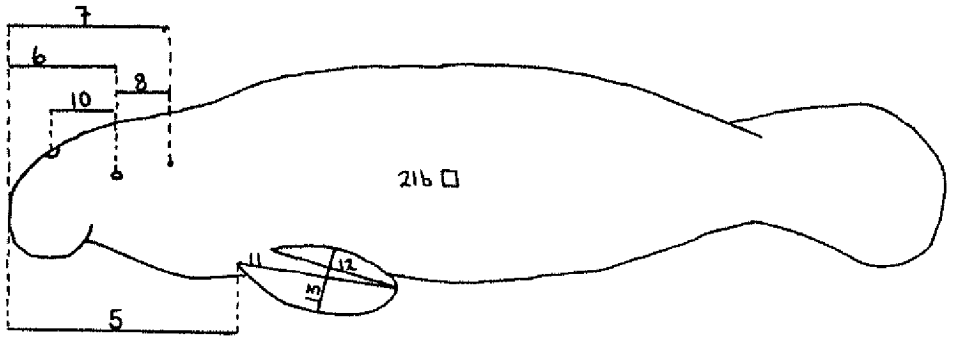
Entire reproductive tract, entire liver, entire brain (in situ), eyes (1 frozen), mandible, kidneys, lungs sectim, spleen, 1 adrenal - 10% NBF

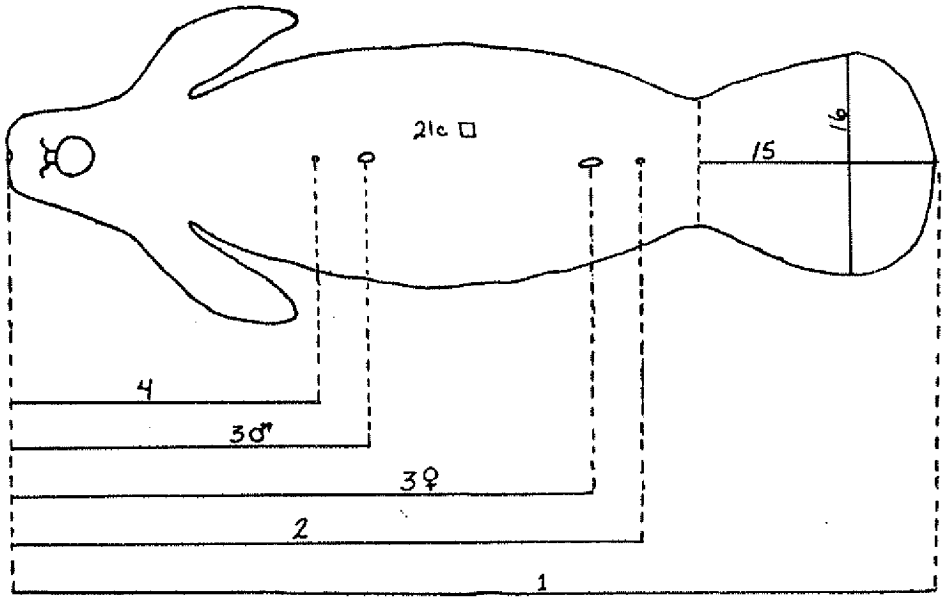
24. Comments:

Draw in and measure any scars or external markings (include photographs)

see scar sheets







NOTES:

U. S. Fish and Wildlife Service
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601

MANATEE SCAR MEASUREMENTS

UNDER PERMIT; PRT 2-8430

Field/Specimen No. _____

Species _____

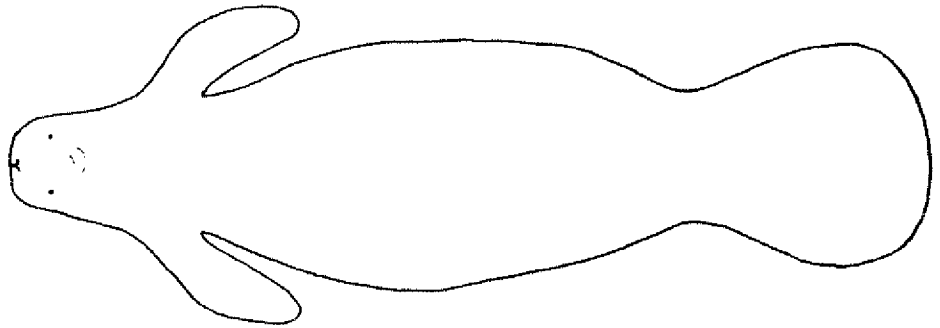
Date Collected _____

by: _____

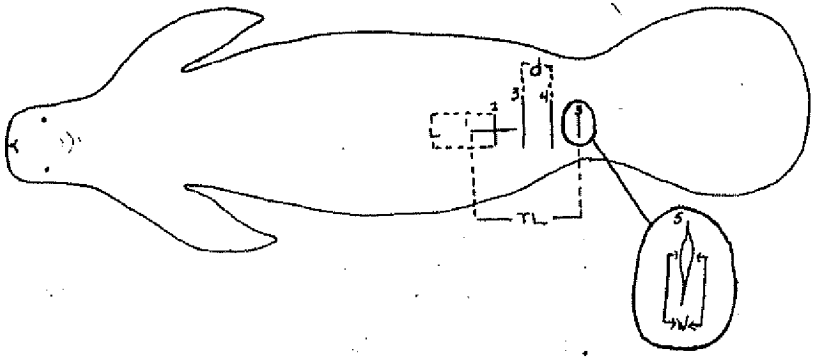
Condition of animal upon collection _____

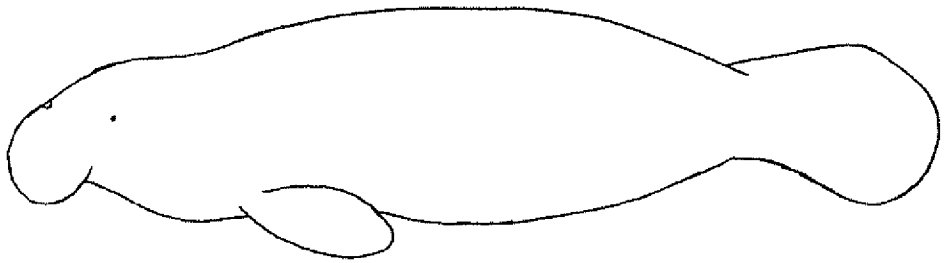
Condition of scar:

- ☐ Fresh (open)
- ☐ Recent, but healing
- ☐ Healing (white)
- ☐ Healed

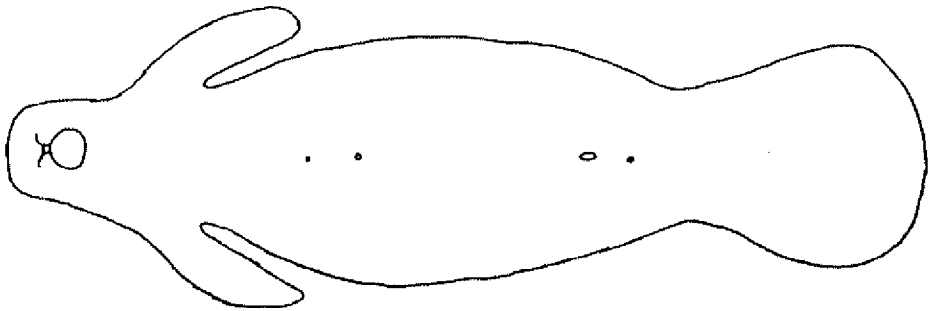


Use a separate sheet for each scar pattern. Please number from anterior to posterior and correlate with a sketch on the silhouettes. Measurements are taken either parallel or perpendicular to the long axis of the scar. USE METRIC. Supplement with photographs whenever possible.
EXAMPLE:





Number									
(L) Length									
(W) Width at widest pt.									
(D) Depth at deepest pt.									
(d) Distance between scars									



Total length of scar series, ant. to post. _____

Total number of scar patterns _____. This is pattern ____ of ____. Measurements by _____

NOTES:

U. S. Fish and Wildlife Service
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601

MANATEE SCAR MEASUREMENTS

UNDER PERMIT: PRT 2-8430

Field/Specimen No. M-307

Species T. manatus

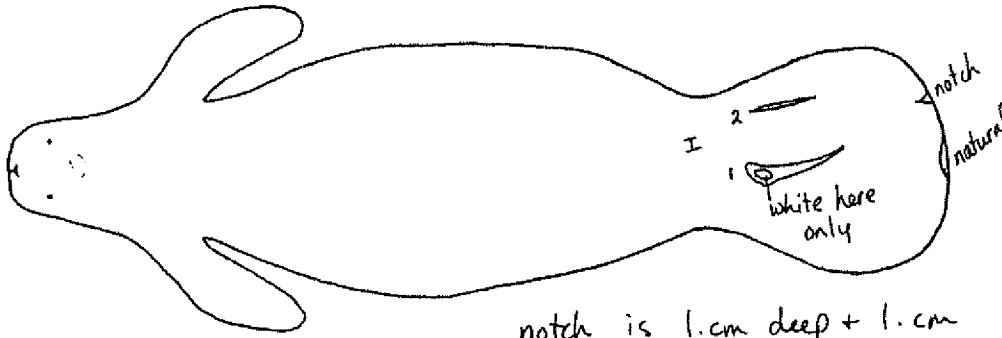
Date Collected 17 Aug 1982

by: DWRC - SP

Condition of animal upon collection Fresh

Condition of scar:

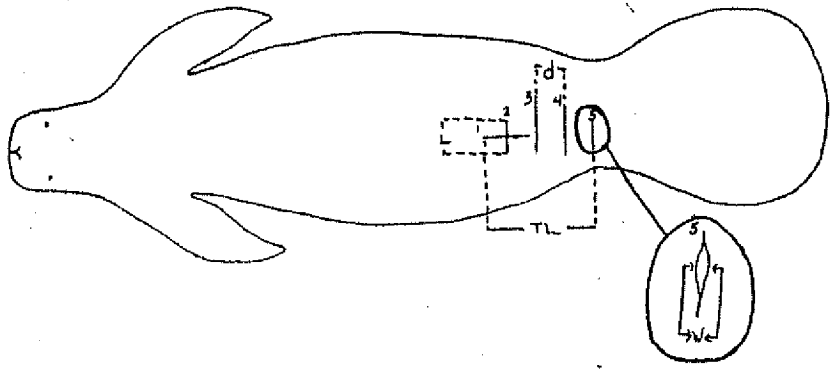
- ☐ Fresh (open)
- ☐ Recent, but healing
- ☐ Healing (white)
- ☒ Healed

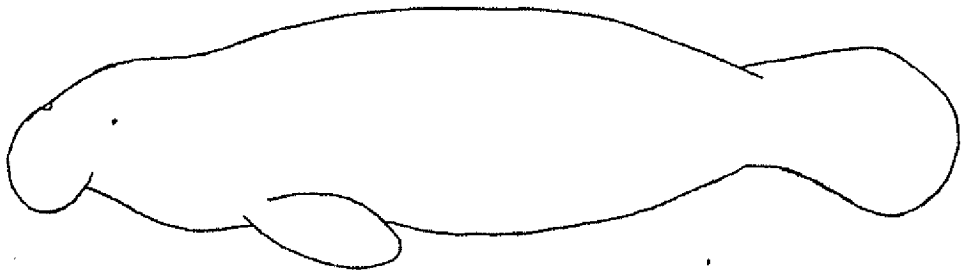


notch is 1.cm deep + 1.cm wide at margin and 22.cm to right of median

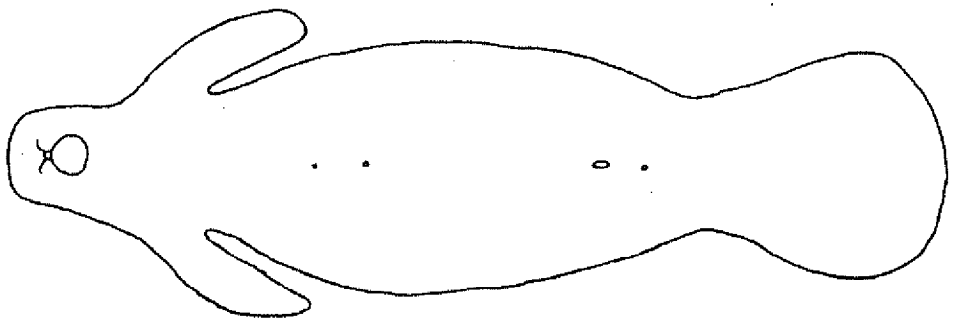
Use a separate sheet for each scar pattern. Please number from anterior to posterior and correlate with a sketch on e silhouettes. Measurements are taken either parallel or perpendicular to the long axis of the scar. USE METRIC. Supplement with photographs whenever possible.

EXAMPLE:





umber	1	2							
(L) Length	29.cm	15.cm							
(W) Width at widest pt.	3.5cm	2.cm							
(D) Depth at deepest pt.									
(d) Distance between scars									



Total length of scar series, ant. to post. _____

Total number of scar patterns 2. This is pattern 1 of 2. Measurements by C. Beck 18 Aug 1982

NOTES:

U.S. Fish and Wildlife Service
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601

MANATEE SCAR MEASUREMENTS

UNDER PERMIT: PRT 2-8430

Field/Specimen No. M-307

Species T. manatus

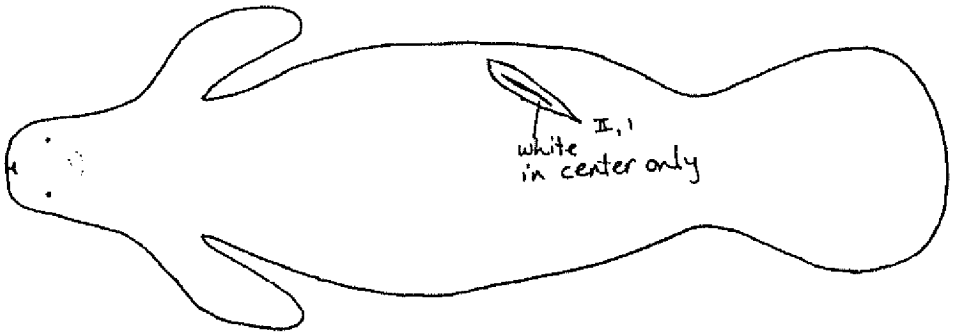
Date Collected 17 Aug 1982

by: DWRC - SP

Condition of animal upon collection Fresh

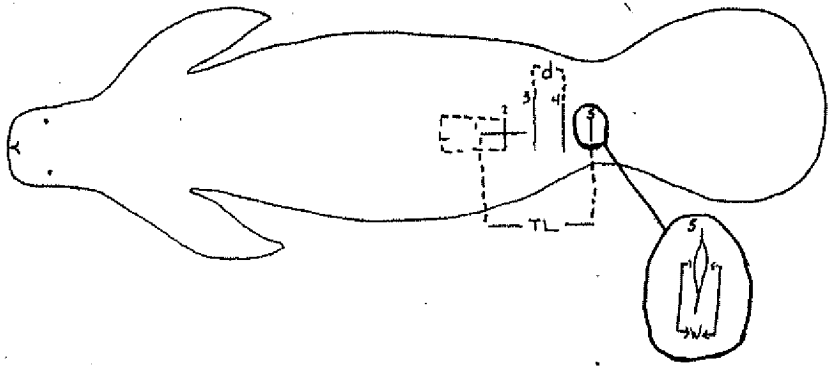
Condition of scar:

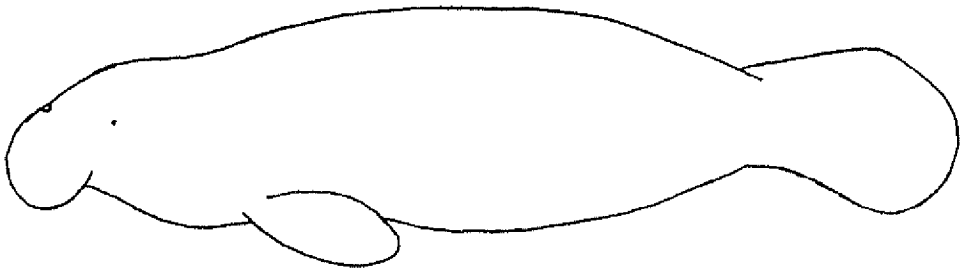
- ☐ Fresh (open)
- ☐ Recent, but healing
- ☐ Healing (white)
- ☒ Healed

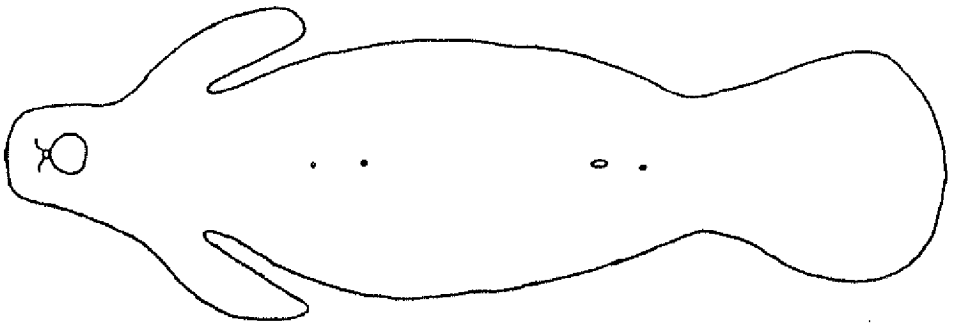


Use a separate sheet for each scar pattern. Please number from anterior to posterior and correlate with a sketch on ıe silhouettes. Measurements are taken either parallel or perpendicular to the long axis of the scar. USE METRIC. Supplement with photographs whenever possible.

EXAMPLE:







umber	1								
(L) Length	21 cm								
(W) Width at widest pt.	2 cm								
(D) Depth at deepest pt.									
(d) Distance between scars									

Total length of scar series, ant. to post. _____

Total number of scar patterns 2. This is pattern 2 of 2.

Measurements by C. Beck 18 Aug 1982

131

NOTES:

U.S. Fish and Wildlife Service
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601

UNDER PERMIT: PRT 2-8430

MANATEE SCAR PATTERNS

Please sketch all visible scars and markings on silhouettes provided. The use of body reference points will aid in analyzing your drawings; be as accurate as possible, keeping your drawings to scale with the manatee sketches.

ID/Field No. _____

Condition of scar:

- ☐ Fresh (open)
- ☐ Recent, but healing
- ☐ Healing (white)
- ☐ Healed

Total length of animal _____

Total number of scar patterns

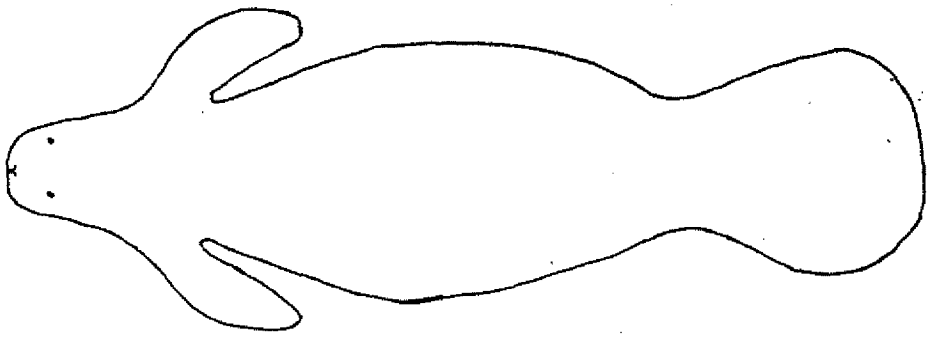
_____

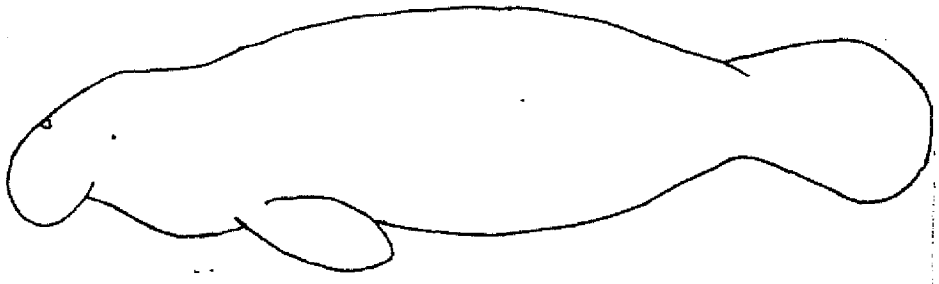
Observations by:

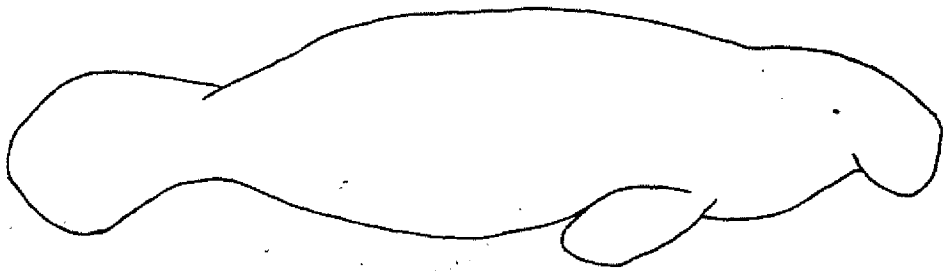
_____

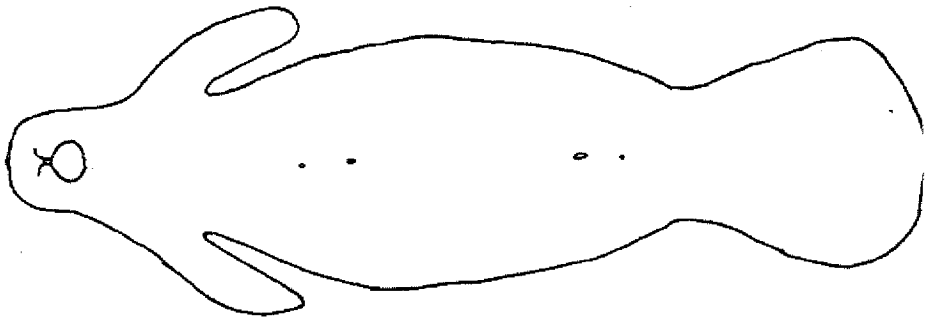
Date _____

Comments:









NOTES:

MANATEE SALVAGE PROGRAM NECROPSY REPORT

FIELD I.D. _____ SPECIES _____

RECOVERY DATE _____ NECROPSY DATE _____

SEX _____ TL _____ WT _____ CONDITION _____

HISTORY

EXTERNAL

ABDOMINAL

STOMACH

DUODENUM

JEJUNUM & ILEUM

CECUM

COLON

NOTES:

FIELD I.D. _____

LIVER

GALL BLADDER

REPRODUCTIVE TRACT

KIDNEYS

URINARY BLADDER

HEART

RESPIRATORY SYSTEM

LUNGS

NOTES:

FIELD I.D. _____

HEAD & NECK REGIONS

SKELETON

OTHER

DIAGNOSIS

CAUSE OF DEATH

BY _____

_____

_____

NOTES:

FIELD I.D. M-307 SPECIES T. manatus

RECOVERY DATE 17 August 1982 NECROPSY DATE 18 August 1982

SEX Female TL 300 cm WT 1200 lbs (544 kg) CONDITION Fresh

HISTORY Shrimp fisherman while trawling saw 2 manatees swim into his net. He pulled net and one swam out but other drowned. He reported incident to Chuck Cowman of the Georgia Department of Natural Resources who reported the death to DWRC-Sirenia Project. Carcass retrieved within about 5 hours after death occurred.

Carcass was loaded from shallow water onto trailer where the larynx was removed and placed in 95% EtOH. The head was removed whole and placed on ice for transport back to Gainesville.

EXTERNAL 4 nails on each flipper.

Fluke edge nearly entire; wide, shallow natural median notch (see photos) and small (1 cm x 1 cm) notch 22. cm to right of center of median notch. Healed propeller scars on dorsal fluke and mid-dorsum - see scar sheet and photos.

ABDOMINAL 4 l of red-wine colored serous fluid in cavity. Serosa and mucosa throughout unremarkable. Esophagus unobstructed.

STOMACH Full of Spartina -fermenting - distinct vinegary odor. No nematodes were present.

Spleen: Vol: 30 ml, 7x5 cm, Wt. = 27.4 g, 4 5mm cream-colored small tags along surface. "Raspberry" rough area covers ~50% of surface.

DUODENUM Full of cordgrass, contents watery- normal. Same odor as in stomach. No nematodes were present.

JEJUNUM & ILEUM 6 small (~2 cm diam.) cysts at upper ileum, near pancreatic duct. Collected in 85% saline and 10% NBF. Cysts in saline examined and appear to contain only debris - no parasite found. No vegetative contents in upper third. Full of thick mucus in upper third. Mud in upper third-dark gray in color. Gray-green Spartina present in middle two-thirds, except lower meter with gray-green mucus only. Meckel's diverticulum present - CECUM 31. cm proximal to ileo-caecal junction.

CECUM Full of Spartina. 1 immature Chiorchis still alive in horn, only one found.

COLON Full. Only 2 (mature) Chiorchis found in upper LI. Contents in upper LI firm - Spartina. Watery vegetative contents by mid LI, and mud present. Mid to lower LI full of black mud with some vegetation. Last 2 m full of green, soft contents.

NOTES:

LIVER 6250. g. Left lobe of liver greatly reduced in size (see photos). Right side appears larger than usual and harder, slightly. Dorsal side of right half has cream-colored streak running through it at surface, 20. cm long x 5. cm wide.

GALL BLADDER Half full, bile reddish brown with a very large amount of yellow sediment. Sample frozen. Area at tip reddened and harder, reddened on mucosa surface at underlying area.

REPRODUCTIVE TRACT Uterus distended but not pregnant. Ovaries were a dark purple color with distinct graafian follicles, corpora lutea and corpora albacantia. Left uterine horn was elongated and distended. Uterine endometrium was covered with large patches or areas of hemorrhagic tissue. The uterine walls were thick, the lumen dilated. There was a large quantity of mucous in the cornu and cervix regions. Repro tract, from below the cervix, collected whole in 10% NBF.

KIDNEYS Unremarkable - good definition between cortex and medulla. Stringy bands radiating through cortex to medulla. Left = 1170. g. Right = 1250.g. 3 arterial branches from aorta to right kidney, only 1 branch to left kidney.
Left adrenal = 7.23 g; Right adrenal = 11.42 g.

URINARY BLADDER Full, urine clear and very pale, slight yellow tint but almost colorless. Mucosa unremarkable.

HEART Clear fluid in pericardium. ~150 ml total. Heavy fat deposits on epicardium. Wt. = 1038. g.

Patent ductus arteriosus - 1 mm opening. Valves unremarkable.

RESPIRATORY SYSTEM No fluid in pleural cavities.

LUNGS Full of blood, heavy, floated in water. Weight both lungs = 5650.g. Bronchi full of blood-tinged mucus, and significant amount of clotted blood, probably from contamination when larynx and head were removed prior to transport. Some froth in upper bronchi also.

NOTES:

HEAD & NECK REGIONS Nasal flukes present in nares, collected total present. Thymus dark purplish-brown in color and firm. *Right side = 127.68 g, left side = 129.30 g. Thyroid - 106.77 g. Left eye in 10% NBF. Right eye frozen. Larynx in 95% EtOH. Cranium opened, and brain left in situ, preserved in 10% NBF.

Brain Weight = 470. g

SKELETON Unremarkable. Right flipper assembly and scapula collected whole and frozen. Left humerus, thoracic vertebra #12 and distal tip of right rib #13 collected in 20% NBF. Mandible and cranium in 10% NBF.

OTHER

Lactating

DIAGNOSIS

1. Left lobe of liver greatly reduced in size, bile discolored.
2. Large spleen, thymus and thyroid.
3. Patent ductus arteriosus (~1 mm)
4. Pulmonary perfusion and mucous in bronchi.
5. 4 liters serous fluid in abdominal cavity.

CAUSE OF DEATH

1. Other Human Related: drowned in fishing net.

BY Robert K. Bonde

Cathy Beck

NOTES:

MANATEE FAT DEPOSITION COMMENT SHEET

Animal No. _____

Blubber layers (photo _____): _____

_____

_____

Ventral Body wall (photo _____): _____

_____

_____

Mesenteries (photo _____): _____

_____

_____

Heart (photo _____): _____

_____

_____

Reproductive tract (photo _____): _____

_____

_____

Other (photo _____): _____

_____

_____

Describe color and consistency of fat when present. Use consistent terminology for qualitative description of amounts present (i.e. none, light, moderate, heavy, very heavy). Photograph each area and check off on data sheet, with roll and frame number. Photograph midventral blubber layers from lateral aspect and note if measurements were recorded on morphometrics data sheet. Use reverse side for further comments.

NOTES:

MANATEE FAT DEPOSITION COMMENT SHEET

Animal No. M-307

Blubber layers (photo CB 125-10 ✓): Moderate to heavy fat deposits - see measurements.

Ventral Body wall (photo CB 124-31 ✓): Moderate fat deposits.

Mesenteries (photo CB 124-35 ✓): Heavy fat deposits on transverse colon. Weight of fat from 1 meter section of transverse colon = 500. g Weight of 1 meter section of transverse colon, trimmed and washed = 520. g

Heart (photo CB 125-26-28 ✓): Heavy fat deposits.

Reproductive tract (photo CB 125-19 ✓): Heavy fat deposits.

Other (photo _____):

Describe color and consistency of fat when present. Use consistent terminology for qualitative description of amounts present (i.e. none, light, moderate, heavy, very heavy). Photograph each area and check off on data sheet, with roll and frame number. Photograph midventral blubber layers from lateral aspect and note if measurements were recorded on morphometrics data sheet. Use reverse side for further comments.

NOTES:

APPENDIX II. Materials required for preparation of preservatives and fixatives.

Preservative or fixative	Components	Amounts
10% N.B. Formalin	Formaldehyde (37-40%)	100 ml
	Distilled water	900 ml
	Sodium phosphate dibasic (anhydrous)	6.5 g
	Sodium phosphate monobasic	4.0 g
5% Formalin	Formaldehyde (37-40%)	50 ml
	Salt or fresh water	950 ml
Buffered Gluteraldehyde	Gluteraldehyde (50%)	10 ml
	Distilled water	70 ml
	Sorensen's phosphate (2.0 M) buffer	80 ml
Bouin's Fluid	Formaldehyde (37-40%)	250 ml
	Picric acid, saturated aqueous solution	750 ml
	Glacial acetic acid (GAA)	50 ml
A.F.A. Solution	Formaldehyde (37-40%)	100 ml
	Distilled water	400 ml
	Ethanol (100%)	500 ml
	Glacial acetic acid	20 ml

APPENDIX II - Continued.

Preservative or fixative	Components	Amounts
Glycerin-Ethanol (70%)	Ethanol (70%)	95 ml
	Glycerin	5 ml
Ethanol (70%)	Ethanol (100%)	700 ml
	Distilled water	300 ml
Saline (1.5%)	Sodium chloride (NaCl)	15 g
	Distilled water	1000 ml

APPENDIX III. Blank and completed loan invoices.

NOTES:

U.S. Fish and Wildlife Service - Sirenia Project
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601
(904) 372-2571

SIRENIA SHIPPING INVOICE No. _____

To:

Date _____

Approved _____

The material listed below is _____
Specimens are normally loaned for a period not to exceed one year.

No. of packages _____ Date shipped _____ Received

Shipment _____ Payment _____ _____
(Name)

Insured _____

_____
(Date)

Please sign and return one copy of this invoice upon receipt of shipment.

NOTES:

U.S. Fish and Wildlife Service - Sirenia Project
412 N.E. 16th Ave., Room 250
Gainesville, Florida 32601
(904) 372-2571

SIRENIA SHIPPING INVOICE No. 181

To: Dr. Alastair Watson
JHMHC
Box J-144
University of Florida
Gainesville, FL 32610

Date 1 November 1982

Approved C. Beck

The material listed below is A TEMPORARY LOAN
Specimens are normally loaned for a period not to exceed one year.

Complete right and left flipper assemblies, first three right and left ribs with corresponding vertebrae, cervical vertebrae, tip of right rib #11, and left pelvic from salvaged T. manatus specimen M-314, data as follows:

Collected: 29 October 1982
FL, Citrus County, Crystal River, Kings Bay, north side of Banana Island.
Length: 219 cm
Weight: 211 kg
Sex: Male, immature
Condition: Moderately decomposed

No. of packages One

Date shipped 30 Oct 1982

Received

Shipment Hand Carry

Payment none

(Name)

Insured No

(Date)

Please sign and return one copy of this invoice upon receipt of shipment.

NOTES:

APPENDIX IV. Cooperator's requests for materials, 1982.

Cooperator	Material requested (amount)	Preparation	Purpose
Dr. J. David Archibald with Dr. Charles Sibley Yale University Peabody Museum of Natural History P.O. Box 6666 New Haven, CT 06511 203-436-0720	Any organs: liver, kidney, heart, lungs, brain, gonads, spleen (25-50 gram samples)	80-85% ethanol (EtOH)	Mammalian systematics using DNA-hybridization techniques
Dr. Ulfur Arnason Institute of Genetics University of Lund Solvegatan 29 S-223 62 Lund, Sweden	Liver, spleen (1 to 5 cm cube)	Frozen	DNA-extraction
with Dr. Warren Nichols Dept. of Cytogenetics Institute for Medical Research Copewood Street Camden, NJ 609-966-7377	Eye (whole), skin, lung (thin piece)	In culture media	To establish cell cultures
Dr. Gerard K. Beekman UNH Marine Advisory Program Marine Program Building University of New Hampshire Durham, NH 03824 603-862-1889	Tissues from major visceral organs (1 cm cubes)	10% n.b. formalin (NBF)	Histological reference collection
Dr. John W. Brown General Medical Research VA Medical Center 1201 NW 16 Street Miami, FL 33125 305-324-4455 Ext. 3425	Adrenals, thyroid (whole)	On ice or frozen	Comparative endocrinology

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Dr. Claus Buergelt Box J-145 J. Hillis Miller Health Center College of Veterinary Medicine University of Florida Gainesville, FL 32610 904-392-4383	Sections from major visceral organs, normal and pathological (1 cm cubes)	10% NBF	Histological reference collection and histopathology
Dr. Ted Bullock Neurobiology Unit University of California Scripps Institute of Oceanography La Jolla, CA 92093	Brains (whole)	10% NBF	Anatomical studies
Dr. David Duvall Dept. of Zoology University of Wyoming Laramie, WY 82071	Cranium (entire)	Frozen	Examination for vomero-nasal organ and histology of olfactory epithelium
Ms. Mary Echols Box J-144 JHMHC College of Veterinary Medicine University of Florida Gainesville, FL 32610 904-392-0921	Limbs (entire)	On ice, frozen or in 10% NBF	Circulation patterns in flippers
Dr. Gerald Fleischer Center for Anatomy & Cytobiology Justus-Liebig-University Aulweg 123 D-6300 Giessen West Germany	Cochlea (entire)	10% NBF	Comparative measurements of hearing organs

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Mr. John Fletemeyer Nova University 8000 N. Ocean Drive Dania, FL 33004 305-475-7487	Muscle (10 cm cubes)	Frozen	Electrophoretic studies
Dr. Donald J. Forrester Dept. of Preventive Medicine College of Veterinary Medicine Box J-136 University of Florida Gainesville, FL 32610 904-392-1844	Parasites (entire, total present)	Preserved	Parasite abundance and internal distribution
Dr. Morris Goodman Dept. of Anatomy 540 E. Canfield Avenue Wayne State University Detroit, MI 48201 313-577-1061	Muscle, heart, liver, kidney, blood (1 kg each)	Frozen	Biochemical and immunological study of mammalian relationships
Ms. Cheryl Hansen Dept. of Zoology Bartram Hall University of Florida Gainesville, FL 32610	Fluke (entire)	Frozen	Anatomical study
Dr. Rickye Heffner Parsons Research Center P.O. Box 738 University of Kansas Parsons, KS 67357 316-421-6550	Brains (whole)	10% NBF + 10-20 ml DMSO (dimethyl sulfoxide)	Comparative studies of auditory nuclei

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Dr. Susan Herring College of Dentistry P.O. Box 6998 University of Illinois at the Medical Center Chicago, IL 60680 312-996-7544	Head (entire, with neck musculature)	Frozen	Histological study of tooth replacement and gross dissections of facial musculature and intra-oral structures
Dr. Roy Horst Biology Department State University College Potsdam, NY 13676	Kidneys (whole)	10% NBF	Study of renal morphology
Dr. Sidney Lees Bioengineering Dept. Forsyth Dental Center 140 Fenway Boston, MA 02115	Rib and humerus from adult male (entire)	Dry or in 10% NBF	Relationships between sonic velocity of bone and mineral content
Dr. George Mann Dept. of Biochemistry School of Medicine Vanderbilt University Nashville, TN 37232 615-322-7311	Muscle (5-10 g samples from several animals)	Frozen	Analysis of Vitamin C content in muscle tissue of sirenians
Dr. Helene Marsh Zoology Department James Cook University Townsville, Queensland 4811 Australia	Reproductive tracts (entire)	10% NBF	Reproductive studies

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Dr. Bruce Mate Marine Science Center Oregon State University Newport, OR 97365 503-867-3011	Dorsal skin and musculature from adult (large slab)	Frozen	Tag application development
Dr. Lee McClenaghan Department of Biology California State University San Diego, CA 92182	Muscle, liver, and kidney (1 cm cubes)	Frozen	Electrophoresis
Dr. William Miller Department of Oral Biology School of Dentistry State University of New York at Buffalo 4510 Main Street Snyder, NY 14226	Mandibles (entire or portion with erupting teeth, from several animals)	10% NBF	Molar progression and gross histological examination
Dr. Albert Myrick National Marine Fisheries Service Southwest Fisheries Service P.O. Box 271 La Jolla, CA 92038	Tympanoperiotic bones (entire from many animals)	Clean	Aging technique using growth layers
Dr. James Paterek Dept. of Microbiology and Cell Science 1059 McCarty Hall University of Florida Gainesville, FL 32611 904-392-5269	Contents from cecum, colon, and rectum (8-oz samples)	On wet ice	Comparative studies of intestinal anaerobic bacteria of acquatic animals in Florida

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Patuxent Wildlife Research Center Laurel, Maryland 20811	Muscle, blubber, kidney, brain (30-50 g samples)	Frozen in specially cleaned jars	Analyses of chemical pollutants
Dr. Bruce Ragsdale and Dr. George Migaki Department of Orthopedic Pathology Armed Forces Institute of Pathology Washington, D.C. 20306	Thoracic vertebra and humerus, normal and pathological (entire)	20% NBF, bone cut longitudinally to allow penetration if possible	Comparative osteology
Dr. Charles Ralph Department of Zoology and Entomology Colorado State University Fort Collins, CO 80523	Brain with pineal gland (whole)	10% NBF	Histological examination
Dr. Roger Reep Dept. of Neuroscience Box J-244 JHMHC College of Medicine University of Florida Gainesville, FL 32610 904-392-3383	Brain (whole and sections)	10% NBF	Histological examination
Dr. John E. Reynolds, III Department of Biology Eckerd College St. Petersburg, FL 33733 813-867-1166, Ext. 484	Liver, pancreas (1 cm cubes) Vertebrae (entire) Sections along GI tract (1 cm cubes)	10% NBF	Histological examination

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Dr. Ursula Rowlatt Department of Pathology 1853 W. Polk Street University of Illinois Chicago, IL 60612 312-996-7510	Hearts with 5 cm length of vessels attached	10% NBF	Comparative anatomical studies
Dr. Tim Rumage Nature Lab Rhode Island School of Design 2 College Street Providence, RI 02903 401-331-3511, Ext. 336	Larynx (entire)	10% NBF or frozen	Sound production studies
Sea World of Florida 7007 Sea World Drive Orlando, FL 32809	Blood, whole, in EDTA tubes	On wet ice	Studies on hormone levels and reproductive activities
Mr. Henry Spivey Department of Biological Science Florida State University Tallahassee, FL 32306	Barnacles (several, from many animals)	Fixed for 24-48 hours in 10% NBF, store in 70% EtOH	Taxonomic studies
Dr. Richard Stroud National Wildlife Health Laboratory 6006 Schroeder Road Madison, WI 53711	Normal and pathological tissues (1 cm cubes)	10% NBF	Histological examination and reference collection

Appendix IV - Continued.

Cooperator	Material requested (amount)	Preparation	Purpose
Dr. Alastair Watson Box J-144 J. Hillis Miller Health Center College of Veterinary Medicine University of Florida Gainesville, FL 32610 904-392-0921	Skeletal anomalies (from several animals)	Clean	Anatomical studies
	Distal ileum and cecum with vitelline diverticulum remnant	10% NBF	Descriptive studies

APPENDIX V. Glossary of terms which appear in the text.*

Abscess - a localized collection of pus in a cavity formed by disintegration of tissues.

Adhesion - the stable joining of parts to one another, usually abnormally.

Aneurysm - a sac formed by localized dilation of a blood vessel.

Anomaly - the marked deviation from normal; defect.

Anorexia - loss of appetite for food.

Anterior - in front of.

Anuria - absence of urine in bladder indicating possible suppression of urine formation by the kidney.

Ascidian - saclike marine animals in the Class Ascidiacea, Phylum Chordata.

Aspiration - the act of inhaling.

Atony - lack of normal tone or strength.

Atrophy - a wasting away, causing a reduction in size.

Autolysis - spontaneous disintegration of cells or tissues by autologous enzymes.

Axilla - the armpit.

Bolus - a rounded mass of ingested food.

Cachexia - a profound state of general ill health and malnutrition.

Caudal - pertaining to or towards the tail.

Chicken-fat clot - a grayish-yellow blood clot, due to the settling of red blood cells before clotting.

Coarctation - stricture or narrowing.

Congenital - present at or existing from the time of birth.

Appendix V - Continued.

Congestion - abnormal accumulation of blood in a part.

Cranial - pertaining to or towards the head.

Cyst - a bladder or bag, usually containing fluid or a semi-solid material.

Dermatosis - any skin disease.

Dilatation - a condition of being expanded or stretched beyond normal dimensions.

Distal - remote; farther from any point of reference.

Edema - an abnormal accumulation of fluid in a body cavity or in the intercellular spaces of a tissue or organ, usually leading to swelling.

Edematous - characterized or pertaining to edema.

Emaciation - excessively thin, wasted condition of the body.

Embolus - a clot or other plug obstructing circulation through a blood vessel.

Encephalitis - inflammation of the brain.

Enteritis - inflammation of the intestine.

Enterotoxemia - a condition characterized by the presence of toxins in the blood which were produced in the intestines.

External auditory meatus - external opening of the ear.

Exudate - a fluid which escapes from blood vessels, usually as a result of inflammation.

Fascia - a sheet or band of fibrous tissue.

Fibrin - a dull white stringy material formed by the coagulation of fibrinogen.

Fibrinous - pertaining to or of the nature of fibrin.

Appendix V - Continued.

Fibrosis - a formation of fibrous tissue.

Fibrous - composed of or containing fibers.

Foci - small discrete points or areas.

Fornix - an archlike structure or space.

Fracture - the breaking of a part, especially a bone.

Friable - easily pulverized or crumbled.

Hemolysis - liberation of hemoglobin; separation.

Hemorrhage - the escape of blood from vessels; bleeding.

Hepatization - transformation into a firm mass, liver-like in texture.

Hyperemia - an excess of blood in a part.

Hyperplasia - abnormal increase in the number of normal cells, which increases the volume of the tissue.

Hypertrophy - increase or enlargement of an organ or part, due to an increase in size of its constituent cells.

Impaction - being wedged in firmly.

Inferior - situated below, or directed downward.

Inflammation - a protective tissue response to injury or destruction.

Ingesta - material taken into the body by the mouth.

Intussusception - prolapse or telescoping of a part of the intestine into the lumen of an immediately adjoining part.

Lateral - denoting a position farther from the medial plane or midline; side.

Lesion - a pathologic or traumatic discontinuity of tissue.

Lobulate - having or consisting of lobes.

Lumen - a cavity or channel within a tube or organ.

Appendix V - Continued.

Meconium - dark green mucilaginous material in the intestine of the fetus.

Medial - situated towards the midline.

Mucosa - mucous producing membrane; this includes the tissue lining the lumen of the GI tract and the urinary bladder.

Mucus - the free slime of the mucous membranes.

Necropsy - examination of a body after death; autopsy.

Necrosis - death of individual cells or groups of cells.

Nodules - a small node which is solid and can be detected by touch.

"Nutmeg condition" - a mottled or speckled appearance to the liver when cut.

Osteolytic - dissolution of bone.

Parietal peritoneum - a serous membrane lining the walls of the visceral cavity.

Parturient - giving birth or pertaining to birth.

Patent - open, unobstructed, or not closed.

Pathogen - any disease-producing agent or microorganism.

Peduncle - the narrow area between the body and the tail of the manatee.

Perinatal - relating to the period shortly before and after birth.

Petechia - a minute red spot due to the escape of a small amount of blood.

Placental scars - conspicuous purple bands in the uterine endometrium.

Plaque - any patch or flat area.

Pneumonia - inflammation of the lungs with exudate and consolidation.

Polyp - a growth or mass protruding from a mucous membrane.

Posterior - directed towards or situated at the back.

Appendix V - Continued.

Postmortem - performed or occurring after death.

Prosector - one who performs the necropsy.

Proximal - nearest to the point of reference.

Purulent - containing or forming pus.

Pus - a viscous liquid inflammation product.

Rupture - tearing of tissue.

Sepsis - the presence of pathogens in blood and other tissues.

Septicemia - systemic disease associated with pathogens in the blood.

Serosa - serum producing membrane; outermost surface or wall of the GI tract.

Serous - pertaining to or resembling serum; usually a watery fluid.

Spicule - a sharp needle-like body.

Stenosis - narrowing or contraction of a body passage or opening.

Suppuration - formation or discharge of pus.

Thrombis - a solid mass formed in the living heart or vessels from constituents of the blood.

Toxicosis - disease condition due to poisoning.

Trauma - a wound or injury.

Tumor - swelling; a new growth of tissue.

Ulcer - a local defect produced by sloughing of necrotic inflammatory tissue.

Vascular - pertaining to blood supply.

Vermin - any of various small animals that are destructive or injurious to health.

Verminous - pertaining to, due to, or abounding in worms or vermin.

Appendix V - Continued.

Verruca - a wart-like projection.

Vesicle - a small bladder or sac containing fluid; a small blister.

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* Definitions adapted from The American Heritage Dictionary of the English Language (W. Morris, ed. 1976. Houghton Mifflin Company, Boston, Mass. 1550 pp.), Dorland's Pocket Medical Dictionary (J. P. Friel, ed. 1977. 22nd ed. W. B. Saunders Company, Philadelphia, Penn. 741 pp.), and Veterinary Pathology (Smith, H. A., T. C. Jones, and R. D. Hunt. 1972. 4th ed. Lea and Febiger, Philadelphia, Penn. 1521 pp.).

APPENDIX VI. Field checksheet for salvage and necropsy procedures.

Topic/Organ System	Procedure/Activity
External	Weigh, photograph, record morphometrics; count nails; describe, measure, photograph scars and wounds. Examine all surfaces and apertures, flippers, fluke, and teats. Examine head, eyes, auditory meatus, nose, and mouth. Collect and quantify ectoparasites and nasal flukes. Collect eyes.
General Internal	Measure lateral and ventral blubber and dermis, describe and photograph. Collect blubber (2 samples), muscle (2 samples). Photograph and describe fat on abdominal wall, mesenteries of transverse colon. Describe, quantify fluids.
Gastrointestinal Tract	Describe all serosal, mucosal surfaces; examine and describe all contents. Collect ingesta, parasites, and histological samples from stomach, duodenum, jejunum, ileum, cecum, mid-large intestine. Describe, measure, collect vitelline diverticulum, spleen (weigh), pancreas. Take culture swabs.
Liver	Collect samples for histology, pollutant residues. Describe and photograph for shape, color, edges. Determine weight and volume; float. Describe bile, surfaces of gall bladder, patency of bile duct.

APPENDIX VI - Continued.

Topic/Organ System	Procedure/Activity
Thoracic cavity	Examine, describe, collect thymus. Describe, photograph heart fat. Describe pericardial sac, epicardium, fluids. Examine and describe endocardium, valves, septa, ductus arteriosus or ligamentum arteriosum, internal fluids.
Respiratory system	Examine and describe hemidiaphragms, trachea, bronchi, bronchioles. Collect parasites. Describe pleural cavity, fluids. Examine, describe, float, collect samples and swabs from lungs. Weigh each lung.
Urinary tract	Examine, collect adrenal glands for histology. Describe kidney fat. Examine and weigh kidneys. Collect samples for histology, pollutant residues. Examine ureter, urinary bladder, urethra. Collect and describe urine.
Reproductive tract	Females: Describe, photograph fat deposits. Examine, describe, collect ovaries, entire tract. Examine uterus for scars, fetus, fluids. Remove pelvic bones.

APPENDIX VI - Continued.

Topic/Organ System	Procedure/Activity
	Males: Describe, photograph fat deposits. Examine, describe, collect testes, epididymides, penis, entire tract. Smear fluid from head of epididymides. Remove pelvic bones.
Head and neck	Examine, describe and collect thyroid, salivary glands, mammary glands, lymph nodes, larynx, esophagus, skull, mandible, brain. Count teeth. Collect parasites. Remove hyoids. Tag skull.
Other	Measure dorsal skin and blubber, examine all bones.