Department of Biology and Wildlife
Wildlife Disease – WLF 305, Spring 2005
Syllabus, Course Objectives, & Necropsy Protocol
Original Documents provided courtesy of Dr. John Blake, Attending Veterinarian
(Adapted by O’Hara)

Lecture Tuesday 2 to 4PM (2 lectures per day will be presented)
Room: Arctic Health Research Building 183
Laboratory Thursday 2-5PM in Necropsy Suite or TBD conference room when needed
(Will require escort into secured facility, meet at main entrance to Animal Quarters in AHRB on 1st floor)

4 credits, Prerequisites: Biol 310 or Biol 111 and 112.
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AHRB 144, Office Hours Noon- 2PM MWF
Associate Professor of Wildlife Toxicology

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Course policies

Attendance/tardiness:
Attendance is vital to the grade. Much, if not all, of the exam information will be based on information from notes given during class. These notes must be obtained from another student when absence is unavoidable. Attendance is recorded occasionally to maintain an idea of who is actually attending. Repeated tardiness will be noted. Out of respect for the instructor and classmates please be on time. Laboratories cannot be missed.

Making up an Exam
An exam may be taken ahead of schedule if a suitable time can be agreed upon if there is a good reason. Exams can be made up after the scheduled day but this is at the discretion of the instructor (i.e., it is not guaranteed). The make-up exam, or the early exam, will not be the same exam given to the other students. There will only be one make-up exam offered. Students who miss more than one exam will have difficulty passing the course.

Plagiarism
Simply will not be tolerated in any form. When in doubt cite and quote your sources.
Academic integrity
Examinations are to be performed by the individual and any attempts to gain assistance or knowingly provide assistance during an examination will be punished according to University policy towards “cheating.” Those taking early or make up exams are to not request assistance with the exams nor provide it. The exams should not be discussed until ALL members of the class have taken a specific exam.

Disabilities Services
The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. The Instructor will work with the Office of Disabilities Services (203 WHIT, 474-7043) to provide reasonable accommodation to students with disabilities. Please make the Instructor aware of any disabilities that may affect access or performance.

OBJECTIVES
The primary objective of this course is to introduce the wildlife biology student to disease processes at the individual animal and population level. This course is intended to impart a basic understanding of disease processes and a basic knowledge of some common disease entities with a focus on the Arctic and sub-arctic regions. Effects on populations and diseases of human health significance are emphasized.

The objectives for the laboratory include: 1) To develop a standard technique for the post-mortem examination (necropsy) of vertebrates. 2) To become familiar with the instruments needed to conduct a satisfactory field necropsy. 3) To learn how to collect and preserve suitable specimens for submission to a diagnostic lab. 4) To learn the importance of a history and the proper description of lesions. 5) To develop an understanding of zoonotic diseases and the importance of a "clean" technique while handling diseased and decomposing tissues. 6) To learn critical evaluation of published work in the area of wildlife disease research or investigations.

APPROACH
The course starts out with an 8 lecture series introducing the mechanisms of disease ending with a discussion on epidemiology. This is followed by lectures on common diseases of mammals and birds using a structure based on disease causing agents (etiology). Using a variety of diseases occurring in wildlife we will discuss the cause, species affected, occurrence, ecology, clinical disease, pathology, differential diagnoses, specimens for diagnosis, and the significance to the animal and population. It is impossible to discuss all causes of disease but our review of certain disease causing agents will emphasize the importance of proper diagnostics and how the wildlife biologist can facilitate this.

The laboratory is divided into 2 parts allowing students to obtain hands on experience in the necropsy suite and time to critiques published articles in the field of wildlife disease.

WHAT THE COURSE CANNOT DO:
A single semester course in wildlife diseases cannot impart diagnostic skills. Work that requires diagnostics must involve trained diagnosticians, usually veterinary pathologists with wildlife experience. This by no means limits wildlife disease work to individuals with diagnostic training. Wildlife diagnostics is only one part of wildlife disease work and may or may not be necessary in all research projects. In fact, the best wildlife disease work is generally done by teams
that include wildlife biologists, population biologists, ecologists, pathologists, toxicologists, microbiologists, parasitologists, etc!

**Wildlife Disease – WLF 305 - Grades**

Laboratory performance and lecture attendance: 15%
Review of journal articles: 15%
Mid-term examination I: 20%
Mid-term examination II: 20%
Final examination: 30%

Letter grades: no +/- grades given.
A = 80-100%, B = 70-79%, C = 60-69%, D = 50-59%, F <50%

**Wildlife Disease – WLF 305- Reference List**

**General Texts on Wildlife Disease:**


**General Veterinary Pathology/Epidemiology Texts:**

**General Wildlife/Exotic Animal Disease Journals:**
- Journal of Wildlife Diseases
- Journal of Zoo and Wild Animal Medicine

**Veterinary Journals:**
- Veterinary Pathology
- Journal of the American Veterinary Medical Association
- American Journal of Veterinary Research
- Canadian Veterinary Journal
- Canadian Journal of Veterinary Research

**Biology/Wildlife Journals:**
- Journal of Wildlife Management
- Wildlife Society Bulletin
- Journal of Mammalogy
- Journal of Parasitology
- Many, many more!

**Species Journals:**
- Alces
- Rangifer
- Etc.
NECROPSY TECHNIQUE (as provided by Dr. John Blake)

A. MAMMALS (see Appendix A)

EXTERNAL EXAMINATION

1) Prior to necropsy a preliminary examination of the carcass should be made in order to evaluate body condition, the presence of swelling or abnormal conformation and to note the presence of abnormal exudates.

2) If practical or needed, the body surface is thoroughly washed in order to facilitate a careful examination of the hair coat and/or skin. Petechiation, ecchymoses, cyanosis, parasitic infestations, and vesiculation are recorded. Wildlife cases will occasionally require skinning to save the pelt.

3) The external openings of the body are then systematically examined, starting with the oral cavity, eyes and ears, the external genitalia and the mammary gland and finally the anus.

4) Palpation and manipulation of the limbs may reveal musculo-skeletal abnormalities such as fracture or dislocations.

OPENING

5) The carcass is then placed on its right side if it is a monogastric or on its left side if it is a ruminant. The abdomen should be facing the prossector.

6) An incision is made through the skin of the axilla of the uppermost forelimb. The skin and the extrinsic muscles of the shoulder attaching the scapula to the body wall are severed. The forelimb is reflected away from the prossector.

7) An incision is then made in the groin area of the uppermost hindlimb. The medial thigh (adductor muscles) are then severed down to the hip (coxofemoral) joint. Take caution not to open the abdominal cavity, this is a particular problem in bloated carcasses. The joint is exposed, the capsule and ligament of the head of the femur are severed and the hindlimb is reflected away from the prossector in like manner to the forelimb.

8) Being careful to avoid the genitalia and the mammary gland, a ventral midline incision is made in the skin covering the body wall (trunk). The skin is reflected away from the prossector to the dorsal midline (up to the spine).

9) Another incision is extended from the shoulder region and extended cranial to the most rostral tip of the mandible (the intermandibular synchondrosis). The skin is then reflected away from the neck and the mandible.

10) The external genitalia are not removed at this time but the mammary glands are removed for
later examination.

11) Incisions are made through the muscles (sublingual muscles) immediately medial to the lingual face of the body of the mandible. The tongue is then drawn through the intermandibular space. The tongue is reflected caudally, the hyoid bones are severed at their articulations freeing the larynx, trachea and esophagus down to the thoracic inlet.

12) The peritoneal cavity is now opened taking care not to damage any abdominal organs. The first incision is made caudal to the last rib extending from the xiphoid ventrally (the caudal most part of the sternum) and to the lumbar transverse processes dorsally. Other incisions are made passing caudally; one through the paralumbar fossa ventral to the lumbar vertebrae and the other along the ventral midline (in the region of the linea alba). The abdominal wall may then be reflected or moved.

13) The abdominal contents are now examined for the presence of abnormal peritoneal content or displacement of any viscera.

14) The normal tonus and doming of the diaphragm are evaluated and the negative pressure in the thoracic cavity is confirmed by making a small hole in the diaphragm and listening for the inrush of air.

15) In order to open the thoracic cavity, the costal cartilages are first cut and the proximal part of the rib cage is elevated (not possible in large animals) in order to permit the use of bone cutters to sever the ribs from the vertebral bodies. For large animals you should use shears or an axe. The thoracic wall is then removed.

16) The thoracic viscera are inspected in situ (while still in the animal) visually for abnormal pleural or pericardial contents or malposition of any of the organs. The pericardial sac should be opened carefully and any samples of fluid or an exudate should be taken at this time.

17) The adrenal glands are located at the cranial poles of the kidneys. Alterations in the size of each gland are noted but they are not removed at this time (standard technique does not recommend their removal but depending on your skill as a prossector this may be the last time you see them, therefore the adrenal glands may be removed if desired).

REMOVAL OF ORGANS

18) The spleen is removed as is the greater omentum to which it is intimately attached. The two structures are separated, inspected for abnormalities and set aside on a clean surface. In ruminants the spleen is firmly attached to the rumen and is located on the left side (the down side if you opened the animal properly). Therefore, the spleen will come out when you remove the liver with the forestomachs and abomasum.

19) In order to prevent spillage of gut contents during removal, the intestines are severed between two ligatures placed at two locations; the duodenum distal to the pancreas and the middle of the
rectum. It should be remembered that the duodenum descends on the right side closely attached to the dorsal abdominal wall by the mesoduodenum. The mesenteries from which the intestine hang from the dorsal body wall are severed and the intestines are pushed dorsally (away from the prosector) and out of the abdominal cavity. Once the mesenteries have been severed the intestines from the duodenum through to the rectum are set aside for later examination. The mesenteric lymph nodes will be examined with the intestines.

20) The ligaments and vessels attaching the liver to the diaphragm and abdominal wall are severed. The esophagus is cut close to the diaphragm. The liver, stomach, duodenum and pancreas are removed as one unit and set aside.

21) A superficial examination of the kidneys and urogenital system is made prior to the removal of these organs. If urine is present in the urinary bladder, squeezing this organ will determine the patency of the urethra. The testicles may be examined at this time. The adrenal glands are removed and set aside (if not already done).

22) Muscles over the wing of the left ileum (right in ruminants) are dissected away from the bone as are the muscles attached along the symphysis pubis. A saw cut is made through the wing of the ileum (a part of the pelvis) and through the pubis. This severed portion of the pelvis is then removed. This procedure allows access to the pelvic canal and the structures within.

23) The anatomy of the urogenital tract will vary depending on the species you are dealing with. In ungulates it may be advisable to examine most of the tract in situ and then remove the portions of the tract that you are interested in.

24) In smaller mammals such as carnivores you may remove the urogenital tract in its entirety. In order to do this, each kidney is dissected from its attachments, care being taken to leave the capsules intact. Each ureter is traced to the bladder and dissected from its peritoneal covering. The suspensory ligament of the ovary and the broad ligament of the uterus are cut close to the parietal peritoneum. The urogenital tract along with the rectum is now drawn through the space in the pelvic girdle and detached.

25) Prior to removing the thoracic viscera, samples are taken of pericardial sac contents, if this is indicated (as noted before in item #16). Any pleural adhesions are noted. Then, by grasping the esophagus, the thoracic viscera are drawn caudally. The dorsal attachments of the mediastinum and a portion of the descending aorta are dissected away to facilitate removal of the heart and lungs which are set aside together with the thymus gland.

26) The dorsal and ventral superficial cervical lymph nodes along with other body lymph nodes are now examined.

27) The major muscles of the thoracic and pelvic limbs are incised and examined for abnormalities.

28) An incision is made through the skin overlying the joints which are exposed as far as is possible. The shoulder, stifle, carpal and tarsal articulations are important joints to examine; however, any other articulation demonstrating abnormality should also receive attention.
29) A femur is next removed and set aside in order that marrow samples will be available should culture and histological study prove necessary later. The femur from the uppermost hindlimb is usually the more convenient for removal because the hip (coxofemoral) joint was opened during the early stages of the necropsy.

30) The head is now removed. The atlanto-occipital joint can be palpated if the articulation is flexed and extended. This joint is opened and the head removed. The retropharyngeal and associated lymph nodes are examined before the head is set aside for later study.

SYSTEMIC EXAMINATION OF THE ORGANS

A clean surface is essential for this procedure; otherwise changes in organs may be missed if contaminated by blood, ingesta or other debris. When you are conducting necropsies in the field the rib cage that you reflected during the early stages of the necropsy can be used as a clean surface.

SPLEEN: A longitudinal incision is made into the spleen and if needed, transverse cuts may also be made. If required, specimens may be collected at this time for laboratory analyses.

MAMMARY GLAND: Palpate the gland to evaluate for any swellings or hardness. Make a series of incisions into the gland to evaluate the cut surface. If milk is present check for clots or flakes.

THE "PLUCK" which consists of the tongue, esophagus, larynx, trachea, lungs and heart is examined first.

TONGUE: The tongue is examined for the presence of foreign bodies, lacerations, erosions or ulcers.

ESOPHAGUS: The esophagus is opened from the pharynx distally. The mucosal surface is examined closely for erosions and ulcers.

TRACHEA: A cut is now made through the dorsal midline of the larynx and down through the trachea to its bifurcation. The tracheal mucosa is examined and the contents noted, such as froth which might suggest pulmonary edema, hemorrhage or necrosis.

HEART: The overall shape and size of the heart is evaluated before any cuts are made. The entire pluck is placed with the dorsal aspect of the lungs away from the prossector and the trachea extending to the prossectors left. This positions the heart on the table with the left side uppermost. From the apex to base the heart is visually divided into thirds and a transverse section approximately 1cm thick (thinner in smaller species) is made at the junction of the ventral and middle thirds (i.e. about 1/3 the distance up from the apex). This allows the prossector to visualize the relative sizes of the ventricle lumens and thicknesses of the ventricular walls and interventricular septum. For routine purposes, the 1cm cross section of heart may be taken for formalin fixation. Small pieces of each part of this cross section may be collected if you are dealing with a large animal. Sections from other sites of the heart may be taken after the heart is completely opened and examined if lesions are visible grossly. The heart is then opened keeping in mind the course of the blood flow. Observations must be made as you dissect the heart because it is very difficult to piece the heart together once you are finished. The first incision is made from the opened right ventricle extending up into the pulmonary artery. The pulmonary valve,
artery, and the interventricular septum are inspected. A second cut is made that extends
from the opened part of the left ventricle towards the base. As the cut nears the base the cut
should be angled toward the aorta (to the left). As the incision enters the aorta you will cut
through the pulmonary artery (these vessels are slightly intertwined). After examining the
aortic valve and the aorta you should flip the pluck onto its other side. From here you make
the third incision through the left ventricle into the left atrium and along the pulmonary
veins. At this time you should examine the left atrio-ventricular valve (mitral valve) and the
atrial septum. Your fourth cut follows up the right ventricle and into the right atrium. You
may now visualize the right atrio-ventricular (tricuspid) valve. Extend the cut into the vena
cava. The myocardium is further incised in order that necrosis hemorrhage, infarcts,
parasites or other lesions may be revealed. It is important that the heart not be removed
from the lungs because should there by any transposition of the great vessels, the
abnormality would be more readily detected if the continuity of the structures remain
intact.

LUNGS: The lungs are gently palpated to detect abnormal consistency. Scissors are used
to cut down the full length of the bronchial tree. Lungworms, if present, are usually located
in the distal regions of the caudal lobes. Cross sections are cut through those parts of the
lobes that appear or feel abnormal. If you intend to collect lung tissue for histological
examination select portions of the lung that have not been palpated and use a very sharp
knife (not scissors). The alveoli are crushed easily and gentle handling is necessary for a
useful microscopic examination.

THYROID: Before the thoracic viscera are laid aside, the thyroid glands are located on
the lateral surfaces of the larynx and examined. An incision is made into each gland.

THE LIVER, STOMACH, DUODENUM AND PANCREAS:

HEPATIC LYMPH NODES: These are located, examined and incisions made through
these nodes.

PANCREAS: The pancreas is examined visually and palpated. LIVER: Patency of the
bile duct is ascertained by opening the duodenum to just beyond the site where the bile
duct opens onto the duodenal mucosa. Gentle pressure on the gall bladder causes passage
of bile into the duodenum. Once patency of the bile duct has been assured, the liver may be
removed from the stomach and duodenum. The diaphragmatic surface of the liver is now
wiped clean with the blade of the knife and examined. The visceral surface is cleaned and
examined and several incisions made into the hepatic parenchyma to look for
abnormalities.

STOMACH: The stomach (abomasum in ruminants) is now opened from the duodenum
through the pylorus and around the greater curvature. Gastric contents are noted and a
gross inspection made of the gastric mucosa for abnormalities. Hyperemia of the gastric
fundic mucosa is common. Care must be taken not to roughly scrape the mucosal surface
of the gastrointestinal tract as artifacts will be produced that may obscure changes. The
mucosal lining has a variety of species variations. If you are working on a ruminant you
should now open the omasum, rumen and reticulum. Contents are noted. In some cases a
pH of rumen contents may be needed.

INTESTINE: The mesentery should be stripped from the mesenteric border of the intestines in
species that have a simple gut (most carnivores). The intestines are laid out on a flat surface in a
parallel loop array for detailed inspection. The duodenum is examined first followed by the jejunum and ileum (DUE TO THE HUMAN HEALTH HAZARD OF ECHINOCOCCUS IN FOXES AND WOLVES THE INTESTINES SHOULD NOT BE OPENED UNLESS UNDER YOU HAVE ACCESS TO AN APPROPRIATE HOOD). Several loops of bowel are opened, their contents examined, and any abnormalities noted. Material for bacteriologic culture should be taken at this time, by making two ties, one at either end of the unopened loop to be submitted. The mesenteric lymph nodes are inspected and incised. If microbiological investigations of these nodes is indicated, unopened nodes are submitted. The terminal ileum, the ileocecal valve and the cecal lumen are opened and carefully inspected. The mucosas are examined and contents noted. Several loops of colon are likewise opened, examined and ligated, unopened sections taken if indicated. The terminal rectum and anus are excised from the urogenital tract and are similarly examined and opened. Most ruminants have a complex intestinal tract and, except when doing special examinations, the intestines may be examined without stripping the mesenteries. Find the spiral colon first and then lie the mass of intestines on the table (ground) with the spiral colon down. Carefully spread out the loops of small intestine and locate the cecum (it has a sac with a blind pouch). Once you have found the cecum you can easily find the ileocecal junction and the ileum. After examining the serosal (outside surface) open up the ileum and examine the mucosal surface. If you intend to sample the ileum do it now (you may have a difficult time finding the ileum later). The mesenteric lymph nodes are arranged in a chain located in the mesenteries along the small intestine. Caution: some species have a loop of colon between the small intestine and the lymph nodes -- fecal balls have occasionally been mistaken for lymph nodes. Make a series of incisions in the mesenteric lymph nodes and take samples if needed. Now check the serosal surface of the duodenum and jejunum. Open the gut in any abnormal areas. Be sure to open up several feet of small intestine in multiple spots. Now do the same with the cecum, ascending colon (including the spiral colon), and the remaining colon and rectum. You will have to flip the pile of intestines over to do most of this. Tied off unopened loops of bowel (~5cm long) may be collected for microbiology. For histological examination a flat, opened piece of bowel is required; DO NOT place tied off bowel in fixative and do not submit a section of bowel that you have rubbed or scraped the mucosal surface!

ADRENAL GLANDS: The adrenal glands are sectioned and examined.

URINARY TRACT: The left kidney is sliced longitudinally. The incision is made from one pole to the other from the cortex through to the pelvis and the capsule should strip with ease. The right kidney is sectioned transversely and similarly examined. An incision next is made into the urinary bladder and its contents and mucosal surface inspected.

GENITAL TRACT: An incision is made through the vulva, into the roof of the vagina, and through the cervix into the body of the uterus. A cut is made with scissors as far as one is able to section the horns of the uterus. The mucosal surfaces of the vagina, cervix, uterus and horns are examined. The ovaries should be palpated and visually inspected for abnormalities. The scrotal sac was opened prior to this and the testicles removed. If not previously done, palpate the testicles and make a series of slices into the parenchyma (tissue).

BONE MARROW: The femur is now picked up and any excess muscle is trimmed from the bone. Holding the femur obliquely over a sharp solid surface, a sharp hit is made with the back of a knife,
or other blunt instrument. This will cause fracture of the femur and expose the marrow for visual inspection and culture if necessary.

**BRAIN:** When dealing with a rabies suspect it not recommended to take out the brain. Submit the entire skull (fresh or frozen) to the Public Health Lab for your area. The following describes how to remove the brain from the skull. The skin and muscles overlying the frontal, parietal and occipital bones are reflected from the surface of the head. Using a saw, a transverse cut is made just behind the orbits. This cut must go down to, but not into the brain parenchyma just behind the ethmoid bone. Now two lateral cuts are made, one on either side of the cranium at the external auricular orifices, to meet anteriorly the first transverse cut. The distal part of these cuts is made dorsal to the occipito-atlanto joints. A blunt instrument such as a chisel is then used to pry off the bony cap, exposing the meninges and brain. Scissors are used to cut and free the meninges and tentorium cerebelli. The brain is removed from the cranial vault by carefully cutting the cranial nerves and hypophysis, beginning at the medulla oblongata. The brain is allowed to gradually fall into the prossector's hand. The brain should be placed on a relatively wet surface; otherwise it will adhere to the dry surface. Gross examination of a fresh brain is not recommended. If only histology is to be done, place the entire brain into 10% formalin. If microbiology is needed cut the brain in half (longitudinally) and place one half in formalin and freeze the rest. If gross lesions are evident be sure to take appropriate measures for additional lab work. See Appendix B for a simpler field technique to remove the brain.

**EYES:** Visual exam of the eyes should have been done during the external examination. One or both eyes may be enucleated for further gross examination and/or collection.

**NASAL CAVITIES:** If necessary, a longitudinal section of the skull, just off the midline will provide a clear view of the nasal cavities and the pharynx. Transverse cuts with a saw may be useful in some species. This is most commonly done in the domestic pig to check for atrophic rhinitis. For this a transverse cut is made through the maxillae at the level of the second premolar tooth, across the nasal septum.

**COMMENTS**
This concludes the examination of the organ systems except for the spinal cord. At the end of each necropsy you should mentally review all the systems to ensure that nothing was forgotten. Tissues for laboratory analyses (histology, bacteriology, mycology, virology, and toxicology) should be collected and set aside during the necropsy. All specimens must be placed in appropriate containers and labeled.

If a uniform technique can be adapted for all, or at least as many species as possible, then the chance of error or failure to perform a complete post-mortem examination will be greatly decreased. The present description stresses the necessity for a complete examination of all organ systems. Obviously this technique applies to fresh carcasses under ideal conditions. Necropsies of decomposed carcasses and necropsies conducted under inclement weather conditions may be abbreviated with the intent of salvaging as much pertinent material as possible.
RECORD

The gross post-mortem examination is not completed until a written record describing all abnormal findings is made and all collected tissues are packaged and labelled appropriately. Don't forget to write down the sex and if possible, an age estimate. Also, record any pertinent information about the circumstances of the death. A photographic record is useful for significant or unusual findings. When photographing lesions be sure to have a ruler or some other reference scale in the picture.

REMEMBER: The results you get from a diagnostic laboratory will only be as good as the quality of your submission. It is up to you to choose, label and preserve specimens in the proper fashion. Also, your written (and photographic) record is the only means of communicating the results of your necropsy to another person.
DISEASES IN WILDLIFE THAT ARE OF HUMAN HEALTH IMPORTANCE

DEFINITIONS
ZOOONOSIS: an infection or infestation shared in nature by man and lower vertebrate animals/birds.
INFECTION: multiplication of microorganisms in the body.
INFECTIONOUS: denoting a disease due to a microorganism.
CONTAGIOUS: communicable, transmission of disease by contact.

VIRAL:
- Rabies ** .................... fox, dog, cat, any mammal
- Contagious ethyma ............... sheep, goat, muskox

BACTERIAL:
- Anthrax ** .................... all mammals
- Brucellosis ** ................. caribou, reindeer
- Tularemia ..................... beaver, muskrat, ground squirrels
- Salmonellosis .................. any mammals, birds
- Yersiniosis .................... primarily muskrat, beaver
  (any mammal/bird)
- Tuberculosis (bovine) .......... primarily ungulates
- Leptospirosis .................. many mammals
- Chlamydiosis .................. primarily birds, also mammals

PARASITIC:
- Echinococcus multilocularis ** ..... foxes, coyote, wolf, dog, cat
- Echinococcus granulosus ** ........ wolf, coyote, dog
- Sarcoptic mange ................ any mammal
- Giardia ........................ beaver
- Toxoplasmosis .................. cat, any mammal
- Baylisascaris spp ............... bears, mustelids, rodents
- Toxocara canis ................ canids

MYCOTIC:
- Ringworm ........................ any mammal

** although it is important to be aware of all the diseases listed above, the starred diseases are of particular significance.
REFERENCES

NOTE: The following references contain excellent material with respect to practical techniques of wildlife disease investigations. Much of the material in this manual has been taken from these references.


