**STANDARDIZED NECROPSY REPORT FOR APES AND OTHER PRIMATES**  
(APE TAG – L.J. Lowenstine, Pathology Advisor)  
**WORK SHEET**

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<td>Sex</td>
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<td>Date of Death/Euthanasia</td>
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<td>Duration of necropsy</td>
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Pathologist or prosector/ institution: ___________________________________________________________
_______________________________________________________________________________________ 

Gross diagnoses:

_____________________________________________________________________________________________

Abstract of clinical history:

______________________________________________________________________________________________

Please check tissues submitted for histopathology.

**External Examination (note evidence of trauma, exudates, diarrhea):**

Hair coat:

_____Skin:

_____Scent glands:

_____Mammary glands and nipples:

_____Umbilicus (see neonatal/fetal protocol):

_____Subcutis (note: fat, edema, hemorrhage, parasites):

    Mucous membranes (note: color, exudates):

    Ocular or nasal exudate?:

_____Eyes and ears:

_____External genitalia:

_____Oral cavity, cheek pouches and pharynx:

    Dentition (see attached dental form):

_____Tongue:
Musculoskeletal System:

Fractures or malformations?:

_____Muscles:
_____Bone marrow (femur):
_____Joints:
_____Spinal column (examine ventral aspect when viscera removed)

Examination of the neck region:

_____Larynx:
_____Laryngeal air sac (see protocol for great apes):

_____Mandibular and parotid salivary glands:
_____Thyroids and parathyroids:
_____Cervical/cranial lymph nodes:
_____Esophagus:

Thoracic Cavity:

Effusions, adhesions, or hemorrhage?:

Mediastinal and coronary fat:

_____Thymus (are there cervical portions as well as antermediastinal?):

_____Heart (see attached protocol):

_____Great vessels (see attached):

_____Trachea and bronchi:

_____Lungs:

_____Esophagus:
_____Lymph nodes:
Abdominal Cavity:

   Effusions, adhesions, or hemorrhage?:

   Omental, mesenteric and perirenal fat:
   
   ____ Liver:
   ____ Stomach:
   ____ Pancreas:
   ____ Duodenum:
   ____ Jejunum:
   ____ Ileum:
   ____ Cecum and (in apes) appendix:
   ____ Colon and rectum:
   ____ Lymph nodes:
   ____ Kidneys and ureters:
   ____ Adrenals:
   ____ Gonads:
   ____ Uterus:
   ____ Bladder and urethra:
   ____ Male accessory sex glands (prostate and seminal vesicles):
   ____ Umbilical vessels, round ligaments of bladder in neonates:
   ____ Abdominal aorta and caudal vena cava:

Nervous System:

   ____ Meninges:
   ____ Brain:
   ____ Pituitary:
   ____ Gasserian ganglia:
   ____ Spinal cord:
   ____ Brachial plexus and sciatic nerves:
WEIGHTS AND MEASUREMENTS (in grams, kilograms, and cm, please):

Body weight: ________________________________

Lymphoid tissue:

Spleen ___________  Thymus ________________

R. axillary LN _______  L. axillary LN _______

R. inguinal LN _______  L. inguinal LN _______

Jejunal (mesenteric) LN _____________

Abdominal Organs:

Liver _________________

R. kidney ____________  L. kidney ______________

R. adrenal ____________  L. adrenal ______________

R. ovary _______________  L. ovary _______________

Uterus (measure 3 dimensions) _____________________________

Placenta (see neonatal protocol) at minimum weigh in toto and measure disc(s) and length of cord):

Thoracic Organs:

Heart _________________  Thymus (above)

Height ______________  Circumference at coronary groove _____________

Left Vent.__________  Rt. vent.___________  Septum__________

Lt. AV valve_______  Rt. AV valve________

Aortic valve_______  Pulmonary valve.________

R. lung _______________  L. lung _______________

Other:

Brain _________________  Pituitary ______________

Thyroids (wt)  Left ___________  Right ___________

Thyroids (3 dimensions) Left_____________  Right___________

Testes (wt.)  Left ___________  Right ___________

Testes Length x dia.  Left ___________  Right___________

Penis (length x diameter) _____________________________

Tumors(?)  Measurements (3 dimensions) _____________  Weight __________
**STANDARDIZED BODY MEASUREMENTS FOR NONHUMAN PRIMATES INCLUDING APES:**

- Crown rump length (linear)
- Crown rump length (curvalinear)
- Cranial circumference (above brow ridge)
- Length of head (tip of jaw to top of crest)
- Width of brow ridge
- Chest circumference (at nipples)
- Abdominal circumference (at umbilicus)
- Left arm: Shoulder-elbow:
  - Elbow-wrist:
  - Wrist-tip of middle finger:
  - Pollex:
- Right arm: Shoulder-elbow:
  - Elbow-wrist:
  - Wrist-tip of middle finger:
  - Pollex:
- Left leg: Hip-knee:
  - Knee-ankle:
  - Ankle-tip of big toe:
  - Heel-tip of big toe:
  - Hallux:
- Right leg: Hip-knee:
  - Knee-ankle:
  - Ankle-tip of big toe:
  - Heel-tip of big toe:
  - Hallux:
ANCILLARY DIAGNOSTICS (CHECK IF PERFORMED, GIVE RESULTS IF AVAILABLE, NOTE LOCATION IF STORED, OR TO WHOM SENT):

Cultures:
  
bacterial:
  
fungal:
  
viral:

Heart blood:
  
serum:
  
filter paper blot:

Parasitology:
  
feces:
  
direct smears:
  
parasites:

Tissues fixed in 10% formalin (list tissues or specific lesions other than those checked above):

Tissue fixed for EM: ________________ Tissue frozen: ________

Impression smears: __________________________________________

Comments (interpretation of gross findings):
NONHUMAN PRIMATE POST MORTEM EXAMINATION

Collection of tissues

Tissues to be fixed in 10% neutral buffered formalin should be less than 0.5 cm thick to allow for adequate penetration of formalin for fixation.

Initial fixation should be in a volume of fixative 10 times the volume of the tissues. Agitation of the tissues during the first 24 hrs is helpful to prevent pieces from sticking together and inhibiting fixation.

If possible please collect two sets of tissues, one for the regular pathologist and one to send to the SSP pathologist for archiving.

Labeling of specimens

If pieces are small or not readily recognizable (eg. individual lymph nodes) they can be fixed in cassettes or embedding bags or wrapped in tissue paper labeled with pencil or indelible ink. Another alternative is to submit lymph nodes with attached identifiable tissue, eg. axillary with brachial plexus, inguinal with skin, bronchial with bronchus, etc.

Sections from hollow viscera or skin can be stretched flat on paper (serosal side down) and allowed to adhere momentarily before being placed in formalin with the piece of paper. The paper can be labeled with the location from which the tissue came.

The formalin container should be labeled with the animal’s name or number, the age and sex, the date and location, and the name of the prosector.

Tissues to be preserved

From the skin submit at least one piece without lesions, a nipple and mammary gland tissue, scent gland, and any lesions and subcutaneous or ectoparasites.

Axillary and or inguinal lymph nodes may be submitted whole from small animals and should be sectioned transversely through the hilus in large primates.

Mandibular, and/or parotid salivary glands should be sectioned to include lymph node with the former and ear canal with the latter.

Thyroids, if it is a small primate, may be left attached to the larynx and submitted with the base of tongue, pharynx, esophagus as a block. In larger primates, take sections transversely through the thyroids trying to incorporate the parathyroids in the section.

Trachea and esophagus and laryngeal air sac sections may be submitted as a block. Cervical lymph nodes may be submitted whole if small or sectioned transversely.

A single sternabra should be preserved as a source of bone marrow. A marrow touch imprint may be made from the cut sternabra and air dried for marrow cytology.

Section of thymus or anterior pericardium should be taken perpendicular to the front of the heart.

Heart: weigh and measure heart after opening but before sectioning. Longitudinal sections of left and right ventricles with attached valves and atria in large animals and the whole heart opened and cleaned of blood clots in smaller animals. In tiny animals the heart may be fixed whole after cutting the tip off the apex.

Lungs: if possible inflate at least one lobe by instilling clean buffered formalin into the bronchus under slight pressure. Fix at least one lobe from each side and preferably samples from all lobes. Small lungs may be infused and fixed in toto.
GI tract: Take sections of all levels of the GI tract including: gastric cardia, fundus and pylorus; duodenum at the level of the bile duct with pancreas attached; anterior, middle and distal jejunum; ileum; ileoceccolic junction with attached nodes; cecum and (in apes) appendix; ascending, transverse and descending colon. Open loops of bowel to allow exposure of the mucosa and allow serosa to adhere momentarily to a piece of paper before placing both bowel section and paper in formalin; or gently inject formalin into closed loops. After samples have been taken for histology it is OK to remove the contents by washing or scraping to further evaluate the mucosa.

Liver: One section should include bile ducts and gall bladder and take sections from at least one other lobe.

Make sure sections of spleen are very thin if the spleen is congested; formalin does not penetrate as far in very bloody tissues.

Mesenteric (jejunal) nodes should be sectioned transversely; colonic nodes may be left with colon sections.

Take sections from each kidney: cut the left one longitudinally and the right one transversely so they will be identifiable.

Fix small adrenals whole and section larger ones (left - longitudinal and right transversely) making sure to use a very sharp knife or new scalpel blade so as not to squash these very soft glands.

Bladder sections should include fundus and trigone. Make sure to include round ligaments (umbilical arteries) in neonates.

Section the prostate with the urethra and seminal vesicles transversely. Section testes transversely.

In small females fix the vulva, vagina, cervix, uterus and ovaries as a block after making a longitudinal slit to allow penetration of formalin. Rectum and bladder (opened) can also be included in this block. In somewhat larger animals make a longitudinal section through the entire track. In large primates make transverse sections of each part of the track and the ovaries.

If gravid: weigh and measure placenta and fetus. Perform a post mortem examination of the fetus. Take sections of disc from periphery and center and from extraplacental fetal membranes. Take sections of major organs and tissues of fetus.

The brain should be fixed whole, or, if too large for containers, may be cut in half longitudinally (preferred) or transversely through the midbrain. It should be allowed to fix for at least a week before sectioning transversely (coronally) into 0.5-1.0 cm slabs to look for lesions. Submit the entire brain if possible and let the pathologist do the sectioning, otherwise submit slabs from medulla, pons and cerebellum, midbrain, thalamus and hypothalamus, prefrontal, frontal, parietal and occipital cortex including hippocampus and lateral ventricles with choroid plexus.

Institutions may elect to send brains to the Great Ape Aging Project.

Fix the pituitary whole. Put pituitary in an embedding bag if it is small. Also remove and fix the Gasserian (trigeminal) ganglia.

Spinal cord - if clinical signs warrant, remove the cord intact and preserve it whole or in anatomic segments (eg. cervical, anterior thoracic etc.)

Take bone marrow by splitting or sawing across the femur, to get a cylinder and then make parallel longitudinal cuts to the marrow. Try to fix complete cross sections or hemi-sections of the marrow.

Take sections of any and all lesions, putting them in embedding bags if they need special labeling.

Remember, it's better to save "too many" tissues than to risk missing essential lesions or details.

This represents a lot of work on the part of the prosector, often under less than comfortable conditions. But the effort expended at the time of the gross post mortem is much appreciated by the histopathologist, and is crucial to our investigations of the causes of morbidity and mortality of free-living nonhuman primate

THANK YOU !!!!!
CARDIAC EXAMINATION FOR APES AND OTHER PRIMATES

Examine heart in situ. Check for position, pericardial effusions or adhesions. Collect for culture or fluid analysis if present.

Remove heart and entire thoracic aorta with "pluck".
   Examine heart again. Check the ligamentum (ductus) arteriosus for patency. Check position of great vessels. Open pulmonary arteries to check for thrombi.
   Remove heart and thoracic aorta from the rest of the "pluck".
   Examine for presence of coronary fat. Examine external surfaces especially coronary vessels. Note relative filling of atria and state of contraction (diastole or systole at death) and general morphology. (The apex should be fairly sharp.)

Measure length from apex to top of atria. Measure circumference at base of atria (around coronary groove).

Open the heart:
   Begin at the tip of the right auricle and open the atrium parallel to the coronary groove continuing into the vena cava.
   Remove blood clot and examine the AV valves and foramen ovale. Cut into the right ventricle following the caudal aspect of the septum and continuing around the apex to the anterior side and out the pulmonary artery. Remove postmortem clots and examine inner surface.
   Open left atrium beginning at the auricle and continuing out the pulmonary vein. Remove any clots and examine valves.
   Open the left ventricle starting on the caudal aspect and following the septum as for the right ventricle. When you reach the anterior aspect, clear the lumen of blood and identify the aortic outflow. Continue the incision around the front of the heart and into the aorta, taking care to cut between the pulmonary artery and the atrium. Open the entire length of the thoracic aorta.
   Remove all postmortem clots. You may gently wash the heart in cool water or dilute formalin to better visualize the internal structures and valves. Examine the foramen ovale for patency.
   Sever the thoracic aorta from the heart just behind the brachiocephalic arteries. Examine intima and adventitia. Please not location and severity of atherosclerotic or fibrous plaques and section aorta for formalin. Sever the pulmonary vessel and vena cava close to the heart. The heart should be weighed without pericardium and after vessels have been cut at above.

Weigh and measure the heart and record (see work sheet).
   Measure height of heart and circumference.
   Measure thickness of right and left ventricles and septum.
   Measure the circumference of the right and left AV valves and the aortic and pulmonary valves.
   Heart weight:
      Prior to weighing
      Remove blood clots (the yellow chicken fat clots can be spun down for serum),
      Sever the aorta from the heart at arch before the brachiocephalic arteries (see diagram below)
      Remove pericardium and anterior and posterior vena cava

Take sections for histopathology or fix the entire heart and send to the SSP pathologist or an MD cardiac pathologist:
   Sections should include:
      Longitudinal sections of left and right ventricles AV valves and atria.
      Sections of myocardium from left and right ventricles including coronary vessels.
      Sections of papillary muscles.
      Sections from the septum at the base of the AV valves (area of conduction system).
      Section of the ascending aorta just above the valves (the most common site of dissecting aneurysms in great apes) as well as sections of descending thoracic aorta and abdominal aorta.
      Sections from any lesions noted.

Fix the entire heart, if possible by emersion in 10% buffered formalin for more detailed examination by a cardiac pathologist.

Other vessels:
   Make sure to open and examine the entire aorta, iliac arteries and popliteal arteries (frequent sites of aneurysms in humans).

   Note the location and severity of fibrous or fatty streaks and overt atherosclerosis. (see diagram)
Branches of the aorta:

A. Aortic root and ascending aorta  
B. Aortic arch  
C. Thoracic aorta/descending aorta  
D. Abdominal aorta  
E. Bifurcation of abdominal aorta to iliac arteries  
F. Common(internal) iliac arteries  
G. External iliac and common femoral  
H. Superficial femoral artery

Please note location of atherosclerosis, aneurysms, dissections or other abnormalities
POSTMORTEM EXAMINATION OF PRIMATE FETUSES, NEONATES and PLACENTAS

The placenta:
Make sure to weigh the fetus and make morphologic measurements.

In addition, measure the placental disc(s) and weigh the placenta.

Describe the placental discs and membranes and the vascular pattern.

Measure umbilical cord length and diameter. If possible, please photograph both sides of the placenta.

The fetus/infant
Follow the general primate necropsy protocol.

Internal examination of the infant:

Note dentition/erupted teeth and carefully examine the palate.

Identify umbilical vein and arteries and check for inflammation. Make sure to save umbilicus and round ligaments of the bladder (umbilical arteries) for histology.

Make sure to save a growth plate (e.g. costochondral junction or distal femur) in formalin.

Before removing the heart from the pluck, open the pulmonary artery to check for patency of ductus arteriosus. Open the lateral side of the right atrium and examine the foramen ovale for patency.

Cultures:
Culture as many of the following as possible (both aerobic and anaerobic cultures if possible):

Stomach content or swab of the mucosa;

lung;
spleen or liver;
placental disc and extra-placental membranes.
POST MORTEM EXAMINATION OF THE AIR SACS OF APES AND OTHER PRIMATES

Examine the skin over the air sac for signs of fistulae or scars. Note thickness of the skin and presence of fat.

Incise the air sac through the skin on the anterior (ventral) aspect.

Note color and texture of air sac lining.

Note presence of absence of exudates, and character of exudate.

Note presence or absence of compartmentalization by connective tissue.

Note extent of air sacs (e.g. under clavical, into axilla, etc.)

Is there a central compartment?

Are the lateral sacs symmetrical (they may vary in size in chimpanzees and bonobos)

Identify and describe the opening(s) from the larynx into the air sac (e.g. single slit-like opening or paired oval openings). Are the openings parallel or perpendicular to the long axis of the larynx and trachea. Note any exudate.

Note the location, size and shape of the opening in the larynx (e.g. from lateral saccules or centrally at the base of the epiglottis).

**Cultures:** Please culture several different sites within the air sacs (we need data to determine if infections are "homogeneous" or compartmentalized).

Diagrams of air sacs to aid in measurements and descriptions.

Gorilla air sacs (From Dixon) Chimpanzee air sacs (From Swindler & Wood)

Information on air sac anatomy is especially important for bonobos as there is nothing in the literature about their air sacs.