

## APPENDIX K

### Bighorn Sheep Disease/Stress/Predators/Research

- I. Disease - Management Tools/Prevention - There are several potential tools that can be used to either prevent disease outbreaks (especially pasteurellosis) in bighorn sheep or to manage outbreaks once they occur.
- A. Prevention of Pasteurellosis (and secondarily, other diseases) - The use of certain management and veterinary techniques as well as following certain guidelines and protocols may prevent outbreaks of disease in bighorn sheep.
  - 1) Translocation - caution should be used when sheep are translocated to insure that diseases are not introduced into disease-free areas. Ways to ensure this include:
    - a. Use monitored source herd - using a source herd for translocation that has been extensively monitored. This requires that a disease monitoring protocol (Appendix I) be developed and that bighorn sheep be periodically captured and tested for all the diseases of concern.
    - b. Monitor herds to be augmented -any herds that will be augmented should be similarly monitored for diseases both before and after augmentation.
  - 2) Preconditioning with appropriate medications (antibiotics) & vaccinations (as available) via pre-baiting - preconditioning of source herds may also help prevent introduction of diseases. This might entail administering antibiotics or vaccinations for several days prior to the sheep being captured. As more work is done, more useful antibiotics and vaccines are likely to become available. Preconditioning might also include feeding animals for several days to weeks to improve body condition prior to transplantation.
  - 3) Appropriate population density- literature review suggests that disease transmission to, from, and between bighorn sheep can be heightened as population density increases. Bighorn sheep population management, designed to maintain sheep numbers below carrying capacity, has been shown to reduce disease transmission.
    - a. Evaluate population objectives and establish population objectives - include disease and stress reduction in consideration. If a post-season population objective has been established for a bighorn herd, critically evaluate that objective, in light of forage availability, population density, and potential disease transmission. If a post-season population objective has not been established, develop one keeping the same factors in mind.
    - b. Adhere to population objectives - once established, bighorn sheep populations can be managed toward objective levels. If below objective, habitat enhancement, predator management, and ram-only hunting seasons can increase population status. If above objective, population size can be lowered via ewe harvest and/or periodic removal of sheep (i.e., trapping for transplanting).
  - 4) Nutrition - bighorn sheep need to be on an adequate plane of nutrition. Malnourished animals are more likely to have starvation-related problems, dietary deficiencies, and are more susceptible to disease. Nutritional concerns include:
    - a. Minimum levels - the minimal levels of nutrients needed by bighorn sheep. This includes energy needs, macronutrient requirements, and micronutrient requirements.

- b. Habitat requirements - there are certain nutritional needs that the habitat needs to provide. When habitat fails to provide these needs, habitat improvements may be necessary.
- 5) Stress management and factors - stress is an important contributor to disease. Factors contributing to stress need to be identified and managed so as to reduce disease susceptibility.
- a. Human disturbance - human disturbance is an important stressor, particularly to bighorn sheep. Human disturbance needs to be identified and reduced when possible, especially at critical times of the year.
  - b. Capture protocol (Appendix II) - capturing animals is always a stressful event. A capture protocol should be designed to ensure proper sampling and proper restraint to minimize stress to the sheep. A standardized capture protocol for wild sheep is being drafted by the Northern Wild Sheep and Goat Council. This protocol should address drop-net, netgun, drive net, chemical immobilization, and other capture techniques. Once finalized, this capture protocol will be customized for use in Wyoming.
  - c. Predator control - predators also cause stress on bighorn sheep and may predispose them to disease. Predator control may help reduce this form of stress.
- 6) Separation of bighorn sheep/domestic sheep
- a. Cooperatively-developed and agreed upon techniques and options, including input from willing permittees:
    - utilize geographic/topographic barriers;
    - alteration (seasonally or spatially) of domestic sheep grazing;
    - habitat enhancement for bighorn sheep, designed to attract wild sheep away from domestic sheep allotments/trailing areas;
    - utilize caution when filling vacant domestic sheep allotments, to minimize possible commingling;
    - utilize caution when transplanting bighorn sheep (new transplants or augmentation of existing bighorn populations), to minimize possible commingling;
    - conversion of grazing allotment use from domestic sheep to cattle (when appropriate and subject to other resource constraints);
    - relocation of domestic sheep use to other allotment(s), including those currently closed or vacant, where chance for co-mingling is much reduced;
    - negotiate financial incentives for permittees to waive domestic sheep grazing allotments back to USFS.
  - b. Response when bighorn and domestic sheep commingle:
    - if there is known, suspected, or highly probable contact, wandering bighorns should be live captured and transferred to Sybille; if live capture can not be accomplished, bighorn(s) should be killed and transferred to WSVL as soon as possible; WGFD Wildlife Division administration (or Director's office, if necessary) should formalize internal procedure (Appendix III) on removal of wandering bighorns that meet above criteria;

WGFD I&E personnel could assist in getting the message out to the public on the necessity of such action(s);

- there should be immediate, mutual, two-way notification of wandering bighorn and domestic sheep sightings (outside of normal, expected ranges and times of year) and disease outbreaks; WGFD field personnel should meet with domestic sheep permittees with allotments in or near core, native bighorn herds, determine when domestic sheep are scheduled to be off of national forest allotments, and agree on a common-sense protocol for removal of stray domestic sheep after turn-off dates have passed; WGFD and USFS should also predetermine appropriate responses in the event of comingling, including inside designated wilderness;
- WGFD and USFS should develop and distribute informational brochure/flyer asking hunters, outfitters, X-country skiers, wildlife photographers, etc. for immediate notification of sightings of wandering domestic sheep, after specific dates when domestics should be off forest allotments; also, recreationists who observe bighorn sheep in unusual locations should also report those sightings;
- domestic sheep producers should instruct and encourage herders not to leave living sick domestic sheep behind when trailing or moving from or between allotments.

6) Veterinary techniques - there are certain veterinary techniques available that can be used to prevent Pasteurella outbreaks among bighorn sheep.

- a. Vaccination - bighorn/domestic sheep - vaccination against Pasteurella and predisposing bacteria and viruses may prevent an outbreak. Vaccination could be used on the bighorn sheep themselves to build up herd immunity. In addition, if vaccination were used on domestic sheep, it may prevent them from carrying strains of pathogens that cause disease in bighorn sheep.
- b. Wormers-oral (external and internal parasites) - deworming may help eliminate predisposing conditions. Lungworms in particular may predispose to pasteurellosis. Bighorn sheep are also particularly susceptible to mites, which could be controlled with an anthelmintic program. Putting the dewormer in oral bait would probably be the easiest route of application.

8) Genetic resistance - some sheep may have a genetic resistance to certain diseases. These sheep need to be identified and tested to determine the extent of this resistance. Different methods need to be developed to analyze sheep for chronic stress.

9) Inbreeding - inbreeding often results in suppressed disease immunity. Populations should be monitored to insure genetic heterozygosity.

B. Control-Outbreak When an outbreak does occur in bighorn sheep, certain procedures need to be followed to document and control it. A summary report on what actions to consider when a disease outbreak occurs is also being drafted by the Northern Wild Sheep and Goat Council. When finished, this protocol (Appendix IV) could be customized for Wyoming use.

- 1) Accurate diagnosis - any dead animals should be necropsied before tissues begin to decay. Ideally, the carcass will be transported to the Wyoming State Veterinary Laboratory in Laramie where a complete necropsy can be performed. If this is not possible, a complete necropsy protocol (Appendix V) should be followed by trained personnel in the field

- 2) Removal of diseased sheep - diseased bighorn sheep need to be removed to eliminate them as a source of disease to other sheep. This can be accomplished in two ways: the animal can be euthanized and necropsied as above, or they may be transported to a holding facility (e.g. Sybille) and quarantined and/or treated.
- 3) Antibiotics-new drugs - newly developed antibiotics and other drugs may have the potential to help control an outbreak. This needs to be investigated
- 4) Isolation of affected herds - herds that are, or have recently been, affected by an outbreak need to be isolated from other herds. We need to insure that management doesn't allow animals from diseased herds to join disease-free herds.
- 5) Minimization of stress - during an outbreak, affected herds need to experience, as little stress as possible.
- 6) Vaccination - vaccination may help control an outbreak. This needs to be investigated.
- 7) Other factors - other factors may have an affect on the severity of an outbreak. This may include water availability, temperature extremes (either hot or cold), and other environmental conditions. While there is little we can do to control these factors, we recognize that they may have significant effects.

### C. Management

- 1) Habitat-habitat management and improvement can enhance nutritional status of bighorn sheep, facilitate use of unoccupied ranges, increase separation and decrease possibility of interaction between bighorn and domestic sheep.
  - a. Maintain or re-establish migration corridors to facilitate expansion and use of bighorn sheep habitats; however, be cognizant of facilitating bighorn sheep movement if that movement could increase potential/likelihood of commingling with domestic sheep. Identify, evaluate, and improve currently unoccupied bighorn habitats that are not occupied by domestic sheep to increase separation and decrease interaction of domestic/bighorn sheep.
  - b. Prevent/reduce timber encroachment on bighorn sheep seasonal ranges, particularly crucial winter ranges and lambing areas; timber removal for commercial purposes, post- and pole-sales, firewood, other forest products, etc. should be evaluated, along with prescribed burning option. Important bighorn habitats where fire is needed for management of desired vegetation should be identified and incorporated into fire management programs of private and public landowners.
  - c. Forage production- forage quality, quantity, and availability are important factors in bighorn sheep habitat management, and can be enhanced by a variety of techniques.
    - Prescribed fire, particularly within designated wilderness areas, is an essential component of bighorn sheep habitat management; more widespread use of prescribed fire could attract bighorn sheep away from areas of potential commingling.
    - Pitting and other mechanical treatments to create micro-habitats, reduce competing vegetation, and enhance water retention, to improve habitat quality and quantity.
    - Fertilizing to stimulate production of desired forage species.

- Spraying herbicide treatments of noxious weeds (e.g., Dalmatian toadflax) on important bighorn ranges, including inside designated wilderness areas, can allow optimal growth of desired vegetation
  - Seeding desired forage species.
- d. Managed grazing can enhance bighorn sheep forage quality and quantity, if done at the right time, intensity, and frequency.
- e. Water development is not a high priority need for bighorn sheep in Wyoming, although occasional development could enhance bighorn distribution, and move competing wildlife (e.g., elk) and livestock away from preferred bighorn foraging areas.
- 2) Population control - once population objectives are established, bighorn sheep populations can be managed toward objective levels. If below objective, habitat enhancement, predator management, and ram-only hunting seasons can increase population status. If above objective, population size can be lowered via ewe harvest and/or periodic removal of sheep (i.e., trapping for transplanting).
- 3) Nutritional & mineral supplementation - adequate nutrition and mineral intake may render animals better able to resist disease. We may have the potential to reduce disease occurrence by providing protein blocks and mineral (vitamin E and selenium) supplementation. Mineral supplements (for domestic and wild sheep) could possibly be used to increase separation distances.

## Stress

- D. Environmental factors - Persistent high or low precipitation and high or low temperatures can stress sheep. Such stress can result in increased susceptibility to disease, decreased reproduction, or decreased growth. Although little can be done about the weather, monitoring weather conditions could predict increased probability of disease outbreaks.
- E. High quality habitat - Improved habitat equals improved nutrition, which improves health status of bighorns, thereby minimizing effects of stress. Improved habitat and health results in better mobility of bighorns, heightening escape from predators as well as possibly pioneering into new habitats.
- F. Minimize disturbances - continual disturbances of any sort can disrupt feeding and movement patterns of sheep resulting in chronic stress.
- 1) Predators - pressure due to predators constantly preying on a sheep herd can cause chronic stress. If feasible and warranted, predators should be managed to decrease such stress.
  - 2) People (e.g., winter range/lambing area closures, etc.) - constant human encroachment in the form of hikers, offroad vehicles, and pets are chronic stressors for sheep. Human interaction should be minimized, if warranted and feasible, to decrease these stressors.
  - 3) Capture protocol - adopt capture protocol (Appendix II) developed by NWSGC to minimize stress on captured bighorns.
  - 4) Surveying/monitoring protocol - a protocol (Appendix VI) should be developed to minimize stress/ disturbance to bighorns when doing survey work (i.e., helicopter classifications, snow machine/ground-based surveys);
    - fly at minimum above ground level-height or survey at minimum ground distance necessary to accomplish survey objectives;
    - minimize time spent surveying any particular group(s) of sheep;

- try to fly or do ground surveys on days when ambient air temperature is above 0°F.

G. Control pre-disposing diseases and parasites - Healthy sheep are better able to fend off new infections. If feasible, sheep should be managed to be as healthy as possible.

- 1) Viruses - viral disease may be controlled if prophylactic vaccines could be developed and administered.
- 2) Lungworms and internal parasites - parasites, such as lungworm, can predispose sheep to pneumonia. Lowering this parasite load by treating sheep with medicated feed or the like could reduce the incidence of pneumonia.
- 3) Other bacteria - some bacterial diseases may be controlled by providing sheep medicated feed.
- 4) External parasites - external parasites can damage hair coats, increase energy expenditure, and promote bacterial disease. Some external parasites may be controlled by providing medicated feed.
- 5) Nutritional deficiencies - sheep need to be on a good plane of nutrition to maintain healthy immune systems. Thus, range management is critical.
- 6) Toxic diseases (poisonous plants) - some plants are toxic to sheep. Sheep reintroduced to a new area may not be able to initially locate their desired forage and be forced to graze on toxic plants.

#### E. Other ungulates

- 1) Habitat/forage competition - if other wild ungulates are competing for limited forage with bighorn sheep, implement off-site habitat improvement projects specifically designed for those ungulates to entice them elsewhere. Enhanced forage production for domestic sheep, well separated from bighorn sheep range, can also be an effective management tool to minimize commingling.
- 2) Disturbances- both wild and domestic ungulates may adversely affect bighorn sheep distribution and habitat use, from forage competition and social intolerance.
  - a. Elk - (same as above, but also reduce elk numbers on overlapping important habitats via sport harvest).
  - b. Wild Horses- manage wild horse numbers to Appropriate Management Levels (AML) as determined in various BLM land use plans.
- 3) Disease - other ungulates, such as deer or mountain goats, could transmit new diseases to sheep. Such species should be periodically monitored for the presence of potential diseases and, if possible, prevented from interacting with sheep.

#### Predators

H. Evaluate Past Efforts -In 1947-1950, predator control was conducted on Whiskey Basin. There probably were other instances where predator control was conducted to benefit bighorn sheep. In 1989 Dan Thiele of WGFD wrote a report (Appendix VII) on predator control efforts. These need to be evaluated to determine if predator control may help some of our current bighorn sheep units.

I. Mortality - Predators obviously can have an effect by causing direct and indirect mortality to bighorn sheep. Predators may have the biggest effect on lambs and may reduce lamb survivability and recruitment.

C. Predator control- prior to beginning predator control, a bighorn sheepspecific literature review on predation should be done, perhaps through the Wyoming Cooperative Fish and Wildlife Research Unit, funded by ADMB or other cooperators.

D. Influence of predators on commingling - Predators may cause, or contribute to, commingling of domestic and bighorn sheep. Domestic sheep grazing most federal lands in Wyoming tend to have strong innate flocking instincts and are herded. When predators attack a herd, domestic sheep may scatter in their attempts to escape. Strays, separated from these herds, may then come in contact with bighorn sheep. Likewise, predators may cause bighorn sheep to disperse off of their ranges and into areas occupied by domestic sheep.

#### IV. Research Topics

##### A. Disease/Health

###### 1) Veterinary tools and techniques

- a. Vaccination - Pasteurella - bighorn/domestic sheep - research needs to be conducted on developing and implementing vaccines that prevent Pasteurella pneumonia both in wild and/or domestic sheep. Vaccines could limit the spread of disease from domestic sheep to wild sheep (and vice versa) and limit disease spread within sheep herds.
- b. Vaccination - Other - if viral diseases are identified that threaten sheep health, specific vaccines and methods of administering them need to be developed.
- c. Parasite control - effective methods of treating wild sheep for parasites need to be developed. This could be done through medicated feeds or licks.
- d. Antibiotic treatment of bighorn sheep during outbreak - treating sheep during a disease outbreak may serve to diminish overall losses. However, effective treatments and delivery methods must be developed and tested.

###### 2) Preconditioning translocated bighorn sheep - preconditioning is a process used by domestic producers to treat animals before shipping or other stressors to decrease the incidence of disease. Research is needed to determine if translocated bighorn sheep may benefit from being held in captivity for a period of time for preconditioning, prior to release in the wild.

- a. Sedative - long-term sedatives might be developed that would decrease the stress on translocated sheep. Decreased stress will result in decreased disease.
- b. Vaccination - sheep held for preconditioning could be given an array of vaccines for viral and bacterial pneumonia diseases. Adverse responses to vaccines could be monitored and treated while sheep are being held.
- c. Thorough disease monitoring - sheep held for preconditioning could be sampled for existing diseases. Blood could be analyzed for several viral/bacterial diseases and feces examined for parasites. Identified diseases could then be treated.
- d. Low-level exposure to resident sheep - it may be beneficial to expose captured wild sheep (for translocation) to a few resident bighorn sheep or domestic sheep

for low-level disease exposure. This could allow wild sheep to develop an immune response that could be beneficial for more serious pathogen exposure.

### 3) Monitor captured bighorn sheep for diseases and parasites

- a. Adopt and use protocol - a protocol (Appendix VIII) should be developed and adopted that will detail uniform methods and samples that should be routinely collected for disease analyses when sheep are captured.
- b. Type *Pasteurella* spp. isolates - there are different kinds of *Pasteurella* pneumonias. Isolates of the different bacteria need to be identified and typed.
- c. Bank isolates for future reference - all *Pasteurella* isolates should be stored for future reference and research.

### 4) Genetic resistance (N-ramp, etc.) - some sheep may have a genetic resistance to certain diseases. These sheep need to be identified and tested to determine the extent of this resistance. Different methods need to be developed to analyze sheep for chronic stress.

### 5) Monitor domestic sheep - likewise, domestic sheep should be monitored. Blood samples and nasal/oropharyngeal swabs should be taken when practical. Any *Pasteurellas* isolated from domestic sheep should be typed to see if they are pathogenic for bighorn sheep.

- a. Banked samples - when adult sheep are handled, they should be bled. Any serum not needed for immediate testing should be banked (frozen and saved for future testing if needed).
- b. Breed specific - certain breeds of domestic sheep are more likely to come in close contact with bighorn sheep. Monitoring of domestic sheep should include data on the breed so we can learn if certain breeds of domestic sheep are more likely to carry diseases of concern for bighorn sheep.
- c. Management styles (shed lambing vs. range) - there are two main styles used by domestic sheep growers for lambing of sheep. Some producers allow lambing to occur in the range, while others bring sheep into sheds for lambing. These lambing styles should be monitored to discover if either is more prone to be associated with infectious disease-related issues.
- d. Status of past collected samples - samples have been collected from bighorn sheep and domestic sheep. The results of past collections need to be summarized, and the location of any banked samples needs to be discovered.

### 6) Stress

- a. Fecal cortisol - some animals excrete a stress hormone which can be detected in their feces. This needs to be examined in sheep under controlled conditions and then applied to field studies. This would be a remote method of determining if sheep were stressed without having to capture and sample them.
- b. Examine effect of tranquilization - long-term tranquilizers that could decrease stress in translocated sheep need to be developed and tested. Such tranquilizers have been shown to decrease disease and injury in other species.



## B. Nutrition/Habitat/Predation

### 1) Nutrition

- a. Macro and micro nutritional requirements - disease resistance is directly proportional to a healthy immune system and the immune system is proportional to a good diet. We know very little about the nutrient requirements of wild sheep. Some nutrients are required only in small amounts (trace nutrients), but are critically important to overall sheep health. Studies need to be conducted to determine these nutrients and how best to insure that sheep obtain adequate amounts in the wild.
- b. Evaluate protein/mineral supplements (blocks) - trace minerals are effectively provided to domestic animals by mineral blocks or licks. Such blocks need to be developed and tested on wild sheep.
- c. Carrying capacity - sheep populations and their range need to be monitored to insure that sheep don't exceed the carrying capacity of their habitat, resulting in decreased nutrition and increased susceptibility to disease. Research on how habitat improvements influence nutritional status and health indicators (e.g., body size, body condition, lamb birth weights, survival to adulthood, age of first reproduction, etc.) of bighorn sheep would be an important step in prescribing management strategies/priorities.

### 2) Habitat

- a. Monitor and evaluate translocated sheep
  - Follow-up surveys, etc. - as much as manpower and funding constraints allow, radio-collared bighorn sheep should be relocated and closely monitored following translocation, with specific emphasis on habitat and forage selection by newly-released bighorns.

### 3) Impact of predation on bighorn sheep

- a. Review existing information (as described above in III.C.).

## C. New Technology

- 1) Habitat monitoring - there are many new technologies in place or in development that are used for other purposes but could be used to better manage wild sheep populations. Remote sensing techniques (e.g., NASA satellites or others) may be able to determine forage types and extent in sheep ranges. Such information could be more rapidly obtained and more accurate than current methods.
- 2) Sheep monitoring - the use of Global Positioning System (GPS) collars could be used to document bighorn sheep movements. Although currently this technology is expensive (\$2,000/ collar), GPS collars can provide information unequalled by any other technique, and acquisition of data requires very little additional effort or expense.

## LIST OF APPENDICES

- I. Disease monitoring protocol for bighorn sheep populations
- II. Bighorn sheep capture protocol
- III. WGFD procedures for removal of bighorn sheep commingling with domestic sheep
- IV. Bighorn sheep disease outbreak control protocol
- V. Bighorn sheep necropsy protocol

- VI. Bighorn sheep population surveying protocol
- VII. White paper on wildlife related predator control, Thiele, 1989
- VIII. Captured bighorn disease sampling protocol

## BIGHORN SHEEP NECROPSY PROTOCOL

**Introduction.** Anytime a bighorn sheep dies naturally or is euthanized for management reasons, a thorough necropsy should be performed. Preferably, the entire carcass would be shipped to the Wyoming State Veterinary Laboratory (WSVL) so the necropsy can be conducted under controlled conditions (arrangements for delivery should be made with Hank Edwards of WGFD (307) 745-5865 or directly with WSVL (307) 742-6638). At times it is nearly impossible to deliver an intact carcass. When this occurs, trained personnel should perform field necropsies. This appendix is meant to serve as a check list and reminder of the tissues that need to be collected on field necropsies of bighorn sheep.

**Methods.** Please follow and fill out the necropsy form provided (additional forms available from Walt Cook at WSVL). Relevant animal information should be noted (location, disease history etc.). When possible, the animal can be weighed. Hair coat quality should be subjectively estimated. The hair coat should be thoroughly examined, and any external parasites noted and collected in a container filled with ethyl alcohol. Body muscle condition can be subjectively estimated on a scale of 0-5 (0=very poor; 5=excellent condition). Incisions can be made along the back at 1) tail base 2) cranial to hind quarter and 3) above the shoulder. Body fat is scored as follows: 0= no fat seen, 5= fat seen at 1 only, 10= fat seen at 1&2, 15= fat seen at all 3 locations. A subjective body condition can also be assigned (excellent, very good, good, fair, poor, very poor, emaciated).

The animal will then be opened per normal necropsy technique. The amount of fat may be measured (in mm) on the heart, kidneys, omentum and xyphoid. A femur may be cracked and the bone marrow examined for color and texture and taken for histology. Standard tissues should be sampled for histology; tissues need to be placed in a leakproof container with plenty of 10% formalin (these are called "fixed" tissues). Be sure to sample at least 5 different areas of the lung. Any abnormal appearing tissues should be sampled for further evaluation at WSVL. A description of the abnormal tissue should be included on the necropsy form. Photographs of lesions/abnormalities are also useful.

All bighorn sheep should have fresh lung taken for virus isolation and microbiological culture. Fresh tissues should be sampled using sterile or very clean technique. This is best accomplished by dipping clean instruments in 70-90% ethyl alcohol and burning the alcohol off over a flame. Do not touch any of the tissues directly with your hands, but place the tissue in a Whirl-pak® bag with the forceps. At least two separate bags containing lungs should be provided. Do not add any preservatives or other material to the bag; only one tissue sample should be placed in each bag. Collapse the bag to expel all air and hold the tabs with your fingers and tightly turn the top of the bag at least four times. Bags, tubes, and containers need to be labeled with indelible ink (e.g. Sharpie(D pens). All bighorn sheep should also have their tonsils sampled. This is done by swabbing the tonsil with a sterile culture swab and placing the swab in a Port-A-Cul™ media tube (available from Hank Edwards).

Blood may be taken for complete blood counts (CBC), serum chemistries, trace mineral analysis, and/or serologic testing for antibodies to relevant diseases. Blood can be taken directly from the heart or from the jugular vein. Ideally, each sheep will have 2 red top blood tubes filled to the top (1 for serology, 1 for trace minerals) and 1 green top (for selenium). If zinc is a concern, a royal blue top tube will need to be filled in place of one of the red top tubes (these tubes are very expensive and not routinely used-contact Hank Edwards or WSVL if you need these tubes). If CBCs and blood chemistries will be performed, a purple top tube will need to be filled as well. If the animal has been dead for more than a couple hours, it will be extremely difficult to obtain quality blood samples.

The lower middle two incisors (I1) may be pulled for cementum annuli aging; alternatively ages can be estimated by tooth replacement and wear and/or horn ring counts. Fecal samples need to be taken to determine parasite loads; this can be accomplished by placing 5-6 inches of the terminal rectum containing at least 20 pellets in a Whirl-pak® bag. Using long Q-tip type swabs, swab deep around the inside of both ears and put the swabs in Whirl-pak® bags. A piece of the ear should also be put into formalin for microscopic examination for mites. Using a culturette, swab deep in the nose and return swab to its housing. Be sure to crush the bottom to release the preservative. **All tissues should be kept cool, but not allowed to freeze.**

The entire gastrointestinal tract should be opened and thoroughly examined, and the type and number of macroscopic parasites recorded. Internal parasites may be preserved in 5% formalin (mix 10% formalin with an equal part water). Other tissues (liver, kidney, brain, rumen contents) should be saved and stored for future testing (e.g. toxicology and mineral analysis). The uterus of ewes should be opened

and the number, sex, weight, crown-rump and crown-nose length of all fetuses recorded. If the herd has had reproductive problems, fetal tissues should be taken fresh and for histology.

We recognize that this protocol is somewhat idealistic. In field situations available personnel may not always have the instruments, expertise, or time to conduct thorough necropsies. When this is the case, remember that it is most important to sample lungs (fresh and fixed) and to provide fresh liver if minerals (especially selenium) are a concern.

**Shipping.** Tissues need to be shipped to WSVL as soon after the necropsy as possible (this is very important for fresh tissues and blood samples). It is preferable for samples to be personally delivered to WSVL. If you choose to ship fresh samples or blood via the US Mail, UPS, or Fed Ex special regulations apply. All samples must be double bagged, the shipping carton must be insulated and protected by an outer fiberboard box. Extra spaces in the box should be filled with newspaper or paper towels. Add frozen ice packs to the package and place all paperwork in a separate plastic bag and put it on top of the insulated container lid. It is best to avoid shipping over a weekend; keep the package in a refrigerator until Monday. If you have further questions, contact Hank Edwards or the WSVL at the numbers above or look on the web: <http://wyovet.uwyo.edu>.

### Bighorn Sheep Necropsy Form

Herd name/location \_\_\_\_\_ Animal id (if any) \_\_\_\_\_

Location: Township \_\_\_\_\_ Range \_\_\_\_\_ Section \_\_\_\_\_ or UTM \_\_\_\_\_

WSV Accession # \_\_\_\_\_ Date of necropsy \_\_\_\_\_

His to' /signs of disease prior to death:

Estimated Age \_\_\_\_\_ Sex \_\_\_\_\_ Weight (if available) \_\_\_\_\_

Hair coat quality:      Excellent      Good      Fair      Poor      Very poor

Species and number of external parasites: \_\_\_\_\_ Collected? \_\_\_\_\_

Body muscle (0-5)      Back fat score: 0      5      10      15

Mm Fat on: Heart \_\_\_\_\_ Kidneys \_\_\_\_\_ Omentum \_\_\_\_\_ Xyphoid \_\_\_\_\_

Bone Marrow Color \_\_\_\_\_ Texture \_\_\_\_\_ Subjective Body Condition: \_\_\_\_\_

Internal Exam Notes:

Species and number of internal parasites: \_\_\_\_\_ Collected? \_\_\_\_\_

# Fetuses: \_\_\_\_\_ Weight: # 1: \_\_\_\_\_ #2: \_\_\_\_\_ Sex: # 1: \_\_\_\_\_ #2 \_\_\_\_\_

Crow-Rump: #1: \_\_\_\_\_ #2 \_\_\_\_\_ Crown- nose # 1: \_\_\_\_\_ #2: \_\_\_\_\_

**Tissues fixed:**

Heart  
Liver  
Spleen  
Lung  
Tongue  
Muscle  
Kidneys  
Rumen  
Reticulum  
Omasum  
Abomasum  
Ileum'  
Gonads  
Brain  
Pancreas  
Ileocecal LN  
Bladder  
Bone Marrow  
Retropharyngeal LN  
Ear Notch  
Tonsil  
Placenta

**Tissues taken for laboratory evaluation:**

Fecal (parasitology)  
Blood (red tops) x2  
Blood (green top)  
Blood (purple top)  
Teeth (both I Is) for aging  
Lungs  
Tonsil swab in Port-A-Cul  
Liver  
Kidneys  
Brain  
Rumen contents  
Feces  
Fat  
Nasal Swabs  
Ear Swabs  
  
**Fetal Tissues Fixed:**  
Liver  
Spleen  
Kidney  
Lung  
Brain

**Others (list):**

**Fetal Tissues Fresh:**

Kidney  
Eyeball  
Abomasum  
Spleen  
Liver  
Lung  
Placenta