

Wild Sheep Capture Guidelines

Sponsored by:

Northern Wild Sheep and Goat Council
and
Desert Bighorn Council

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[These guidelines are dedicated to all those individuals that have tried to put wild sheep
in available habitat, or have tried to keep them there...C.L. Foster]

TABLE OF CONTENTS

INTRODUCTION	215
REQUIREMENTS FOR TRANSPORT OF BIGHORN SHEEP FROM CANADA TO THE U.S.	216
U.S. FEDERAL IMPORT PERMITS	217
CANADIAN CERTIFICATES OR PERMITS	218
STATE PERMITS	218
OTHER IMPORTANT CONTACTS/CONSIDERATIONS	219
ANIMAL HEALTH AND STANDARD TESTING	219
VITAL SIGNS FOR WILD SHEEP	219
MEDICATIONS, VACCINES AND TREATMENTS	220
ROUTINE TREATMENTS	220
EMERGENCY TREATMENTS	221
HEALTH TESTING REQUIREMENTS	223
BLOOD TAKING/TESTING	224
PASTEURELLA SAMPLING	225
FECAL SAMPLING	225
CAPTURE AND HANDLING PROCEDURES	226
METHODS OF CAPTURE	226
SAFETY	228
COMMENTS COMMON TO ALL METHODS	229
CAPTURE METHODS	232
NET GUN	233

DROP NET	235
LINEAR DRIVE NET	236
CORRAL TRAP	236
CHEMICAL IMMOBILIZATION	237
TRANSPORT	238
RELEASE	240
PERSONNEL ASSIGNMENTS AND DUTIES	240

LIST OF TABLES

Table 1. Vital signs for wild sheep	247
Table 2. Health tests recommended by the western association of fish and wildlife agencies, western wildlife health cooperative, 2002.	248
Table 3. Optional health tests for wild sheep.	250
Table 4. Personnel assignments for wild sheep capture methods.	251

LIST OF FIGURES

Figure 1. Example of label for wild sheep samples	251
Figure 2. Wild sheep capture base camp	252
Figure 3. Wild sheep capture drop net layout	253
Figure 4. Wild sheep capture linear drive net set up.	254

LIST OF APPENDIXES

Appendix 1. Equipment List	256
Appendix 2. Contact Personnel	258
Appendix 3. Blood Taking Protocol by Dr. Helen Schwantje.....	260
Appendix 4. Examples of Data Record Forms	265
Appendix 5. Plans – Oregon Sheep Transport Box	268
Appendix 6. Plans – Arizona flight box	273
Appendix 7. Design – Hobbles	279
Appendix 8. Design – Blindfold	280
Appendix 9. Design - Helicopter Transport Bag	282

WILD SHEEP CAPTURE GUIDELINES

INTRODUCTION

The need for this document was identified at the 2nd North American Wild Sheep Conference (1999). It is intended to provide a set of guidelines for capturing and relocating wild sheep. The document covers capture operations and permit requirements for capturing and importing sheep from other states or Canada. Reasons to catch wild sheep vary from needing to catch one or two individuals that have strayed from their range to catching many individuals for marking, research or transplant. Therefore procedures identified in this document will not apply to every capture or will need modified depending on the situation. The document provides activities or considerations various agencies have used to catch wild sheep. The Northern Wild Sheep and Goat Council (NWSCG) and Desert Bighorn Council (DBC) hope that future capture operations will benefit from these guidelines.

Wild sheep are the only North American species for which the prevention of disease is a constant consideration in management activities. Many aspects of wild sheep disease are poorly understood. For that reason it is important that the recommended health tests identified in the document be completed. If we ever understand the various aspects of disease in wild sheep it will be because those of us that catch sheep collected samples and had them analyzed. If funding is tight collect the samples and store them in case future analysis is needed.

PRE-CAPTURE PROCEDURES

Preparation should start at least 6 months in advance. If the capture site is in another state, or nation permission to capture must be received before any planning starts. The process to secure permission to capture, or clearance for the release site, may take several months to several years to negotiate. After approvals have been secured, the following activities should be reviewed and those applicable, completed. One individual should be assigned to complete these duties. This individual should become the Capture Boss described later in this document.

- 1.) Select actual capture site(s), number, sex and age of sheep to be caught and method of capture. Compile any historical herd health information for the source herd. If no herd health information exists it may be possible to substitute information from other ungulates in the same herd range as the source herd. This must be done several months in advance to prepare the capture contract (if necessary), select a capture contractor, develop Foundation for North American Wild Sheep (FNAWS) Grant In Aide request or other funding sources, and order radio collars.
- 2.) Select release sites and the number, sex and age of sheep to be released at each site. Determine ear tag color, type, and size to be used on each release site. Color should be different than colors used on previous releases in the same district/drainage/area in case the sheep do not stay where they are released. Determine radio collar needs. Order radio collars with frequencies assigned to each release site. Make sure frequencies do not overlap with other radio marked species in the area.
- 3.) Assign a wildlife veterinarian to assist with the capture, transport and release. If the agency completing the capture does not have a wildlife veterinarian on staff, develop a personal

service contract with a private practice veterinarian. The veterinarian selected should have experience with large ruminants.

- 4.) Identify and secure required permits for capture, transport and release.
- 5.) Determine which samples are to be collected during capture. Decide which tests are required or desired, and how much blood must be taken. Contact the labs you will use and ask them if they require any special handling of samples. On new capture sites, a full complement of tests on each adult sheep is recommended. On capture sites that have a recent sampling history for herd health, less testing (50%) is adequate for collection of herd health data.
- 6.) Assemble sample kits just prior to capture. Contents of the kits are determined by capture method and selected herd health tests. Coordinate the contents with your veterinarian.
- 7.) Develop a data record form with details applicable to the project.
- 8.) Most of us catch sheep in the colder climates of North America when animals are concentrated on winter range. Desert bighorn biologists often catch sheep when temperatures exceed 100°F. Throughout the various sections to follow we will use the term: Hot Climate Considerations for desert bighorn captures or periods of unseasonably warm weather during northern captures. Keep in mind that a period of 65°F weather during a January capture in Oregon when sheep are in winter coat can result in as many heat related stress problems as a 100°F September capture in New Mexico.
- 9.) Whether you are running a large New Mexico style netgun capture with 50 people or 2 biologists need to clover trap and mark 4 Dall Sheep in the Yukon, plan each step of the capture and handling process. Strive for efficiency and reduced handling time. Capture operations are the glamour duties we all dreamed about when we decided on a wildlife career. There will always be more people that want to help than duties. Don't let the desires of all those willing helpers compromise the health of the sheep.
- 10.) The best place for a captured sheep during an operation is in the transport vehicle, away from people. It is easy to get carried away with sampling, treatments or handling. Critically review each planned activity to ensure it is needed and will not substantially increase handling time and animal stress. A certain amount of animal handling is necessary, but unnecessary activities will only compromise the health of captured individuals.

REQUIREMENTS FOR TRANSPORT OF BIGHORN SHEEP FROM MEXICO OR CANADA TO THE U.S.

Requirements for importation of sheep from Mexico or Canada are not terribly complicated, but start the permit process, making phone calls, and working on permit logistics at least 2 months ahead of time. Things start to get busy about 3 weeks ahead of the capture as you are working on trapping and permit logistics. Before starting the permitting process, decide which Port of

Entry will be used, because it will be a factor in some of the permits needed. Establish a good contact within the wildlife agency managing the source herd to help with their export requirements.

U.S. FEDERAL IMPORT PERMITS

**U.S. Department of Agriculture,
Animal Plant Health Inspection Service**
Veterinary Services, National Center for Import and Export
4700 River Road, Unit 38
Riverdale, MD 20737-1231
Contact person: Betsy Sillers (301) 734-8145
Fax (301) 734-6402

Lead time – approx. 3 weeks, longer if holidays are included. The permit is good for a 14 day period and can be extended.

Submit VS FORM 17-329 Application for import or in transit permit. Forms are available at www.aphis.usda.gov

Requirements for U.S. Entry (These will be listed in a letter accompanying your federal import permit and normally include)

- 1.) Health certification by a veterinarian accredited in the province of origin.
- 2.) Brucellosis testing. Card test for *B. abortus* and compliment fixation or ELISA for *B. ovis*. The test must be completed before the sheep can cross the border. Can be done at any USDA or Canadian Food Inspection Agency (CFIA) accredited lab. Currently there is no lab in western Canada that can do these tests. You will have to airfreight or fly the samples to an USDA accredited lab. State Department of Agriculture Labs are USDA accredited. Make sure they have a current USDA, APHIS **Controlled Material or Organism permit**, which is shipped with the samples and, required to get animal samples into the country. Most labs that commonly analyze serum will have this permit. If they have the permit you will need a copy to be shipped with the serum. If they do not have the permit request they get one from the USDA, APHIS address shown above. In case of inaccurate results, positives or incompletes, ensure you have a backup plan with the source herd managers and wildlife veterinarian. This is critical to avoid long delays during transport.
- 3.) Treatment of each animal with ivermectin or one of the benzimidazoles, fenbendazole, oxfendazole, and albendazole.

U.S. Fish and Wildlife Declaration for Importation or Exportation of Fish and Wildlife: Form 3-177.

Fill out and leave at port for USFWS Wildlife Inspector along with Provincial Sundry Permit (Canada).

Contact person will depend on the Port of Entry you choose. Ask the Port Veterinarian for the name and contact number of the Wildlife Inspector. Contact the Wildlife inspector before the capture to start the 3-177 permit process. Forms are available at <http://permits.fws.gov>

Entry at a port not approved for importation of wildlife will require a **USFWS Port Exemption Permit** (good for 2 years). The USFWS can also require that you work through a border broker if it is considered you are making a “formal entry” vs. an “informal entry”. This is up to the discretion of the USFWS and the Port Director. They will not recommend a broker but can tell you which broker handles most of the animal imports at that port.

CANADIAN CERTIFICATES OR PERMITS

Health Certificate

Issued by a veterinarian certified in the province of origin. Required by USDA to get sheep across the border. You must work with a Canadian veterinarian to fulfill this requirement. The Canadian Food Inspection Agency (CFIA) will require negative Brucellosis test results before they counter-sign the permit. The Provincial Wildlife Veterinarian will have the certificate counter-signed by a CFIA port veterinarian.

Provincial Export (or Sundry) Permit

Permit issued by the Provincial Wildlife Agency giving you the sheep. Required by USFWS. Obtain this at the end of the capture from the local wildlife agency biologist.

STATE PERMITS

State Department of Agriculture Requirements – variable

Some agencies may require tuberculosis testing. No case of tuberculosis has ever been documented in free-ranging wild sheep, and the federal government and many states have dropped this requirement. Contact the State Veterinarian, Department of Agriculture for the state in which you will release. If the State Veterinarian has no experience with wild sheep, provide references or documentation on health issues including a list of the standard disease tests you are planning to complete. Western wildlife agencies have agreed to a testing protocol proposed by the Western Association of Fish and Wildlife Agencies, Western Wildlife Health Cooperative (WWHC), which should relax prior requirements.

OTHER IMPORTANT CONTACTS/CONSIDERATIONS

Port Veterinarian – Contact the USDA veterinarian at the Port of Entry to be used and ask them about any requirements. They usually are on duty during normal working hours, so make special arrangements for entries during non-business hours. Also notify the CFIA port veterinarian.

US Customs, Port Authority – Before the capture contact the Port Directors office and ask for specific information needed. When leaving the capture site call the Port and tell them the estimated arrival time. There will be an entry fee. Set up the billing for this cost before the capture. No pictures are allowed of an U.S. Port of Entry. Tell your media people to not take pictures of sheep crossing the border.

Contact the wildlife agency for every state or province through which sheep will be transported. They may require a through-state transportation permit.

No vaccine or other “biologicals” or prescription drugs can be brought into Canada. A Canadian veterinarian will have to buy the needed medications and have them for you at the capture site. Leave any leftovers in Canada. Check with the U.S. Port Veterinarian to see if medications needed for the return trip can be left at the Port.

If importing bighorn from another state, skip all references to federal requirements in this section. It will still be necessary to coordinate with the receiving states department of agriculture.

ANIMAL HEALTH AND STANDARD TESTING

VITAL SIGNS FOR WILD SHEEP

When handling wild sheep, vital signs (Table 1) should be monitored so that proper treatment can be given at an early stage when an animal becomes stressed. Exercise and handling will elevate all these values and higher ambient temperatures will aggravate them further.

Take pulse and respiration for 6 seconds and multiply by 10. This will not give an exact pulse but it will be close enough to determine critical problems. Pulse and respiration have wide fluctuations during the restraint period but are generally less than the stressed levels. Checking gum color and capillary refill is a very good way to monitor blood pressure and shock. Any handling will cause pulse and respiration to be above normal. Therefore temperature and gum color are the best measure of shockiness. A veterinarian should monitor gum color and make decisions on treatments for shock. Restrained sheep will usually have temperatures in the stressed range. The most important consideration is to have at least two temperatures that are descending and below the extreme range.

MEDICATIONS, VACCINES AND TREATMENTS

There are no field medication or treatment protocols that can effectively treat many of the complications seen with field captures. The best protocol is to use the most effective capture method; one that causes the least stress, takes the shortest time, and results in the least physiological changes in the animal. Reliance on drugs or treatments instead of the most appropriate capture method can result in increased handling times, stressed sheep and a higher incidence of complications.

The use of specific treatment or prophylactic medications on wild sheep should only be performed after consultation with a veterinarian experienced with wildlife and specifically with wild sheep. Selection of medications and protocols can be controversial and opinions vary on their effectiveness. Pre-project planning with experienced personnel is strongly advised to discuss the most appropriate protocols suitable for the specific situations associated with the project. Treatment protocols have three objectives; to protect wild sheep from the stress of capture, to aid individual sheep when released into a new environment and to treat emergency situations as they arise. The project veterinarian will select which routine or emergency treatments are advisable and may prefer specific products used and dosages.

Automated syringes (syringe guns) - A syringe gun with a 16 or 18 gauge 1-inch needle can substantially increase handling efficiency, especially if the drug used is thick in consistency. Needles should be changed between each individual. Keep in mind that many of the suggested medications freeze easily or do not flow well in cold temperatures. Syringe guns should be kept warm between uses.

ROUTINE TREATMENTS

1. WATER

Wild sheep commonly have elevated body temperatures following capture that involves chasing and during processing periods. Hyperthermia (body temperature > 107 F/41 C) is the most common complication noted during capture events and, if uncorrected, will have serious physiological, even fatal consequences. Cold water rubbed into the haircoat may help reduce body temperature. Water most effective if rubbed into the neck, belly, under the legs, and to the mammary area.

HOT CLIMATE CONSIDERATIONS:

Mix ½ gallon of isopropyl alcohol per 5 gallons of water to increase the evaporative cooling effect. Horns are believed to dissipate heat. Applying 100% isopropyl alcohol with a spray bottle to the horns may help overall reduce body temperature.

In hot climates it may be prudent to direct capture crews to apply water and take a baseline temperature before transport of sheep to base camp/processing site. If transport is directly after capture, this is not necessary. However, if sheep are restrained for 10 or more minutes before transport, a temperature should be taken, recorded and water applied. The crew should write the temperature on the horn with a permanent marker and then notify the pilot of sheep with critical temperatures so they are the first treated at base camp.

2. ANTHELMINTIC.

An injectable broad-spectrum anthelmintic (dewormer) can be chosen that is injectable, has an extended length of action, is highly effective against ecto and endo parasites and is larvicidal. Although sheep populations can carry a large variety and high number of parasite species, the translocation of animals with reduced parasite loads may prevent the transmission of organisms to the new habitat and can give individual translocated animals an advantage. There is no evidence that any anthelmintic can remove all parasites with a single dose, however some have been documented to reduce overall numbers to some degree and reduce larval lungworm shedding. Prior screening of source and recipient herds for parasites can ensure specific knowledge of the parasites that can be potentially transferred with the translocation. These drugs do not generally thicken in cold weather.

3. SELINIUM/VITAMIN E

Combination injectable preparations are frequently given as a treatment and prophylaxis for capture myopathy and to supplement low selenium levels found in many wild sheep ranges. Although there is no evidence that treatment at the time of capture is beneficial or protective, it is unlikely to cause harm and may be of long term benefit to animals with low or marginal selenium levels. These drugs do not generally thicken in cold weather.

4. ANTIBIOTICS

Long acting injectable preparations of penicillin or oxytetracycline are frequently given as treatment for capture related injuries and in order to prevent the development of pneumonia in stressed animals during and following transport. Although there is no guarantee that effective antibiotic levels are reached and that the antibiotics used will be effective against the organisms present, many wildlife workers feel that there is little harm done with the use of antibiotics. Single antibiotic doses are unlikely to result in the development of antibiotic resistant bacteria; however this is of increasing environmental concern. Since wild sheep are so highly sensitive to stress and pneumonia this may be considered a valid treatment.

5. CLOSTRIDIUM BACTERIN (7 or 8 WAY)

Clostridial infections of muscle tissue have been diagnosed in translocated sheep. Clostridial bacterins are given to domestic ruminants to prevent diseases such as tetanus, blackleg and gastrointestinal overgrowths. However, vaccinations are generally poorly effective in animals under stress and require booster injections for full protection. Many projects do not routinely use bacterins for these reasons.

EMERGENCY TREATMENTS

Animals may require treatment for shock, hyperthermia, acute or subacute muscle damage or myopathy, trauma or other conditions recognized following capture or combinations of these conditions. Common symptoms may include high (hyperthermia) or low (hypothermia) temperatures, increased or decreased heart rate, increased or decreased respiratory rate with varying quality of respiratory depth, increased capillary refill time and pale or blue mucous membranes. Other symptoms are dependent on the body system involved.

The earlier treatment can be initiated the more likely abnormal symptoms can be reversed, however field treatment is often not successful. Emergency treatments should attempt to

stabilize animals and should only be given under the direction and supervision of a licensed veterinarian.

1. OXYGEN

Many physiological responses that occur during capture result in complications that will benefit from supplemental oxygen. Oxygen administered via a nasal cannula at a rate of 5 + liters per minute can be very beneficial and is especially advised in critical care and emergency situations.

The delivery systems can be a mask held over the nose and mouth, however use of a nasal cannula does not block the mouth or face for other activities.

2. INTRAVENOUS FLUIDS

LACTATED RINGERS SOLUTION: Ringers is used to reduce acidosis and reverse the dehydration brought about by shock, hyperthermia, and other capture stress factors. An IV administration kit will be required for each bag you use.

GLUCOSE (5%) OR DEXTROSE (20%): Given to combat hypoglycemic shock. This condition is usually observed after the sheep have been held in a transport vehicle for several hours. An individual may not be able to exit the transport vehicle and usually has a low body temperature. An IV administration kit will be required for each bag you use. A can of non-diet soda administered orally will work if IV fluids are not available.

3. INJECTABLE SOLUTIONS

SODIUM BICARBONATE: Given to counter severe metabolic acidosis brought on by excessive muscular activity, excitement, chase, and resistance to handling. Usually given in Ringers Solution.

DEXAMETHASONE SP (4mg/ml): Used to treat individuals suffering from acute shock or more severe capture stress. Assists in controlling respiration and heart rate, blood sugar levels and improves general well being. Dex is a steroid and can cause abortion if given in the last trimester of pregnancy.

NON STEROIDAL ANTI-INFLAMMATORY: (Banamine): Used on animals with elevated temperatures not responding to routine cooling treatments. Also used on animals with musculoskeletal injuries or other trauma as an anti-inflammatory and analgesic agent.

4. COLD WATER ENEMA

Used to combat extreme temperatures. An enema bag and application tube designed for humans works very well on wild sheep. The enema tube must be carefully inserted into the anus to keep from tearing the colon.

5. ADDITIONAL EMERGENCY EQUIPMENT

Suture Kit, Ambu bag

HEALTH TESTING REQUIREMENTS

There are two purposes for health testing. First is monitoring health of the source herd and to provide initial information for new releases. A history of exposure to various diseases is invaluable in investigating disease concerns in the future, especially when confronted with an all age die-off. The second reason is political. Certain tests are required for importation or transport of wild sheep. Additionally, potential for disease transmission to livestock or existing wildlife populations is a common concern. Health testing can provide data needed to address that concern.

The WWHC has developed a health testing protocol for wild sheep (Table 2). Table 3 presents additional tests that managers can consider.

The councils recommend the WWHC protocol be completed for any wild sheep capture. Considering the impact of disease to wild sheep herds it is irresponsible for a wildlife agency to plan a capture operation and not complete recommended testing for all adult individuals captured. The only reason to not test all adult sheep captured is if the source herd has a recent history of sampling and therefore pre-existing health information is available. In this case, at least 50% of the captured adults should be tested. For monitoring herd health it is not necessary to sample lambs, however U.S. and some state import permits will require sampling of all sheep captured.

If you are importing sheep from another state/province check with the state veterinarian for the receiving state to see if any additional tests will be required as part of the state import permit. Requirements for additional tests may be based on old information and/or personal biases. Wildlife veterinarians with the WWHC can be very helpful with these discussions, and assist in providing up to date information on wild sheep diseases.

During project planning all desired/required tests need to be identified so the correct type and amount of specimens can be collected at time of capture. Certain tests can be completed at almost any animal health diagnostic lab while others require special labs. Handling procedures vary depending on lab and tests selected. Work with a veterinarian before capture to determine which labs to use and how specimens are to be handled.

BLOOD TAKING/TESTING

It is the responsibility of the capture boss to determine all samples to be collected, amount of blood to be drawn, and proper handling and distribution of samples. Coordination with a veterinarian will make this duty easier. A sample kit for each animal should be prepared before the capture operation begins. Each kit and every blood tube in the kit should be labeled with a sample number which references the year of capture and the animal number (Fig. 1). In 1995

Oregon captured 90 bighorn from 3 different herd ranges, 95-001 was the number of the first sheep caught at the first site and number 95-090 was the number of the last sheep caught at the last site. This sample number is very important since it ties all samples back to the individual animal and its capture records. Sample numbers do not necessarily correspond to ear tag number, so be careful not to confuse the two. An acronym identifying the agency collecting samples should be put on all labels to insure labs handling samples from different states or provinces do not confuse samples.

Size of syringes and needles and number and type of vacutainers needed will depend on which tests are to be conducted and the amount of serum required for those tests. A syringe should be large enough to draw adequate volume for all test needs with one venipuncture. As a rule, use a 16 ga. x 1.5 in. needle with two 35ml syringes or one 60cc syringe. Use of vacutainer needles is not recommended because of the volume required. A 60ml draw will usually provide enough whole blood and serum for all tests. Know how much blood is needed and leave the rest in the sheep.

Serum separator tubes (also called tiger tops, red/gray tops or red/black tops) are recommended to simplify serum collection. Usually red top, tiger top and royal blue top vacutainers are used for serum collection. Purple top and green top vacutainers are used for whole blood collection. Once blood is drawn and transferred from the syringe to vacutainers, the tubes should be kept at room temperature (cab of pickup or ice chest with warm water bottles) and allowed to sit a minimum of 2 hours so a blood clot forms. Place vacutainers in a centrifuge and spin for at least 10 minutes at 2500-3000 rpm to separate serum from the clot. Balance tubes in the centrifuge or breakage will occur. If tubes are not approved for centrifuging, remove the rubber stopper before spinning so they do not break. For convenience spin tubes each evening of the capture at the motel, lab or other facility.

After centrifuging pour off or aspirate serum into serum tubes, which are labeled with the same sample number. Usually the serum from each individual vacutainer is transferred to a corresponding serum tube however, depending on tests, serum from one vacutainer can be split into more than one serum tube. Take care not to pour any solids into the serum tube since this will cause problems with testing. Band the serum tubes for each animal together, place them in a cooler and/or freeze depending on the situation at the capture site. Usually serum samples can be frozen and whole blood samples cannot be frozen. Talk to the labs you are using before capture and make sure you know how each sample should be handled.

PASTEURILLA SAMPLING

In 2000 *Pasteurella haemolytica* was renamed to *Mannheimia haemolytica*. Various serotypes of this bacteria have been implicated as the cause of pneumonia outbreaks in some wild sheep herds, resulting in all age die-offs. The purpose for this test is to support on-going research and to acquire baseline information on the types of *Pasteurella* or *Mannheimia* bacteria present in a herd, so that in case of a pneumonia outbreak, there is reference information. *Mannheimia hemolytica* and *P. multocida* are the organisms of primary interest. Nasal swabbing is not accurate for bacterial culture, therefore pharyngeal swabbing is necessary.

Originally bacterial samples were taken at the tonsillar crypts using a laryngoscope, speculum and an Accu-culshur swab. Since then research indicates that a general pharyngeal wipe is as effective. A pharyngeal wipe is faster and causes less stress. In 2001 Accu-culshur swabs went out of production. Port-a-cul swabs are now preferred for bacterial recovery. All samples must be marked with the appropriate sample number. There is variation on how different labs want samples handled, and how different swab types should be handled. Check with the lab before the capture operation.

FECAL SAMPLING

Fecal samples are taken to check for gastrointestinal parasites and lungworm larva (*Protostrongylus stilesii* and *P. rushii*) as an indicator of overall lungworm loads and herd health. Usually 10-12 pellets provide an adequate sample. Pellets are extracted with the fingers of a rubber-gloved hand, lubricated with K-Y jelly prior to being inserted into the anus, and packaged in the glove by rolling it off the hand inside out. Write the sample number on the glove or place the glove and pellets in a pre-labeled whirl-pak.

ECTO-PARASITES

Scabies, a skin disease caused by mites (*Psoroptes* spp.) is the most debilitating disease caused by ecto-parasites in wild sheep. Scabies is known to be endemic in many sheep populations in the United States, but is unknown to occur in other locations and Canada. Sheep that have not been previously exposed to the mite or are under stressful conditions appear to be extremely susceptible and can be severely and even fatally affected.

There are several tick species that may be found on wild sheep, depending on the geographical location of the sheep herd. In most cases ticks cause few clinical symptoms, but in some regions they may serve as vectors of infectious organisms. Tick infestations have been associated with mild to severe hair loss in wild sheep during fall and winter months but are usually insignificant.

Each sheep captured should have an examination of the ears and hair coat for mite and tick infestations, focusing specifically inside the ears for mites and in the axillae, groin and under the tail for ticks. Yellowish waxy debris, crusts or flakes inside the ear may be an indication of mites. Animals affected may shake their heads vigorously and there may be localized or generalized hair loss with evidence of self-inflicted trauma. *Psoroptes* mites are microscopic but can be collected by wiping inside the ear with a cotton or Dacron swab and placing the swab in a red top Vacutainer tube for later evaluation. Mite infestations of the skin are usually obvious but may require diagnostic skin scrapings. Larger ecto-parasites such as ticks can be collected with fingers or forceps and placed in a red top tube or a Whirl-Pak bag for short term transport to a diagnostic laboratory for species identification.

CAPTURE AND HANDLING PROCEDURES

METHODS OF CAPTURE

This section compares the different methods used for capturing wild sheep and considerations for selecting a capture method. Wild sheep captures are inherently expensive. With radio transmitters, capture contracts, sampling and analysis of samples, and transportation of relocated animals, can exceed \$1000 per animal relocated. For transplants, initial budget estimates, without personnel costs should assume costs of \$1100/animal. It is very important that minimum health testing be completed on all adults captured. If available dollars are tight, cut the budget somewhere other than health testing, or seek additional funding. Mature rams are not recommended for transplant. Rams older than 3 years (larger than ½ curl) usually do not stay with the relocated group and are aggressive in the transport vehicle. Older rams usually stray off, never to be heard from again or show up in areas of non-habitat or close to domestic sheep. There is no physiological or capture stress related reason not to move big rams, but since they are aggressive during transport and usually won't stay with your new herd it is not a good use of available funds or sheep.

Helicopter netgunning, drop nets, linear drive nets, corral traps and chemical immobilization are the common methods used for capturing wild sheep. Each technique has advantages and disadvantages. The objective of any capture should be to capture the desired number of sheep as quickly and efficiently as possible without causing excessive stress to the animals or compromising safety for the capture crew. Detailed planning and selection of the correct technique is important.

Helicopters are used to pursue sheep while net-gunning, drive netting or darting. Because the animals are chased, elevated body temperatures are common. There is a strong correlation between ambient temperature and how long individuals can be chased before body temperatures reach extreme levels. In general chase times should not exceed 3 minutes, however if ambient temperatures exceed 60°F (in the winter) chase times may need to be shortened to about 1 minute. It is important to discuss chase times and stress with the pilot prior to the capture. Monitor body temperatures as the capture proceeds and modify chase times as necessary.

Helicopter net-gunning is the most commonly used capture technique for large numbers of animals. Sheep are captured by shooting a net from a helicopter over individual animals. Captured animals are flown to a base camp in transport bags for processing and transport, or worked at the capture site and released. Depending on the experience of the capture crew, this technique is fast, safe and efficient, and specific age and sex ratios can be selected. The netgun crew is able to go to the sheep rather than try to get the sheep to come to a predetermined spot, and access from the ground is not required. With this technique, an experienced crew working with normal herd densities should be able to deliver 4 sheep/hour. If conditions are good more than 4 sheep/hour is common. One disadvantage to this technique is that it requires a helicopter and there are wild sheep ranges with powerlines, residences or highways that preclude pursuing sheep from the air.

Drop nets are the second most commonly used capture technique. They work very well in areas where helicopter pursuit is restricted, or vehicle access to the capture site is available. Drop nets require adequate ground access for baiting activities and trap/transport vehicles on the day of capture. Drop nets require a large group of sheep that are easy to bait. This technique usually will not work on ranges with conditions that are not severe enough to force the sheep to use bait

or with limited access to the trap site. Effective baits used for drop net captures include good quality alfalfa hay, apple pulp and salt. Drop net captures require approximately 1.5 people per sheep expected to be caught in any single drop. Because animals are coming to bait it is hard to select for a specific age/sex ratio in the animals captured. However, surplus animals can be released immediately with little or no harm. It usually takes a minimum of 30 days to get animals hooked on bait and habituated to the net. One major benefit to this technique is animals are restrained the least amount of time.

Linear drive nets were commonly used in the early 1980's but are not used as much today. Drive nets come in 6 X 100 foot sections and six to 12 sections are usually required. Nets are generally placed in a U shape in a shallow draw, and sheep are driven downhill into the nets with a helicopter. A net crew of 12-20 people is required to drive sheep the final distance once they are inside the arms of the U, and restrain sheep once they are tangled in the nets. Once the sheep are captured they are placed in transport bags and flown to a base camp for processing. The advantage of this technique is ground access is not required and nets are mobile, therefore herding time can be shortened substantially compared to a fixed drive trap. Disadvantages are, the technique is less efficient than using a netgun; it requires more helicopter hours for the same number of sheep; it requires a large capture crew; it requires an equally large base camp crew.

Corral trapping is a relatively inexpensive method of capture and requires only a small capture crew. Trap panels need to be 8 feet tall and set up in an angular fashion (Coggins, 1999), or circular with a diameter less than 15 feet so animals cannot get a running start to jump out. Trapped animals can be physically restrained in squeeze or handling chutes for processing, then released or moved directly into the transport vehicle. Corral traps work well in locations with ground access and severe enough conditions so that sheep use the bait (e.g. winter conditions with persistent snow cover or severe summer conditions at water sources). They also work well with herds that are habituated to structures or in locations where the trap can be constructed and left long enough for sheep to habituate.

Clover traps (Taber and Cowan, 1971) normally used for deer have been used to catch sheep or Simmons box traps (Simmons and Robertson, 1970) have been designed for capture of dall sheep or rocky mountain goats. They are most efficient when it is only feasible to catch a few animals at a time or when the limitations of budget or crew size prevent the use of alternative methods. Traps should be checked twice daily.

Chemical immobilization is the least used capture technique for large numbers of sheep. Herd ranges where helicopter darting could be used might also be netgunned. Netgunning has similar result without the time or problems associated with darts, immobilizing drugs, induction and recovery periods. Ground darting in order to capture a single individual or a small number of animals for health testing or radio collaring can be very economical and effective. Ground darting requires conditions where sheep can be approached close enough for an accurate shot, and terrain where immobilized individuals will not injure themselves during the induction period. Chemical immobilization should not be attempted without specialized training and access to suitable pharmaceuticals.

SAFETY

The goal of any capture operation is to catch, handle and release healthy wild sheep. To accomplish these goals safety of the sheep, as well as the capture crew, is critical. Detailed planning is imperative and it is critical to have one person in charge of the project. The “capture boss” needs to visualize each step of the process recording everything needed for the operation from the time the crew first arrives until the last sheep is released.

It is the responsibility of the capture boss to develop a capture plan to ensure sheep are handled as efficiently as possible. Efficient handling reduces the time any one sheep is handled, and thereby reduces stress. Delays in the capture process can usually be attributed to equipment not being at hand when needed, crew members not doing the job assigned, or crew members trying to help where they are not needed. All of these result in longer handling times and more stress to the animals. All talking while handling the sheep needs to be minimized and there is no reason for anyone to raise his or her voice.

Capture crew safety must be a priority. Even the simplest captures where animals are caught, sampled and marked then released at the capture site have safety risks because you are handling a wild animal in steep rocky terrain. Think about potential safety concerns and plan accordingly. Helicopter capture operations pose inherent risks with people working in and around the aircraft. The capture boss needs to identify those individuals with reason to be near the helicopter, educate them on proper conduct, and demand that everyone else stay away.

Most capture operations require the use of many chemicals and needles. Crew members using these needles should be well trained and inform others around the sheep when they are handling drugs or needles. This may be done by simply having the individual with control of the needle say the word “Needle” when approaching someone else on the crew. The other crew member should not move until they can see the individual with the needle or are told the needle is clear. Needle punctures are painful at the very least, and depending on the drug in the syringe, can be life threatening.

The capture boss needs to make sure everyone assigned a duty can complete that duty. This will require a lot of honesty. Capture operations require some crew members to lift and carry animals. Don’t assign someone with a bad back to one of the lifting duties. Queasy stomachs at the sight of blood or needles will preclude an individual from directly handling sheep. There are many jobs associated with any capture; ask and make sure everyone can do the assigned job.

In order to complete a safe capture, everyone involved must thoroughly understand how the operation will be laid out, completed, and what is acceptable or unacceptable conduct. The crew needs to meet the afternoon or evening before the capture and assign duties, answer questions and outline how the operation will be completed. Each morning during the operation there should be a 5-minute safety/orientation session to review duties, operation layout, and address concerns. After the days capture operation is completed get some or all crew members together to critique what happened that day and look for ways to improve the operation.

It is easy to get caught up in the urgency of handling animals. With the exception of severe human injury, there is no reason to run or yell while working animals. It is imperative that everyone relax, do the job they are assigned and enjoy the operation.

COMMENTS COMMON TO ALL CAPTURE METHODS

Radio Collars

Because a capture for relocation should target only young rams it is possible to fit radio collars too tight as the rams mature and necks swell during rut. Wild sheep are true horned animals and therefore collar slippage is rarely a problem. However, loose collars may cause abrasion or irritation as animals lower their heads and the radio hits their jaw, especially during combat. Mandibular damage has been caused by collars which are too loose. Biologists working with Rocky Mountain Bighorns in Hells Canyon recommend collar lengths of 22 inches for ewes and 30 inches for rams. Another technique is to fit ewe collars snug with 2 fingers underneath the collar perpendicular to the neck. Fit yearling or two year old ram collars snug with a palm width underneath the collar perpendicular to the neck. Expandable collars can be designed from Kevlar material or with spacers or thread designed to break after a period of time.

Make sure all magnets are removed from all radio collars the night before the capture starts. Leave magnets off until the capture is done. If radio collars will be carried with magnets off inside the helicopter they may cause interference with communications. If you leave the magnets on until the collar is hung on a sheep, put a MAGNET OFF box on your data form as a reminder. The piece of tape that will never rot or break is the one holding a magnet on a radio collar which is on a sheep running away from you.

Color coding collars can be useful for visually identifying individuals. Collar straps can be colored with permanent markers however, the colors will fade in time. Attaching large colored and/or numbered plastic ear tags or attaching other plastic material to the collar gives a good long lasting mark. Collars need to be marked before the capture starts. Once an animal is restrained there is no time for marking collars. It is not always necessary to radio collar all individuals in a transplant. Three to 4 collars per 15 head may be adequate to monitor success of a transplant. The number of individuals collared depends on the research or management question you want answered.

Ear Tags

Many makes and models of ear tags are available. Small plastic or metal ear tags can be put in the ears. Before the capture, make sure you have the proper pliers and replacement needles for the brand of tag purchased. If one purpose for the tag is to visually identify a live individual, placement of the tag becomes important. Tags placed in the ear(s) facing forward are easier to see from the ground. If placed in the ear facing back they are easier to see from the air.

Individuals fitted with radio collars can be identified by putting large plastic tags in the collar and the ears can be left intact. If most observations will be from the air put the tag in the top of the collar. Put a tag on each side of the collar if observations will be from the ground. Even the largest commercial tags are inadequate for identification of individual animals necessary in some research projects. If individual ID is necessary colored plastic strips approximately 15 cm long

can be affixed to collars with pop rivets. Any marks need to be on the collars prior to capture starting. There won't be time to attach tags or color mark collars while sheep are being worked.

Communications

The importance of having excellent communication during the capture can not be over stressed. Communications can be as simple as having someone wave a flag when the drop net falls so team members know when to move into position. Or as complicated as setting up satellite phone links so the capture team on the mountain can communicate with base camp or off site personnel. Before the capture set up and test the communication system you think you need. Make sure extra batteries fit the equipment you are using, are available, and are carried as needed. If you use programmable radios have several copies of the frequency list available, and identify those members of the team that know how to program the radio.

Data Records

Record forms should be set up before the capture and have a space to record all the information you will want, after you no longer have physical contact with the animal. At the least records for each animal should include: date captured, species, sex, age, a list of all samples taken, a list of all treatments given, all marks and how or where they were attached, comments as necessary.

Genetic Banking

The councils encourage individuals hankling wild sheep to collect horn or hair samples and bank them for future genetic analysis needs. Idaho has been banking samples for several years and have used them for enforcement needs, to identify specific herd range of and individual, and for identification of paternity or maternity. Horn or hair samples can be stored indefinitely dry at room temperature. At this time horn material is more dependable then hair samples. A small amount of horn material such as the spirals left over after pinning or a piece of horn tip removed with side cutters while the animal is restrained provides abundant genetic material. These samples should be collected for development of a genetic material bank, and would not take the place of live tissue (blood, meat, ear punches) collected to answer a specific research question.

Capture Timing

When to schedule capture operations depends on availability and migration patterns of the source herd, capture technique used, weather conditions and access to the source herd and release site, and personnel availability. Captures of transplants for mature ewes should be scheduled to avoid the last 6 weeks of pregnancy.

Stretchers

Several agencies use stretchers to carry sheep from the drop net or helicopter drop off point through processing and to the transport vehicles. Stretchers may save lower back strains for personnel carrying the sheep.

Weighing

Recording weights of individual sheep may provide useful data, especially if release plans require the use of a helicopter or boat. Without proper planning the process to weigh each animal can significantly increase handling times and compromise animal health. If you must weigh each sheep, use a hanging scale suspended from a large tripod or A-frame and stationed so animals being moved in transport bags or on stretchers can be weighed quickly then moved to a tarp.

Hobbles

Good hobbles are a single strap of well oiled leather or plastic coated nylon with a strong D-ring buckle. Whichever material is selected they should remain pliable when wet and frozen. Hobbles must be easy to put on and take off.

The hind and fore leg on each side of an animal should be hobbled together, rather than hobbling both fore legs and both hind legs. This makes it easier to keep the animal sternal during handling. Keep 12 pairs of hobbles in the capture supplies in case your contractor shows up with sub-standard equipment or an individual comes with hobbles missing.

Blindfolds

Blindfolds must be designed to cover the eyes but leave the mouth and nose open for respiration. Attachment of the blindfold needs to be a simple snap buckle or velcro. It is imperative that blindfolds are easy to put on, will stay on during flight or handling, and easy to remove. Blindfolds can be made from any non-abrasive material. Materials that remain pliable when wet or frozen are preferred. As with hobbles, have 12 blindfolds in your capture equipment.

Tarps

For capture methods that require setting up a specific processing area or base camp, it is good to have canvas tarps to lay the sheep on during processing. Use of tarps keeps the crew from having to work in mud, and clean up between sheep is easier. Tarps act as a focal point in base camp, which results in more efficient processing. Tarps should be staked on the corners. Stakes should be flush to the ground so no one trips. Canvas tarps are preferred over plastic as they are less slippery when wet and more resistant to rotor-wash. New Mexico has taken the tarp concept one step further by placing their sheep on sturdy tables for processing. This keeps capture personnel from having to stoop over sheep during processing.

HOT CLIMATE CONSIDERATION: For captures being completed on hot days in direct sunlight, put a sun shade over your tarps to provide shade for sheep and crew. This will aid in treating elevated body temperatures.

Euthanasia

Any capture operation runs the risk of injuring animals. At times these injuries are severe and euthanasia is the only humane option. The American Veterinary Medical Association (2001) has published euthanasia guidelines. For wild animals the use of a .22 caliber gunshot delivered to the head or neck is approved as a humane euthanasia method. Other approved techniques include use of potassium chloride in association with an anesthetic agent, use of barbituates (Euthanasia), use of carbon monoxide, and exanguination. The use of potassium chloride without an anesthetic is considered inhumane. Meat from animals euthanized with methods

other than gunshot or exsanguination will not be fit for consumption, and current veterinary recommendation is that carcasses of animals euthanized with barbiturates be burned. Be prepared to complete the process quickly and professionally. If chemical euthanasia is selected know the dosage rates before the capture starts.

Thermometers

Digital thermometers are preferred over glass thermometers, because they are easier to read and less likely to break. Most commercially available digital thermometers are designed for human use and read temperatures up to 108°F. If possible try to find thermometers that read up to 110°F. For animals requiring emergency treatment a continuous read thermometer is very useful. Continuous read thermometers must be calibrated before each capture.

Physical Examination

Each animal captured should have a full physical examination to evaluate their physiological responses, body condition, general health and suitability for translocation as well as for any capture related trauma or complications. Animals demonstrating variations from a previously established standard of health should be evaluated immediately by the project veterinarian.

Body temperature, respiration and heart rates should be recorded on arrival at the site and animals triaged according to these levels. These should be repeated at least once during handling and the appropriate treatments initiated if necessary. Sampling procedures should be performed and medications/treatments administered according to the project protocol. Once the individual protocol is completed and checked, hobbles and blindfold can be removed and the sheep can be released into the field or transport vehicle. It is vital to perform these actions as quickly, quietly and as efficiently as possible in order to reduce handling time and stress.

CAPTURE METHODS

Within this section there is little information describing specific activities required to actually catch a wild sheep. We have attempted to describe considerations needed to restrain, process, transport and release wild sheep. Every capture situation will require modifications therefore the only absolute is that sheep need to be handled as quickly and efficiently as possible for the health of the animal and safety of the crew. How one should actually catch the animal depends on more variables than can be described in this document. Appendix 2 presents a list of individuals experienced with the various facets of wild sheep capture and are willing to give advice.

NET GUN

Net gun capture is specialized and an experienced capture team that keeps the health of the animals as a priority will be invaluable to your operation. Several private companies are available to provide net gunning services, and most agencies now contract the actual capture to ensure the most experienced are completing this most critical step. This does not mean that an agency should not decide to put together their own capture team, but keep in mind that with experience comes efficiency and most agency personnel don't net gun enough animals in a year to get truly efficient. Find a capture crew with a good reputation and the equipment necessary to provide you a quality job. Write the capture contract with enough detail to ensure both parties know what is expected. The contractor should have enough handlers (3-4) so animals are worked and transported to base camp quickly. Contract capture crews should provide needed equipment to net gun, hobble, blindfold and transport sheep to base camp. Some have the

expertise to collect samples as well. They should have a minimum of 20 nets so they don't run out while used nets are being repacked.

The councils recommend that sheep be transported sternum down to keep the weight of the rumen off the lungs and ensure animals don't regurgitate, then aspirate rumen content. With a helicopter, the best way to transport sheep is hobbled and blindfolded in specialized transport bags slung on a cable under the ship. Sheep can be blindfolded, hobbled and carried inside the helicopter but enough people need to be with the sheep to keep them sternal and guard against a slipped hobble or blindfold causing an accident. Sheep have been slung under the helicopter from their hobbles, sternum-up. For minimal distances this does not seem to have negative physiological effects. Slinging animals by their hobbles has been questioned socially and professionally.

Base Camp Procedure and Set up

Capture of wild sheep for transport to another location usually requires some type of base camp or processing area, because many sheep are handled in a short period of time. Following is a description of procedures and personnel needs for efficiently operating a base camp.

The Personnel Assignment section and Table 4 identify individuals needed for a net gun capture base camp. Figure 2 shows a generic base camp set up. For ease of operation and to keep people from tripping over each other, arrangement of the base camp is important. Tarps need to be close to the vet-supply truck and arranged so that sheep can be brought to and removed from the tarps without restraint teams tripping over each other. Sheep should be placed on the tarps in the same sequence every time. Restraint teams always go to the same tarp. This keeps ear tags, sample collection, and records in the proper sequence. Failure to do this can confuse the recorder and compromise record keeping. Transport vehicles should be located close enough to tarps so sheep can be loaded easily, but not in the pathway of sheep being moved from the helicopter to the tarps. Transport vehicles should be situated away from the generator, social area, or helicopter refueling site to minimize disturbance. Determine the location of the helicopter landing zone and how the helicopter should approach. This should be far enough away from the work area that rotor wash does not effect the operation but close enough to minimize the distance sheep must be carried. It is important that the helicopter lands with the same attitude each time, so tail rotor location stays the same. The helicopter coordinator must be alert to changes in wind direction.

Base Camp Etiquette

Talk in whispers or low voice. Do not disturb sheep in transport vehicles and do not congregate around them. Relax, do assigned duties, and pay attention for problems. Suggestions for modifications or changes should be taken to the capture boss. Ask if someone needs help before assisting. If a problem occurs with one of the sheep, go directly to the lead veterinarian. For any other type of problem, go to the capture boss.

Base Camp Function

Prior to the capture the following items are completed. The capture boss determined what samples will be taken and how they should be handled. Capture and release sites were identified and the target number of sheep is known. All sample kits and capture supplies are on hand,

properly labeled and ready. The night before the capture the crew got together and had a safety/orientation meeting. At the start of the capture, after base camp is set up and the helicopter has left, conduct a 5-minute safety/orientation session, emphasizing helicopter approach and exit.

Assuming adequate sheep densities, good weather and ferry distances of less than 5 miles, a qualified net gun crew should be able to deliver a minimum of 4 sheep per hour to base camp. When the helicopter returns it usually has 1-4 sheep in bags hanging from the transport hook. The helicopter coordinator goes to the landing zone, and takes them off the hook as the helicopter sets the sheep down. Restraint teams approach as the sheep are being unhooked. Restraint team A carries their sheep to tarp A and starts removing the bag and net, pouring water, and taking temperatures. Restraint teams B through D move a sheep to their respective tarps and do the same. Blood takers, swabbers, medicators and the veterinarian work through the sheep getting samples or giving medications. Ear tagger/radio collar puts in tags but only attaches radio collars after the blood is drawn. Recorder checks to make sure all needed data are written down, all samples collected, and all treatments given. If processing is completed and a sheep does not require additional treatment, the recorder gives approval for the sheep to be loaded. Once approved the restraint team puts their sheep in the transport vehicle. If all the sheep are in good shape this whole process takes about 5 minutes per sheep. During processing the helicopter coordinator services the helicopter with new nets, bags and water (optional). As people complete their assigned duty they go and re-pack nets, or get ready for the next load of sheep. If you are working 4 -5 sheep at a time this process requires 18 to 20 people.

New Mexico has modified the process described above by having all marking, sampling and health monitoring done by a single team per sheep. As described above the sheep are moved from the helicopter to a tarp or table. At that tarp a team gives completes all processing for that sheep, and there is a complete team at each tarp. After processing the animal is moved to the transport vehicle. If you are working 4-5 sheep at a time this process requires about 50 people.

DROP NET

Because a drop net operation usually catches 20-30 sheep at a time, a modification of the net gun base camp system is needed to efficiently work sheep and minimize handling time. Assuming there is vehicle access to the drop site and sheep can be completely worked at the net, it is more efficient to have sample teams go to the sheep rather than moving each animal to a tarp for processing. The goal of healthy sheep is still the same, and depending on the samples you are collecting 20-30 sheep should be processed and loaded in 30-40 minutes. Each sheep is worked as soon as it is freed from the net, then moved to the transport vehicle and loaded. The Personnel Assignment section and Table 4 identify duties needed for a drop net capture.

Some drop net captures occur in areas without vehicle access (e.g. wilderness). In these cases sheep are cleared from the net, hobbled, blindfolded and slung in transport bags to a base camp for processing. A crew of approximately the same number of people as sheep expected to be caught in any single drop will be needed at the net. Select a drop net site which includes helicopter hook-up access.

Procedure and Set-up

Selection of the site for the drop net is dependent on having access for baiting and enough room to station capture and transport vehicles near the net for processing. Feed baits such as alfalfa hay or apple pulp require daily monitoring and re-supply. Salt baits do not have to be checked as often. Depending on conditions sheep may need to be baited for as much as 30 days prior to the capture. Set up the net on site and trip it several times before you want to catch anything to ensure that everything is working.

Figure 3 shows a generic layout for a drop net capture site after the net has fallen and all personnel are on station. The sample kit consists of a gallon zip-lock bag with all injections drawn up in individual syringes and marked whether the injection is given IM or SQ, ear tag, pharyngeal swab, nasal swab, syringe and needle for drawing blood, glove for taking fecal, and vaccutainers. Each zip lock bag and all contents are marked with a sample number, and the ear tag number and color is written on the outside of the zip lock bag. When building the kits keep a separate record of the eartag number and color put in each kit. Have 6-8 plastic buckets with the capture equipment, for carrying and collecting kits. Each sample team will need a tube of K-Y jelly and ear tag pliers. Each handler and net roller needs a pair of hobbles, blindfold and thermometer. It is common to catch unwanted individuals in drop net captures. The entire capture crew needs to know which type (sex/age) of sheep are not wanted so they can be released as soon as possible.

Drop Net Function

Prior to dropping the first net the capture boss must decide the exact location where vehicles will be staged, and where they will move to once the net falls. Drivers must be informed of the staging order and where they should drive. Prior to the drop all personnel except the trap supervisor and net rollers are stationed away from the net. When the correct number and sex/age composition of sheep are under the net the trap supervisor triggers the net release. The net falls and sheep are captured. Net rollers stationed close to the net move to the edges to stop escapes. Handlers move to the net and restrain sheep. Sample teams move the vet truck into place, get sample kits and go to sheep. Transport crews move trailers into place (all magnets are off all radios before the net falls). Capture boss and Lead veterinarian provide assistance as needed. Sheep are hobbled, blindfolded, removed from net, sampled and medicated, collared, moved to trailers and loaded. As sheep are loaded people are free to assist wherever needed. With an average of 25 sheep per capture and only standard animal health sampling, the whole process should take less than an hour from the time the net falls until the last sheep are loaded.

The vet truck contains all veterinary supplies. If an individual becomes stressed or shocky before loading, it is moved to the vet truck where the lead vet can start treatments to stabilize the animal. Spread a tarp at the back of the vet truck in case you need to work an animal.

LINEAR DRIVE NET

Linear drive nets are usually set up in an open U shape across a small drainage so that sheep being driven down hill cannot see the pocket of the net until they are within the wings (Fig. 4). It usually requires about 1200 feet of drive net for an effective trap. If you are catching a small

number of sheep without using a helicopter less net is required. Drive net comes in 6'X100' sections. The Personnel Assignment section and Table 4 identify duties needed for a drive net capture. The net crew consists of 4 to 5 people at the end of each wing and approximately 10 people stationed on either side of the pocket. As the helicopter drives sheep toward the net everyone on the net crew lies flat under cover. When sheep pass the ends, individuals stationed there run across the mouth of the trap and drive sheep toward the pocket. When sheep hit the net all crew members restrain, blindfold and hobble an animal. Each crew member should have a thermometer, and water should be stationed near the net to treat high body temperatures while awaiting transport.

Wind direction is extremely important. If the wind is blowing from net crew toward approaching sheep, capture attempts often fail. When purchased net sections are usually white. They can be dyed earth tones if captures will primarily occur without snow. If snow conditions at the capture site are uncertain a mix of white and brown nets are required. If trapping on snow use brown nets for the wings and white nets for the pocket, so it doesn't appear that there is a barrier to escape. If trapping on bare ground use the brown nets for the pocket. Once sheep are restrained they are placed in transport bags and flown to base camp. From that point follow the base camp procedures described in the Net Gun section.

CORRAL TRAP

Corral traps work well if located on a site with road access and severe enough climatic conditions to get sheep to use bait consistently. Corral traps are permanent structures and it may take 2-3 years for sheep to habituate after construction. A squeeze chute or handling chute should be attached to the trap to increase handling efficiency. With a handling chute, 4 people can easily work 10-15 sheep. The most important consideration with corral trapping wild sheep is that the trap needs to be built in irregular angles (Coggins, 1999), or round with a diameter less than 15 feet, so animals do not have enough distance run and jump the trap. Round traps are easier to construct but all sheep captured are constantly harassed while working animals through the handling chute. Traps of irregular shape can be sectioned off and a smaller number of trapped animals can be processed while the remainder are kept separate and un-harassed. The door can be manually tripped if sheep are habituated to humans, or a set trigger and trip wire can be rigged so sheep trip the door. Sampling procedures are the same as other techniques but animals will be restrained in the chute and not hobbled. A sample kit should be built for each individual expected to be captured. Depending on how much sampling needs to be done, blindfolds can help keep animals calm while in the chute. When catching sheep for transplant, build the bottom of the handling chute to the same level as the bottom of the transport vehicle, so animals can easily exit the chute to enter the vehicle.

CHEMICAL IMMOBILIZATION

Chemical immobilization is an appropriate technique for capturing single or small numbers of wild sheep in specific circumstances that allow a close and undisturbed approach. It is not appropriate for the capture of large (>20) numbers of wild sheep from the ground or from a helicopter. The remote delivery of drugs in darts can be an effective tool to selectively capture, mark, collar and/or sample wild sheep in a number of field situations. Care must be taken to avoid accidental darting of nontarget animals. Wildlife professionals considering the chemical

immobilization of wild sheep should recognize that this is a difficult species to immobilize in field settings and extra care must be taken to prevent and, if necessary, treat complications that occur as a result of immobilization. It is recommended that wildlife professionals interested in this technique refer to *Chemical Immobilization of Wildlife* (Kreeger et al., 2004), *Chemical Immobilization of Wildlife Course Manual* (CAZWV, Ed. M. R. Woodbury, 1996), other references (Jorgensen et al, 19..) and contact those who are experienced with the field immobilization of wild sheep.

Chemical immobilization should only be performed by personnel who have the appropriate training and experience; specific training and qualifications may be mandatory in certain jurisdictions. At all times the safety of the animal and humans involved in each procedure should be the first priority.

There is no satisfactory single drug or combination of drugs that can be recommended for the immobilization of wild sheep (Kreeger pers. com.). The most reliable combination is a narcotic, carfentanil citrate (Wildnil ®) and an alpha-2 agonist sedative, xylazine hydrochloride. This combination has the advantages of good analgesia, muscle relaxation and reversibility. The narcotic can be reversed with naltrexone for the carfentanil and the sedative can be reversed using yohimbine or tolazoline.

Carfentanil is an extremely concentrated narcotic with a high potential for human toxicity. This drug must only be used by specifically trained and licensed individuals with the appropriate back up support in case of accidental human administration. Narcotics also have the potential for negative effects on the animal such as extended induction/excitatory and recovery periods as well as respiratory depression. These may lead to elevated body temperature as a result of excessive muscle activity. Therefore it is important to monitor body temperature and to be prepared to reverse the drug effects and treat hyperthermia.

Other drug combinations have been used to immobilize wild sheep, including ketamine hydrochloride/xylazine hydrochloride, ketamine/medetomidine and tiletamine hydrochloride:zolazepam (Telazol ®)/xylazine). However, in field settings results with these combinations are not always predictable or dependable. Any animal that is excited or stressed is much more likely to be refractory to chemical immobilization, particularly when using alpha-2 agonists.

The most suitable remote delivery systems (dart rifles) and darts are those that are the most suitable for the field circumstances and cause as little trauma as possible. Generally, those that deliver small volumes of drug with a low pressure propellant are the most desirable. In most cases, 2 -3 ml darts with 1 inch to 1¼ inch needles and metal barbs will be adequate.

Large capture crews are not required when immobilizing sheep. Two individuals have immobilized and processed up to 20 sheep in one day under ideal conditions of sheep feeding at a baited site (Kreeger pers. com). Since chemical immobilization is not generally predictable, pre-capture planning is vital. Only very experienced, thoroughly briefed personnel should be present with the appropriate drugs and supplies for the immobilization and sample collection.

The supplies must include emergency and first aid drugs and equipment with protocols for their use on both humans and animals.

Drug withdrawal times for some of the drugs used in wildlife chemical immobilization are available for domestic species, but these may not be recognized for wild sheep in the local jurisdiction. Investigation of this issue should be made prior to the project and notification of the hunting public is strongly advised if applicable to the sheep population. Animals captured with drugs are not immediately suitable for human consumption and under some legislation may never be legally acceptable for consumption. Wild sheep captured with drugs should be clearly marked with ear tags or collars with contact information included, particularly if capture occurs within 30 days of a hunting season, a time often used when official withdrawal times are not available. Capture crews need to be prepared to apply marks to all individuals immobilized. Marking also insures that all individuals released on site are not re-darted.

Carcasses of animals that die during and within days of immobilization events should be considered contaminated and may be toxic to scavenging animals. Following necropsy examination of the carcass, disposal methods appropriate for the area should be used.

TRANSPORT

The councils recommend that sheep are not transported individually in crates or boxes. Wild sheep are gregarious and will settle down and haul very easily with other animals. The only time aggressive behavior is observed is when sheep are stressed or if larger (>3 yr. old) rams are included in the group. It is recommended that if adult rams are transported, they be segregated from ewes and lambs. This can be accomplished by partitioning trailers or having a separate transport vehicle for rams. Partitions must provide visual obstruction without compromising ventilation.

For transport a conventional 4 horse trailer or a special sheep box on the back of a pickup work very well. A sheep box allows easier access to release sites with poor road conditions, but more sheep can be hauled in a trailer. Transport 10 sheep per approximately 40 square feet (the area of a standard, long/wide box pickup bed), or 20 sheep in most conventional 4 horse trailers. The primary concern is that any transport vehicle has good ventilation especially when the vehicle is not moving, to provide good air exchange, reduced temperatures and humidity. Most captures take place in late fall or winter and animals are in winter coat so cold temperatures are rarely a problem, even if the sheep are wet.

HOT CLIMATE CONSIDERATION: Transport vehicles should be kept in the shade on hot days. If temperatures are excessive it is necessary to drive the vehicle between loads to keep air circulating. Blocks of ice inside the transport vehicle will assist in reducing temperatures. Make sure you have communication between all transport vehicles and base camp if they leave base camp.

If sheep will be held for more than 12 hours during transport, provide good quality alfalfa or grass hay for feed and clean water. Be very selective with the hay used. Several areas have hay quarantines for noxious weed control. Even without quarantines you do not want to introduce

weeds to the release site. Make sure the hay is not purchased from a grower that winters domestic sheep on their fields. California introduced contagious ecthyma to a wild sheep herd by using hay from a domestic wintering field. A commercial electrolyte powder in the water will help during long hauls. Use cedar shavings or hay on the floor for bedding material.

Most conventional trailers have a feed bunk in the front of the trailer and this area needs to be blocked with plywood. Other large openings at or below head level to a sheep (breast height for you) should be blocked. If using plywood, Oriented Strand Board or sheet metal to block openings, cut a lot of 4" holes for ventilation and observation ports. If the inside of the trailer is dark sheep cannot be observed and ventilation will not be adequate. Openings above head level should not be blocked, assuming they are small enough so a sheep can't jump through them.

Several states have special sheep boxes or trailers for transport. A sheep box is a cab high canopy with special doors for loading and unloading. They can be made of sheet metal and angle iron, or plywood and dimension lumber. Metal boxes are more aerodynamic and last longer. It is rare for ewes, lambs or young rams to challenge a person inside the transport vehicle. Therefore if an animal has problems it is easier on all concerned to enter the box to administer treatment and not try to remove the animal. Blindfold the animal being treated.

Pickup manufacturers change length and width dimensions of standard long/wide beds with changes in body style. Therefore do not assume a box built to fit one make, model or year of pickup will fit a different make, model or year. Check to make sure boxes fit the transport vehicles early enough to allow for modifications.

RELEASE

Plan the release to occur in daylight so animals have time to get oriented in their new range. Usually it is better to hold sheep overnight and release them in the morning than to release in the dark or at dusk.

HOT CLIMATE CONSIDERATION: During hot weather the risks involved with releasing in the dark must be weighed against holding the animals in a hot trailer over-night. You probably have less risk of mortality releasing in the dark than holding the animals until dawn.

Try to select release sites so animals are moving uphill or downhill as they leave the transport vehicle. This is not mandatory but it will help animals stay together, and up or downhill to escape terrain is a normal escape path for wild sheep. The best releases are to back trucks or trailers into the base of the steep ground and open the door. Unfortunately that is not always possible. If conditions require that sheep be flown into the release site there are 3 options. Option 1 is to hire a large helicopter, hobble and blindfold animals, and lay them on the floor of the helicopter for aerial transport. Twin rotor Chinooks can haul about 20 sheep per trip. Option 2 is to hobble and blindfold sheep, place them in transport bags and haul as an external load under a smaller helicopter. With the proper cable system, a Bell Long Ranger can lift 10 sheep in a single trip. Keep in mind that the amount of weight which can be lifted changes with terrain and weather. The ultimate decision belongs to the pilot. Your job is to know what your sheep weigh. Both options require a crew with as many people as sheep to be released at any one time be stationed at the release site before any sheep are transported. When sheep arrive, the crew

should take all the sheep out of the helicopter or transport bags, then hobbles and blindfolds are stripped off as fast as possible so animals are released as close to a single group as possible. Option 3 is to build a specialized flight box which is slung under the helicopter with about 4 sheep per trip. Arizona has built several flight boxes which are kept on a trailer and loaded with sheep as they are processed (Remington and Fuller, 1989). Know the weight of each flight box used. No hobbles or blindfolds are needed. One person must be stationed at the release site prior to transport to release the sheep.

Biologists re-introducing bighorns to Hells Canyon consistently use boats to access release sites. A jet sled or other type of boat with open deck space is best. Sheep are hobbled and blindfolded in the transport vehicle then carried to the boat and laid on the deck. At least 1 person per 2 sheep rides on the boat to keep animals sternal during the trip. The capture boss and boat captains need to calculate load weights to ensure boats are not overloaded, and determine the number of trips or boats needed. Extra people are stationed at the release site to assist with unloading and quickly strip hobbles and blindfolds.

PERSONNEL ASSIGNMENTS AND DUTIES

The focus of this section is capture for transplant, when many sheep will be worked in a short period of time. Capture for marking or sampling a few sheep and release at the capture site requires the same amount of attention to detail but considerably less people. The duties listed are not absolutes. For the various methods of capture each resource agency have their own modifications. The author and editors have stolen from the various duties and activities currently being used in an effort to describe the most efficient methods for capturing and handling wild sheep.

During any type of capture for transplant sheep are caught on the mountain then moved to some type of transport vehicle. Somewhere between the capture site and the transport vehicle it will be necessary to collect samples and attach marks. There are 3 basic methods to complete this step:

1. A base camp is set up and sheep are delivered. The focal point of the base camp are 4 or more tarps and a vet truck with capture supplies. Usually more than one sheep is delivered to base camp at a time, and when delivered they are placed on one of the tarps. Each member of the capture team has a specific duty. Members complete their duty on each animal, moving between animals until all the sampling and marking is completed and sheep are in the transport vehicle.
2. As in method 1 a base camp is set up with tarps as the focal point. Unlike method 1 each tarp has a sample team of 3 to 4 people and when a sheep is delivered to their tarp this team completes all the necessary sampling, health monitoring and marking for the sheep on their tarp. Upon completion the sheep is then moved to the transport vehicle.
3. This method is used for drop net captures. There is no fixed processing area and no tarps used. When the net falls, sheep are worked free of the net and sampled. Assuming you catching about 20 sheep per drop there are 3 sample teams. The sample team consists of

a recorder, blood taker and 1 assistant. The sample team completes all sampling and marking then moves on to the next sheep, repeating the process until all sheep are sampled and marked. After a sheep is processed those individuals designated as handlers and net rollers put the sheep in a transport vehicle.

All duties listed below are needed in each method, however they can be divided among more people than suggested or combined with other duties, depending on the rate animals will be delivered and how many people are desired/available to help. Capture conditions and personal preference will determine which option is used and how it may be modified. An efficient base camp operation will average less than 10 minutes per animal processed. The listed duties are presented assuming you are running an Option 1 base camp. We will try to present considerations for modifying the duties for other options.

For a base camp the number of people needed will vary with objectives of the capture, number of samples being collected, speed with which the animals are expected to be captured, and number of sheep that can be delivered to base camp at any one time. Usually there are more people at base camp than the duties listed. It may not be possible to give everyone a chance to handle a sheep. Keep well being of the animals in mind and be ready to say no. Fewer people than listed will cause the whole operation to run less smooth, increase mistakes, compromise safety and ultimately compromise the welfare of the animals being processed. Personnel numbers identified (Table 4) assume sheep will be delivered to base 4 at a time, and more than 4 sheep/hour will be received. If conditions indicate less than 4 sheep/hour will be received several of these duties can be combined and less people are required. For a drop net operation approximately 1.5 people are required for each sheep expected to be caught in any single drop.

Capture Boss – (Used in all capture methods). One person who is responsible for making sure all the pre-capture preparations occur and running the entire capture operation. At the actual capture this individual will assign duties, assist where needed, and make decisions as they are needed. The capture boss should not have a specific duty, but oversees the entire operation and makes corrections as needed. Any non-medical problems, issues, or concerns that arise during the capture operation are taken to the capture boss. Capture boss decisions are final.

Specific duties include:

- Selects capture method to be used.
- Sets up the capture contract (if necessary) and coordinates with the capture contractor.
- Identifies and orders all supplies needed for capture, sampling, transport and release.
- If captured sheep are to be imported/exported coordinates with the giving/receiving agency to insure all permits are secured and scheduling is completed.
- Selects capture dates and sets up schedule.
- Identifies transport and release methods needed and insures all equipment is available and serviceable.
- Selects capture crew and assigns duties.
- Coordinates any media interest.
- Works with lead veterinarian to secure all needed medications and treatment supplies.
- Selects labs for analysis of samples and finalizes sampling procedures.
- Insures all samples are properly handled and delivered to the labs within the proper time.

- Distributes sampling results to the appropriate biologists and veterinarians.
- Constantly critiques the capture process and identifies improvements.

It is possible for the capture boss to delegate some of these duties, but it is imperative that he/she knows that those delegated duties are being completed in a timely manner and are not causing conflicts with another aspect of the capture. Capture boss duties start a minimum of 4 months before any capture and continue until the final lab results are received and distributed. Depending on the complexity of the capture, 20-30 days before the capture all this planning will become a full time job.

Any single capture operation has a significant number of decisions that must be made during planning and completion. Someone must make those decisions and they cannot be made by committee. A good capture boss asks for a lot of advice throughout the process but it is imperative that their decisions be final. A lengthy decision making process causes unnecessary delays and can result in sheep mortality.

Lead Veterinarian – (Used in net gun, drop net and drive net captures). Primary duty is health and well being of captured sheep. Specific duties include:

- Administers emergency treatments.
- Monitors pulse, respiration and color.
- Completes ultra-sound analysis for pregnancy.
- Selects treatments for stressed animals.
- Recommends changes to procedure as needed.
- Trains individuals giving treatments or taking samples, and assists them when needed.
- Has the final say on all medical related decisions.
- Provides advice to the capture boss.
- Supervises activities of other veterinarians that may be present.

In a drop net capture the lead vet must monitor health for 20-30 sheep at a time rather than the 4-6 sheep processed at once in a base camp. Additional veterinarians are very beneficial, or the lead vet can train one or two biologists to monitor health signs. Drop net captures usually result in lower stress levels because sheep are not run prior to capture. Stress will increase the longer sheep are restrained.

Recorder – (Used in all capture methods). One or more people depending on the type of record form you select. Responsible for recording data during the capture. Specific duties include:

- Record at least 2 temperatures, 1 pulse, and 1 respiration per animal, temperatures must be below the extreme level and descending.
- Notify veterinarian of any problems.
- Checks with team members that all medications have been given, samples taken, ear tags/radio collars are on and recorded correctly.
- Records injuries or anomalies.
- Records any emergency treatments given.
- Gives final approval for a sheep to be moved to the transport vehicle.

Recorders must have the ability to stay focused while multiple sheep are being processed. Some states or provinces use a data form that allows recording information on one page for multiple animals and with this form only one person is needed to record data. Other agencies use one data form per sheep and therefore there is one recorder for each sheep being processed. Both systems work once your capture team is trained.

Restraint Teams – (Used in methods using a base camp). Four teams with 3 people per team. Each team is responsible for moving one sheep from helicopter through processing and to transport vehicles, with several other duties in-between. The team stays with their individual sheep throughout the process. Team members and duties:

- Head Person:
 - With tail person, carries sheep from helicopter to tarp.
 - Removes sling bag and net.
 - Rubs water into the front half of sheep.
 - Positions head for sampling and treatments.
 - Assists with radio collaring.
 - Ages sheep or makes sure it is done and given to recorder.
 - Pays attention that all samples and treatments are completed before sheep is taken off tarp.
 - Advises recorder when sheep is ready to be loaded.
 - With tail person carries sheep from tarp to transport vehicle.

- Tail Person:
 - With head person, carries sheep from helicopter to tarp.
 - Removes sling bag and net.
 - Rubs water into back half of the sheep.
 - Takes rectal temperatures (at least 2) and notifies lead vet if temperatures are extreme.
 - Takes fecal sample and records sample number on fecal glove.
 - Pays attention that all samples and treatments are completed before sheep is taken off tarp.
 - Advises recorder when sheep is ready to be loaded.
 - With head person carries sheep from tarp to transport vehicle.

The procedure for taking temperatures and fecal is to get the first temperature, take the fecal and then take any additional temperatures.

- Water Pourer/Head Restraint:
 - Assists with moving sheep by controlling head and horns. Controlling the head is an important safety concern. If the sheep throws its head back while being carried, the person closest to the neck can take a horn in the face.
 - Pours water on sheep at the request of head or tail person.

- Assist with removing bags, nets, hobbles, and blindfolds; trimming radio collars, etc.
- Finds the lead veterinarian, recorder or other personnel as needed.
- This person is an extra set of hands around each sheep but their activities are controlled by request of the head and tail people.

In an option 2 base camp the head and tail person become part of the sample team and someone else brings the sheep to the tarp for processing then moves it to the transport vehicle after processing.

Blood Taker/Sample Team – (Used in all capture methods). For option 1 you need 2 blood takers. In option 2 there is one sample team per tarp and one member of the team draws blood. Responsible for managing blood kits and using them in order, taking the proper amount of blood, filling all vaccutainers, and properly storing vaccutainers before spinning. For safety, blood takers must notify those people around the sheep that they are coming in with a needle. The lead veterinarian should not be one of the blood takers because of his/her responsibility to monitor health and status of all sheep on the tarps.

In a drop net capture the blood taker becomes one member of a sampling team. Members of the team include the blood taker, one assistant and a recorder. Sample teams move through the sheep as they are cleared from the net. Teams carry their sample kits in one plastic bucket. When a sheep is blindfolded, hobbled and cleared from the net the team takes all samples, gives all medications and affixes ear tags. All samples, used syringes and the record form are put back in the sample bag and the bag is placed in a second plastic bucket carried by the recorder. On a typical drop net capture of 20-30 sheep there should be at least 3 sample teams. Try not to change membership of sample teams during multiple day captures. Once a team works a few sheep they get very efficient. Changing members reduces efficiency and increases stress.

Swabber – (Used in methods using a base camp). One person to take pharyngeal swabs and nasal swabs, mark samples with the correct sample number, and store swab(s) properly for transport to the lab. These samples are not always taken at every capture site every year, so this person could be reassigned to another duty at those sites where no swabs are used. Pharyngeal swabs should be taken for several years in a row at new capture sites until a history is developed, then approximately every 3rd year after a herd history is developed. Nasal swabs are usually required by a state department of agriculture as a condition of the import permit, and are in addition to viral analysis of serum. For option 2 or 3 the sample team will take swabs.

Medicator – (Used in methods using a base camp). Two people, depending on the standard medications selected. One gives wormer and BO-SE and one gives Penicillin and 7-way clostridium vaccine. Medicators need to know dosage rates and the type of injection (IM, SQ), and are responsible for ensuring that guns are cleaned and lubricated as needed during a multiple day capture operation. Medicators need to notify people around the sheep of an incoming needle. For option 2 or 3 the sample team will take swabs.

Pulse/Respiration – (Used in methods using a base camp). One person takes pulse and respiration and gives to the recorder. This duty is optional however, when there are 4 or more sheep being processed it is hard for the veterinarian to keep up with pulse and respiration

monitoring, especially if one sheep is stressed. Veterinarian(s) will monitor pulse and respiration as needed, during drop net captures.

Ear Tags/Radio Collars – (Used in all methods of capture). One person for base camp captures and 3 people for drop net captures. Duty it is to affix ear tags and radio collars (base camp), or just radio collars (drop net). This duty should be the biologist receiving sheep for transplant so he/she can make decisions on location of ear tags and which animals will get radio collars. It is important that ear tag numbers are properly recorded with the correct sample number. The person putting on ear tags must keep the recorder informed of which tag went on which sheep. Responsible for removing all magnets from all collars and ensuring that frequencies are recorded correctly.

In a drop net capture, the sample team puts on ear tags. Radio collars can be put on before sheep are moved from the net or near the transport vehicle. Collaring at the net results in sheep only being picked up and carried one time, but it is one more process that must be completed in the middle of sheep, sample teams, handlers and veterinarians. It is imperative that these people know the desired number, sex and age of sheep to be collared. No collars are put on until after the sample team is finished. Because the sample team will have moved on to another sheep prior to collaring these people need to keep a separate record of the ear tag number and color, and collar frequency put on each sheep so that data records can be updated after all sheep are processed.

Another option is after the sample team is done, the sheep is moved from the net area to the transport vehicle. Somewhere along this route the sheep is set down, a radio collar is attached, the collar frequency and ear tag number and sex is recorded on a separate form. Then the sheep is picked up and put in the transport vehicle. If you choose to PIT tag rams the people putting on collars can put in the PIT tag at the same time.

Helicopter Coordinator – One person whose primary responsibility is to unload sheep and maintain communication with the helicopter pilot. It is essential that this person has direct communication with the helicopter. All personnel need to understand that coordination with the helicopter operation goes through this person only. This person is responsible for unhooking sheep for the restraint teams and supplying the helicopter with nets, bags and water. He or she takes the lead on getting people together to repack nets and sling bags.

Media Person. Wild sheep captures are very popular and generate a lot of media interest. One individual should work with any media or public present to ensure they get the information and pictures needed without compromising efficiency or safety. He/she will need information on objectives, techniques and safety measures for the capture.

Load Supervisor/Transport Crew – In base camp operations one person controls transport vehicle door(s), and just before loading removes blindfold. Often one capture site will be worked for more than one release site. Therefore, this person will take the lead on getting sheep into the correct transport vehicles, keep track of sex ratios in different vehicles, and monitors general health of the animals before transport. He/she needs to be advised by the recorder about which

sheep were stressed or shocky before they were loaded so he/she knows which individuals to monitor after loading but before transport.

If the release will require use of flight boxes or boats the load supervisor may need to keep a list of ear tag number and weight of each sheep and which box it went in. Loads can then be calculated to ensure that the flight box or boat is not over loaded.

For drop net captures the transport vehicles are staged away from the net then moved into place after the net drops. The transport crew consists of at least one person per vehicle to move them into place and assist handlers with loading. They may have the responsibility of putting on radio collars and recording collar frequency, and ear tag number/color (See Ear Tags/Radio Collars).

Enforcement - There will be operations with individuals present that do not support the capture program. If there is any chance these people will be present, it is very beneficial to have an enforcement officer as a member of the capture crew.

Handlers – (Used in drop net captures). At least one handler is needed for every sheep expected to be caught in any single drop. Depending on their experience with animal restraint handlers may need to work in teams of two people per sheep. Handlers are stationed away from the net. When the net drops they move to the net, select a sheep and put on hobbles and blindfolds through the net. They must be cautious to not get strands of net under the hobbles or blindfolds. Handlers stay with their sheep until all sampling and marking is complete then help load it in the transport vehicle. Each handler should have a thermometer so they can take a rectal temperature while waiting for the sample team. Sheep should be kept sternal prior to loading.

Net Rollers – (Used in drop net captures). Six people are required for a 70-90 ft² net. Net rollers need to be experienced at capture and restraint. They are put in the bait truck or stationed close to the net. When the net drops they run to the edges of the net to stop escapes. Once the handlers arrive the net rollers work the net toward the center and assist handlers with removing their sheep. When all the sheep are free of the net and as sample team duties are completed, net rollers help the handlers carry their sheep to the transport vehicle. These people control the flow of sheep from the net to the transport vehicle so bottlenecks do not occur. Net rollers usually have time to age sheep, tell that age to the handler, and the handler gives the age to the recorder.

Net Crew – (Used in linear drive net captures). This group of people set up the drive nets, and blindfold, hobble and place captured sheep in transport bags. Minimum number of people for a net crew is 12. Plan on having at least one person for each sheep expected to be captured in any single drive.

Trap Supervisor – (Used in drop net captures). One individual responsible for baiting and monitoring the drop net prior to capture. Individual informs capture boss of number, sex and age of sheep visiting the net so capture date can be selected, also trips the net on capture day.

Water Pourer – (Used in drop net captures). Because stress increases the longer sheep are restrained, high body temperatures can occur. One or 2 people with 5 gallon water jugs need to move through sheep providing water where needed.

Table 1. Vital Signs for Wild Sheep.

	Normal	Stressed	Extreme
Temperature (F/C) ^a	102/38.5	103+/39.5+	107+/41.5+
Pulse (bpm) ^b	80	130	160
Respiration (rpm) ^c	40	60	75

^a degrees Fahrenheit/ degrees Celcius

^b beats per minute

^c respiration per minute

Table 2. Recommended Wild Sheep Health Sampling Analyses ^a, Western Association of Fish and Wildlife Agencies, Western Wildlife Health Cooperative, 2005.

Test	General Information	Number of Vacutainers	Serum (ml)
Scabies	Swabbing and examination of ears and/or skin for mites is recommended. Samples should be sent to a veterinary parasitologist. Serology is not considered to be reliable. Health histories of source and recipient herds should be similar with regards to Scabies as naïve animals may be severely affected on exposure.	n/a	n/a
Ticks	Representative specimens should be collected intact in a container (Vacutainer) and forwarded to a veterinary parasitologist	n/a	n/a
Contagious Ecthyma (Orf or Soremouth)	Physical examination can usually diagnose active infections. These animals should not be relocated. Health histories of source and recipient herds should be similar with regard to CE as naïve animals may be severely affected on exposure.	n/a	n/a
Serology	Brucellosis (<i>B. ovis</i>) Bluetongue/EHD Respiratory-associated viruses: RSV, PI-3, IBR, BVD OPP Anaplasmosis Leptospirosis (5 strains) Malignant Catarrhal Fever Johne's disease (Paratuberculosis)	2-3 (10 ml red or 6 ml tiger top)	8-10

These diseases are among the most commonly assessed in wild sheep. Exposure to some is common in some herds and rare or nonexistent in others. The choice of disease, test used, interpretation of results and disposition of animals should be discussed with local and state/provincial/territorial/federal wildlife and livestock disease experts prior to the project. Some test results may be required by health authorities prior to movement, others may be performed after sheep are released.

Serum Bank	Held frozen for future retrospective use. Useful in disease outbreak situations for herd disease history	1	4
Trace Mineral	Selenium, Copper, Molybdenum, Iron, Manganese and Zinc. Trace mineral levels may play a significant role in herd immunity of wild sheep, however normal levels are still not well defined.	1 (7ml royal blue)	2
Pharyngeal	Bacterial culture of the pharynx may identify presence of bacteria of high virulence in a sheep herd. <i>Mannhaemia</i> .and <i>Pasteurella spp</i> are of particular significance and require a specific type of swab and culture conditions. Port-a-cul swabs and sterile sampling techniques are recommended. The reference lab (Univ. of Idaho Caine Vet. Center) should be contacted prior to shipping. Swabs should be refrigerated and arrive within 48 hours of collection. The absence these bacteria on culture is no guarantee of their absence in the herd, but is considered useful knowledge.	n/a	n/a
Feces	20-30 fresh pellets (10 grams). Flotation for parasite ova and Baermann for larvae. Samples should be sent fresh or frozen to a veterinary parasitologist familiar with wild sheep parasites.	n/a	n/a

^aIt is strongly recommended to document and share the herd health history of source and receiving sheep herds where translocation is used for sheep management. This should include previous sampling and results, herd demographics, disease outbreaks and other diagnoses. Diseases endemic in sympatric wildlife and domestic species, particularly domestic sheep and goats are of strong interest as well and should also be documented.

Table 3. Optional Health Tests for Wild Sheep.

Test	General Information	Number of Vacutainers	Serum (ml)
Pregnancy	Use a 7ml red, tiger or blue vacutainer or use some serum from one of the standard tests. Pregnant Specific Protien-B (PSPB) or Progesterone level test to check for pregnancy. Need only send samples from adult females. For PSPB: Dr. Garth Sasser, BioTracking, 105 E 2 nd St. #2, Moscow, ID, 83843. (208) 882-9736. www.biotracking.com Most labs can test for Progesterone. If your capture is later in the pregnancy period, and you have access to a trans-abdominal ultra sound you can determine pregnancy during handling. Do not use a rectal probe ultra sound.	1	1-2
Nasal Swab	For virus isolation. PI-3, IBR, RSV, BRSV.	-	-
Blood	Hematology/ CBC (3ml purple top) Clinical biochemistry (10 ml red or tiger top)	- 1	- 4-5
Genetic Analysis	Genetic analysis can be done from hair, tissue or whole blood. Collect blood in 7ml green or purple top vacutainer. It is very important that you ask the lab how they want samples collected and how much sample they want. Other DNA work, such as NRAMP analysis May require specific samples. Contact the research biologist for sample instructions.	1	3-4

Table 4. Personnel Assignments for Wild Sheep Capture Methods.

Assignment	Net Gun	Drop Net	Linear		Chemical
			Drive Net	Corral Trap	Immobilization
Capture Boss	X	X	X	X	X
Lead Veterinarian	X	X	X		
Recorder	X	X ^a	X	X	X
Restraint Team	X		X		
Blood Taker/Sample Team	X	X	X		
Swabber	X		X		
Medicator	X		X		
Pulse/Respiration	X		X		
Ear Tags/Radio Collars	X	X ^b	X		
Heicopter Coordinator	X		X		
Media Person	X	X	X	X	X
Load Supervisor/Transport Crew	X ^c	X ^d	X ^c		
Enforcement	X ^e				
Handler		X			
Net Roller		X			
Net Crew			X		
Trap Supervisor		X			
Water Pourer		X			

^a Member of sample team

^b Ear tags are put on by sample team

^c Load Supervisor

^d Transport Crew

^e Optional

Figure 1. Example of label for wild sheep samples



^a Acronym which identifies agency submitting sample

^b Year of capture

^c Sample number

Figure 2. Wild sheep capture base camp

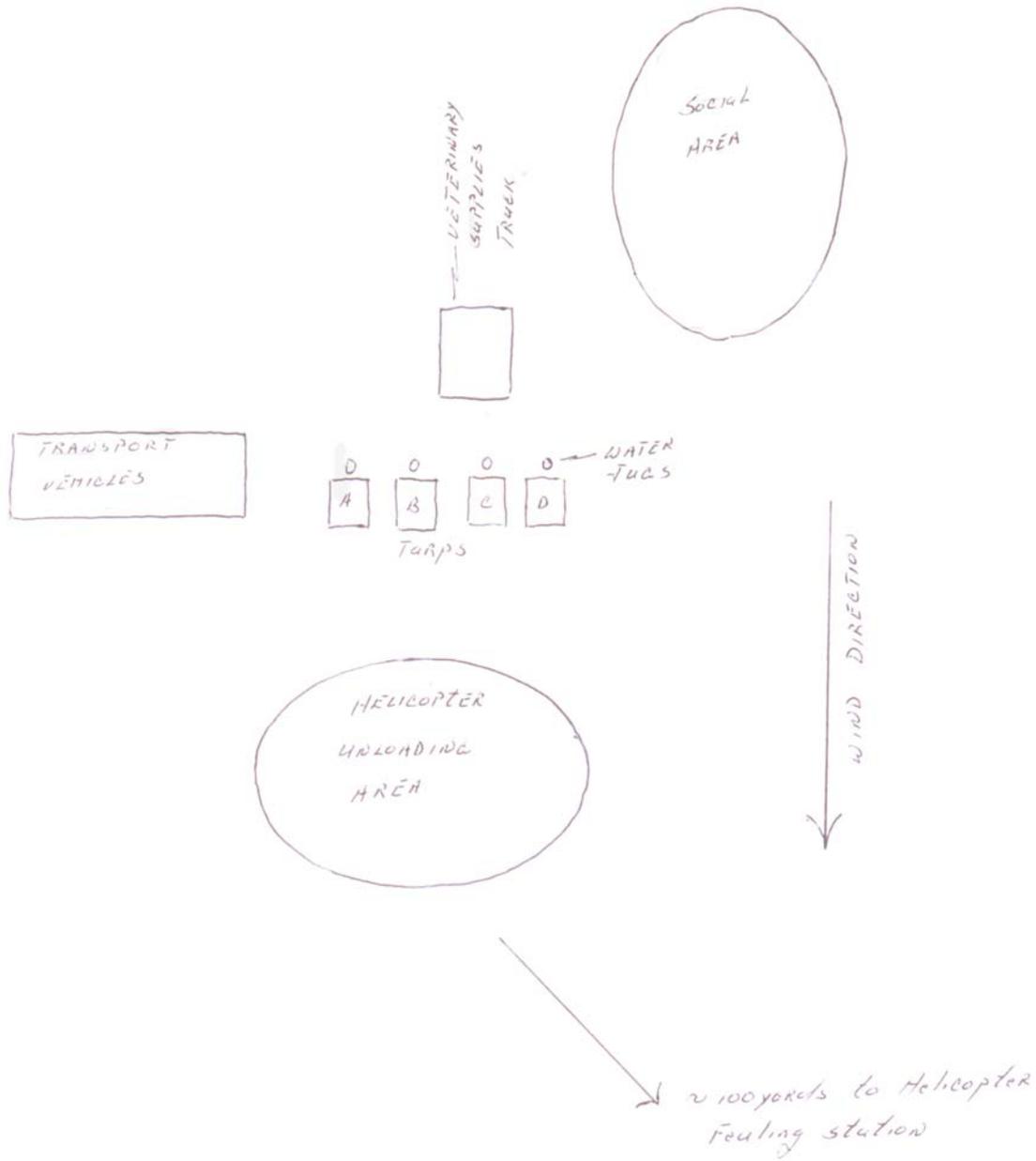


Figure 3. Wild sheep capture drop net layout. Diagram depicts period after net has fallen with all vehicles and personnel in place.

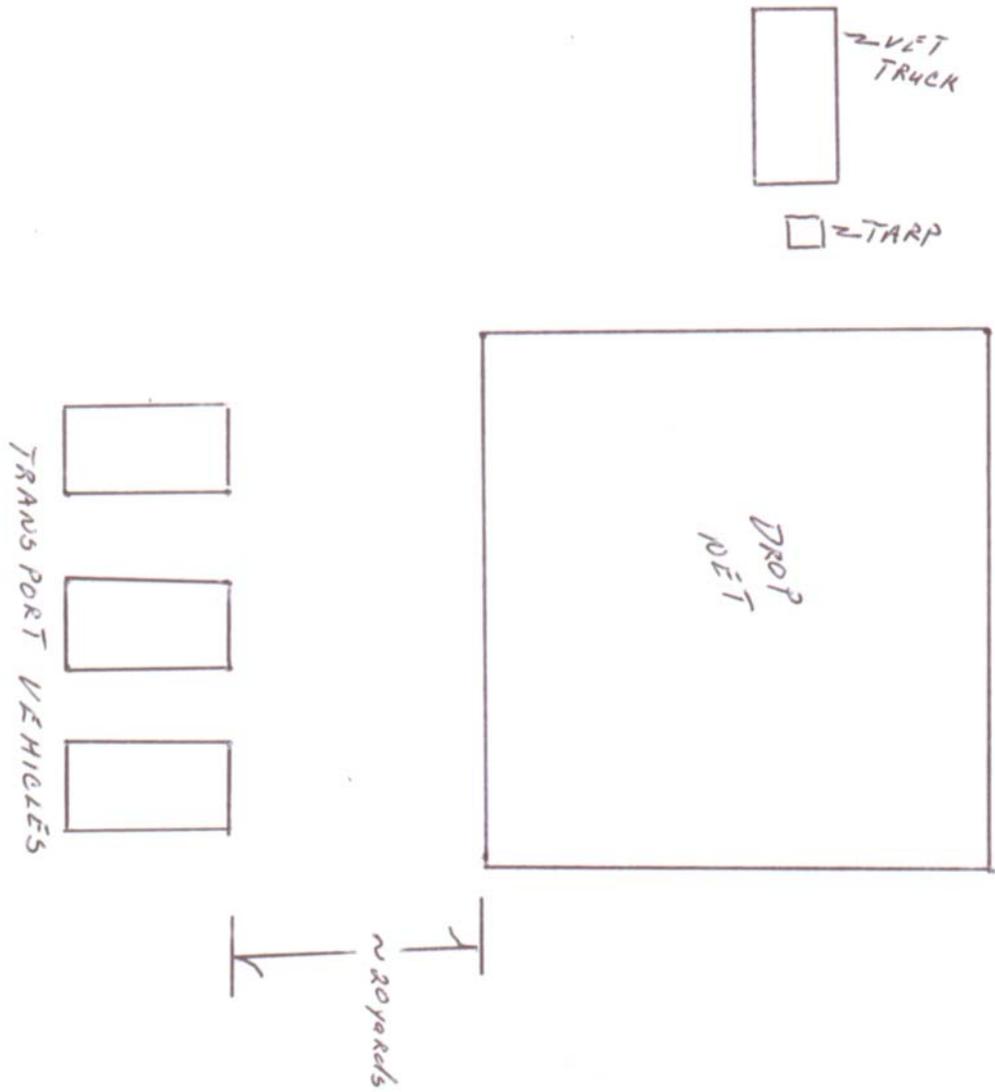
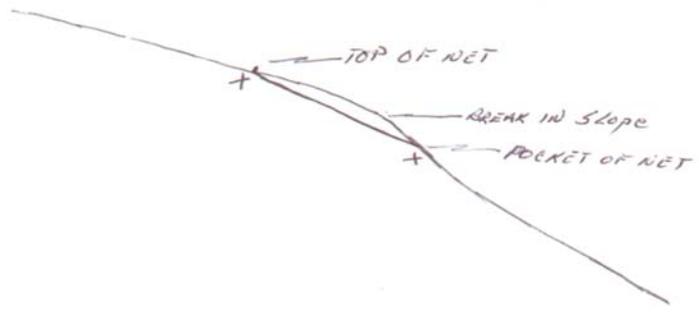
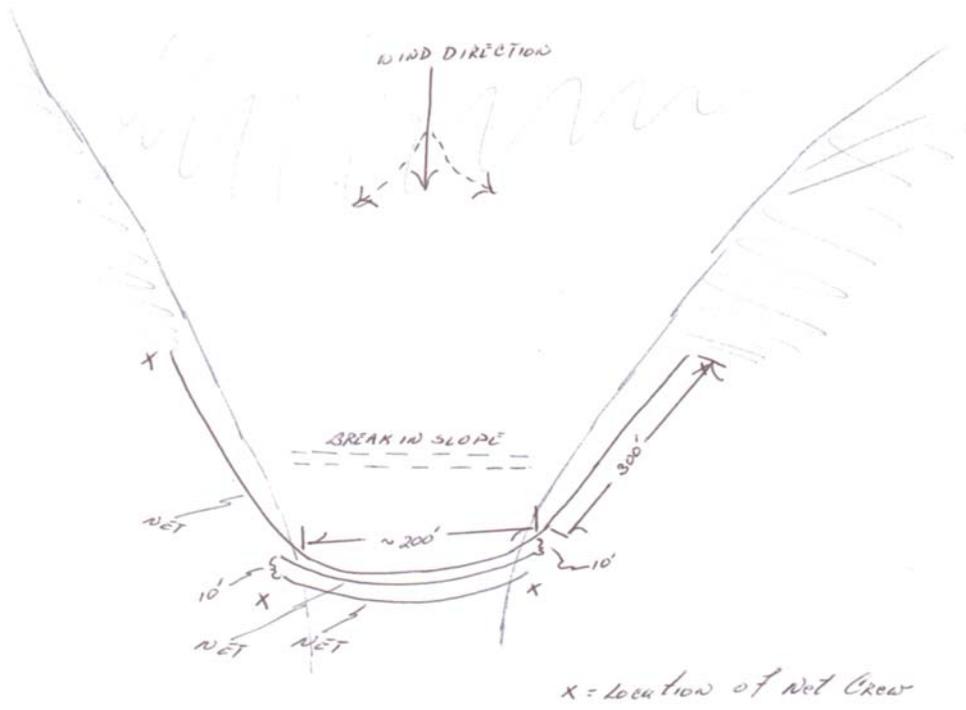


Figure 4. Wild sheep capture linear drive net.



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APPENDIX 1

EQUIPMENT LIST

General Supplies

- Blindfolds (12 or more)
- Canvas Tarps (4) with 40dd spikes and ½ inch fender washers (4 per tarp)
- Clip Board and Record Forms
- Extra Radio Collar Supplies: attachment hardware, nuts, nut drivers
- Heavy Shears (for trimming radio collars)
- Hobbles (12 pair or more)
- Paper Towels
- Parachute cord, super glue, duct tape
- Plastic Bags: (assorted sizes) zip locks, whirl-packs, large garbage bags
- Plastic Buckets (6-12)
- Push Broom
- Scrub Brushes
- Sharpie Markers (20 black, 20 red), Pencils
- Stretchers
- 5 gallon water jugs (6 minimum)

Medical Supplies

- Bandage Material
- Disposable examination gloves
- Enema tube and funnel
- K-Y Jelly (6 tubes)
- Lactated Ringers solution, 5% Dextrose solution, IV drip kits
- Oxygen bottle with regulator and plastic tube or face mask delivery system
- Tackle Box containing extra syringes (3,6,10,35 cc) and needles (18 & 16 ga.) (1 & 1.5")
- Tackle Box containing extra ear tags, pliers and replacement needles
- Stethoscope(s)
- Surgical Instruments: hemostat, scalpels, needles
- Surgical scissors and Serrated Scissors
- Suture Kit
- Swabs: Pharyngeal, Viral, Common
- Vacutainers: a small assortment of extras in case of breakage
- Wound Medication: anti-bacterial spray, blood clotting powder, tamed iodine solution

Sample Kit Contents

- Large syringe(s) (2-35ml or 1 60ml)
- 16ga.X1.5" needle
- Vacutainers (number and type depends on tests selected)
 - 2-3 Tiger top (10ml)
 - 1 Royal blue top (7ml)
 - 1 Purple top (3ml)

- 1 Green top (7ml)
- May also include:
 - Ear tags
 - Individual syringes and needles for medications
 - Examination Glove
 - Record Form
 - Swabs: Pharyngeal, Viral, Ear

Medication Supplies

- Ice chest or Insulated box
- Medications (options include: Banamine, BO-SE, Clostridium Vaccine, Penecillin, Oxytetracycline, Wormer, Dexamethasone, Sodium Bicarbonate)
- Syringe Guns: (2-3), soap and small test tube brush , glycerin lube

Necropsy Kit

- Skinning knife, scalpels, boning knife
- Sharpening stone/steel
- 10% Formalin
- ziplock bags and whirl pack backs
- specimen bottles
- scrub brush
- anti bacterial soap

Blood Processing Equipment

- Centrifuge
- Ice chest with ice packs for holding serum, biological specimens, purple & green vaccutainers, swabs.
- Ice chest with warm packs for holding tiger top and royal blue vaccutainers
- Test tube racks (5), with large enough openings to hold a 10ml vaccutainer

APPENDIX 2

CONTACT PERSONNEL

Following is a list of people that have experience in various forms of trapping and transplanting wild sheep. They were instrumental in developing this document. They may not have all the answers to all your questions, but if you contact them they will be able to refer you to someone that does.

Frances Cassirer, Hells Canyon Initiative Coordinator, Idaho Fish & Game, 1540 Warner Ave., Lewiston, ID, 83501. (208) 799-5010. Email: cassirer@idfg.state.id.us Import, Drop Net, Net Gun, Animal Health, Rocky Mountain Bighorns.

Vic Coggins, District Wildlife Biologist, Oregon Department of Fish and Wildlife, 65495 Alder Slope Rd, Enterprise, OR, 97828. (541) 426-3279. Email: coggins@oregontrail.net Corral Trapping, Animal Health, Rocky Mountain Bighorns.

Mark Drew, Veterinarian, Idaho Fish and Game, Wildlife Health Lab, 16569 S. 10th Ave. Caldwell, ID, 83605. (208) 327-7070. Email: mdrew@idfg.state.id.us Lead Veterinarian, WWHC member.

Bill Dunn, Program Leader, New Mexico Dept. of Fish and Game, POB 25115, Santa Fe, NM, 87504. Phone(505) 827-9927, Email: wcdunn@state.nm.us Desert Bighorn.

Marco Festa-Bianchet, Professor, Departement de biologie, Universite de Sherbrooke, Sherbrooke, Quebec, J1K2R1, Canada. Box Traps, Thin Horns.

Craig Foster, District Wildlife Biologist, Oregon Department of Fish and Wildlife, POB 1214, Lakeview, OR, 97630. (541) 947-2950. Email: Craig.I.foster@state.or.us. Capture planning and implementation, California Bighorns.

Kevin Hurley, Wildlife Biologist, Executive Director Northern Wild Sheep and Goat Council, Wyoming Game & Fish Department, 2820 State Hwy 120, Cody, WY, 82414. (307)-527-7125. Email: Kevin.Hurley@wgf.state.wy.us Drop Net, Net Gun, Chemical Immobilization, Rocky Mountain Bighorn.

Emily Jenkins, Veterinarian, Western College of Veterinary Medicine, Univ. Saskatchewan, 52 Campus Drive, Saskatoon, SK, Canada, S7N 5B4. (306) 966-7246. Email: Emily.jenkins@usask.ca Thin Horns.

Susan Kutz, Veterinarian, Western College of Veterinary Medicine, Univ. Saskatchewan, 52 Campus Drive, Saskatoon, SK, Canada, S7N 5B4. (306) 966-7242. Email: susan.kutz@usask.ca Thin horns

Terry Kreeger, Veterinarian, Wyoming Game & Fish, Sybille Wildlife Research Unit, 2362 Hwy 34, Wheatland, WY, 82201. (307) 322-2571. Email: Terry.Kreeger@wgf.state.wy.us Chemical Immobilization, Lead Veterinarian.

Ray Lee, Foundation for North American Wild Sheep, 720 Allen Ave, Cody, WY, 82414, (307) 527-6261 Email: rlee@fnaws.org Desert Bighorn, Capture and Import.

Leon Pielstick, Veterinarian, Harney County Veterinary Clinic, 1050 Crane Blvd. Burns, OR, 97720 (541) 573-6450. Email: leonandsusan@centurytel.net Lead Veterinarian.

Eric Rominger, Professor, Department of Fisheries and Wildlife Science, University of New Mexico, PO Box 704, Santa Fe, NM, 87504. (505) 660-0038. Email: erominger@msn.com Capture planning, Desert Bighorn, Rocky Mt. Bighorn.

Helen Schwantje, Veterinarian, Wildlife Branch, BC Environment, POB 9374, STN PROV GOV, Victoria, BC, Canada, V8W 9M4. (250) 953-4285. Email: Helen.Schwantje@gems2.gov.bc.ca Import/Export, Lead Veterinarian, WWHC member, All Wild Sheep.

Walt VanDyke, District Wildlife Biologist, Oregon Department of Fish and Wildlife, 3814 Clark Blvd., Ontario, OR, 97914. (541) 889-6975. Email: Walt.A.VanDyke@state.or.us California Bighorns.

APPENDIX 3

BLOOD SAMPLE COLLECTION AND PROCESSING FACT SHEET

BC Wildlife, Helen Schwantje, DVM

INTRODUCTION:

Animal handling for any reason can put the animal, as well as handlers, at risk. The collection of as much information as possible, while properly handling the animal, supports the project justification, economics and science. If done correctly, the sample collection can be fast and safe for all, and produce information valuable to both the individual project and overall population management.

The collection of serum and genetic material for banking is recommended, as a minimum, whenever an animal is handled. Banking can be coordinated through Dr. Helen Schwantje, Wildlife Veterinarian for the Wildlife Branch. There may also be a standard series of samples appropriate for the species, project and useful to other cooperative studies. Consultation with the project leader and Dr. Schwantje prior to animal handling, regarding recommended samples and techniques is advised.

BEFORE THE PROJECT:

Before samples are collected in the field, the project leader should be clear what information is required from the samples, what type of sample is needed, how they should be collected, processed, preserved and stored. Individual animal kits with the appropriate materials can then be prepared beforehand. For example, numbered ziplock plastic bags with all needed supplies previously labeled are useful and easy to transport.

A data sheet should be prepared prior to the field work, including a checklist for samples, to ensure collections are completed in the field before animal release. The sheet can include animal history, and include location, number, species, sex and age of animals, reaction to handling, and other appropriate data.

SAMPLES:

BLOOD

Blood is one of the most common samples collected from wild animals and can be used to determine physiological condition, disease exposure and genetic profiles. **Blood is fragile.** Proper collection, handling, processing and storage are critical to assure good quality samples, or the effort and sample is wasted. Improper treatment of blood samples will result in the inability to perform tests or inaccurate results. The type of sample handling and storage will vary with the

sample purpose, whether for serum chemistry, hematology, serology, microbiology, virology, trace elements, toxicology or genetics.

Generally, blood is collected into sterile glass tubes, manufactured with or without a preservative (Vacutainer®), and kept refrigerated and protected from freezing, excessive heat and strong sunlight.

Blood has two basic components: solids, including red and white cells, and liquid or serum, containing a number of measurable compounds. Blood solids drawn from the body will clot, unless treated with an anticoagulant. Serum is the clear liquid left after blood clot formation and retraction. Clot formation is best accomplished at room temperature for 6 to 12 hours, but it can occur much faster.

Serum should be separated from other blood components as soon as possible for most laboratory analyses, but this may vary. Centrifugation is used to complete the separation and maximize the harvesting of serum. A pipette or 3 ml syringe with a 1 1/2" needle can be used to draw off the serum. A different pipette/syringe with needle must be used for each sample to avoid contamination.

If no centrifuge is available, serum can be aspirated, or poured off, taking care that the clot is not disturbed. This may be a delicate procedure. Some tubes (serum separator tubes or SST tubes) contain a gel which separates the clot from serum after centrifuging, allowing easy separation by pouring off the serum. If separation of serum and cells does not occur, blood cells break down after about 24 hours and the leakage of pigments (hemolysis) can destroy the quality of samples. Hemolysis also occurs with rough handling of blood, shaking of tubes, use of too small a needle, repeated puncturing of the blood vessel, bacterial contamination and extremes of heat and cold.

Separated serum not analyzed immediately should be placed into new glass tubes (3 ml size saves space), labeled properly or numbered corresponding to the data sheet and frozen. Tubes should not be overfilled as the liquid will expand and push the stopper off when frozen.

BLOOD COLLECTION EQUIPMENT:

Two systems are commonly used to withdraw blood. They are the Vacutainer® double ended needles and plastic cuffs or disposable plastic syringes and needles. Both utilize Vacutainer® glass tubes.

Vacutainer® double ended needles are screwed into a plastic cuff. One end of the needle is inserted into the vein, while the glass blood tube is inserted onto the other end. The needles used may be small bore (20 gauge) and these can damage red cells. Larger needles are available, however, it may be difficult to collect large volumes or multiple tubes of blood with this system, especially with active, physically restrained animals under field conditions. The needles are easily dislodged with animal movement. Blood can freeze in narrow bore needles before entering the tube during cold weather.

Syringes of various sizes (6, 12, 20, 35 or 60 ml) with large bore (16 or 18 gauge) needles attached, have advantages in some situations, particularly when multiple tubes of blood are required. Blood is drawn into the syringe, then transferred to Vacutainer® tubes. Some samplers use flexible extension tubes that link the needle in the vein to the syringe and allow movement of the animal without dislodging the needle from the vein.

Vacutainer® tubes have colour coded rubber stoppers, depending on the content. They are red for no anticoagulant, red/black for separator gel (SST), purple for EDTA anticoagulant, green for heparin, etc. There are three sizes; 3 ml, 7 ml and 10 ml.

All blood collection equipment must be sterile and disposable. Used needles, syringes and tubes should be disposed of in appropriate water proof, puncture proof containers according to safety policies.

BLOOD COLLECTION TECHNIQUE:

The sampler must be familiar with the anatomy of the species to be collected from and the preferred sites for blood collection. For many species, the jugular vein is the largest and most superficial vein. For bears, big cats and some other carnivores, the femoral vein in the groin, or saphenous vein in the hind leg is covered with thinner skin, less hair and farther from teeth and claws, so may be the preferred site. Alcohol can be used to flatten hair, outline the vein and clean the surface of debris. Correct positioning, firm but gentle holding off of the vein and lack of movement of the animal will ease collection. Practice is mandatory for expertise to develop. Please contact someone familiar with this technique (experienced biologist, local veterinarian) for training before attempting it in the field.

Since veins are a low pressure system, blood pressure must be created by holding off the vein at a location between the site to be punctured by the needle and the heart. Holding off the vein in this manner is necessary to see and enter veins. For example, on the neck, the jugular vein is usually accessed at a mid neck position, using thumb or fist pressure below this position to allow the jugular to stand out. For the foreleg, the cephalic vein is accessed on the upper front surface of the foreleg with a tourniquet or assistant's hand holding the vein off at the elbow level.

When the sampler is ready to collect blood, the vein is located and held off. If using a syringe, the plunger should be checked for free movement and any air expelled from the syringe. The needle cover of either type of needle is removed and the needle turned so that the bevel, or slanted opening, is facing up. The vein is visualized or palpated with the finger, and the needle is inserted through the skin at a slight angle (20 - 30 degrees), either directly over the vein or parallel to it. Entry into the vein is confirmed by blood appearing in the hub of the needle. The needle is advanced slightly into the vein, maintaining the plastic cuff or syringe parallel to the skin surface, to avoid pushing the needle through the other wall of the vein. Gentle pressure is used to either advance the vacuum tube onto the double ended needle within the cuff of the Vacutainer® system, or gentle pressure on the syringe plunger will withdraw the desired quantity of blood. To prevent excessive bleeding, finger pressure should be maintained on the puncture site for several minutes after needle withdrawal and release of pressure. Bleeding can be pronounced when using large bore needles.

BLOOD HANDLING:

Blood is pulled into tubes by vacuum pressure when using the Vacutainer® system. They should not overfill by this technique. When using syringe and needle systems, the needle and filled syringe is removed from the animal, the needle removed from the syringe, the stopper removed from the tube and blood gently expressed into the tube along the inside wall. Tubes should be filled approximately 3/4 full, so that rubber stoppers can be properly replaced. Alternatively, the needle can be inserted through the tube stopper for vacuum fill. It must be noted that excessive turbulence of blood can damage blood cells, so allow the vacuum to pull the blood into the tube rather than pushing it in.

If multiple syringes are used to collect larger quantities of blood, the needle is gently pulled away from, or turned off the syringe tip, the syringe handed to an assistant to decant into tubes, and a new syringe attached to the needle, still in the animal's vein. This can be a delicate procedure and vein access may be lost if excess handler or animal movement is present.

Blood collected in anticoagulant tubes (purple and green tops, usually) is used for the examination of cells or genetic evaluations. Fill these tubes first to avoid clotting. Immediately after collection into these tubes, the blood and anticoagulant should be **mixed gently** by rocking the tube from side to side 4 to 5 times. It should then be kept as still as possible and refrigerated until required. In some situations, these tubes can be frozen for storage. Consult with the laboratory, researcher or Dr. Schwantje first.

Blood collected for serum separation (red or red/black tops) should be kept upright, as still as possible for 6 to 12 hours (1/2 hour minimum) to allow clotting, then spun for serum separation as soon as possible, finally the serum should be frozen for storage.

Please call Dr. Helen Schwantje (250-953-4285) with any questions regarding this fact sheet.

BIGHORN SHEEP HERD HEALTH SCREENING AND SAMPLING PROTOCOL

PHYSICAL EXAM:

Age - estimated years Sex

Weight - estimated

Health comments:

IDENTIFICATION:

Eartag #s Right Left

Radiocollar frequency # (if used)

PHARYNGEAL SWABS:

BACTERIOLOGY - Accuculture swabs preferred, attention for Pasteurella spp., save cultures for biotyping

BLOOD SAMPLES:

SERUM - 10 ml red top vacutainer X 2 or 3

- **SEROLOGY** - routine screen for Brucella ovis, BRSV, PI-3, BVD, BT, Scabies ...plus/- for export testing if applicable

- **CHEM SCREEN** - if desired

- **BANK** - extra serum

SERUM - 7 ml blue vacutainer X 1

-**TRACE MINERALS**

WHOLE BLOOD - 10 ml heparin(green vacutainer) or 7 ml EDTA(purple vacutainer) X 2 (depending on involved lab)

- **GENETICS** analysis (for **NRAMP, MICROSATELLITES**)

- **CBC** - if desired

- **BANK**

******BLOOD MINIMUM: - 2 X 10 ml red top tubes, plus**

- 1 X 7 ml purple top tube or 2 X 3 ml purple top tubes

OTHER SAMPLES:

HAIR FOLLICLES

- 20 hair roots for genetic banking, store dry in paper envelope, freeze (check with lab involved)

FECES

- **FLOATATION + BAERMANN** - fresh, store chilled

- consider **JOHNE'S** if warranted

EXTERNAL PARASITES

- if any, save in alcohol

- check **EARS** for mites by swabbing deeply, store chilled

TREATMENT - advised as minimum

- **VITAMIN E/SE**

- **IVERMECTIN** (or other larvicidal)

- **ANTIBIOTIC** (long acting tetracycline)

APPENDIX 4

Examples of Data Record Forms



BIGHORN SHEEP CAPTURE FORM – HELLS CANYON

Capture date _____ Time _____ Herd _____

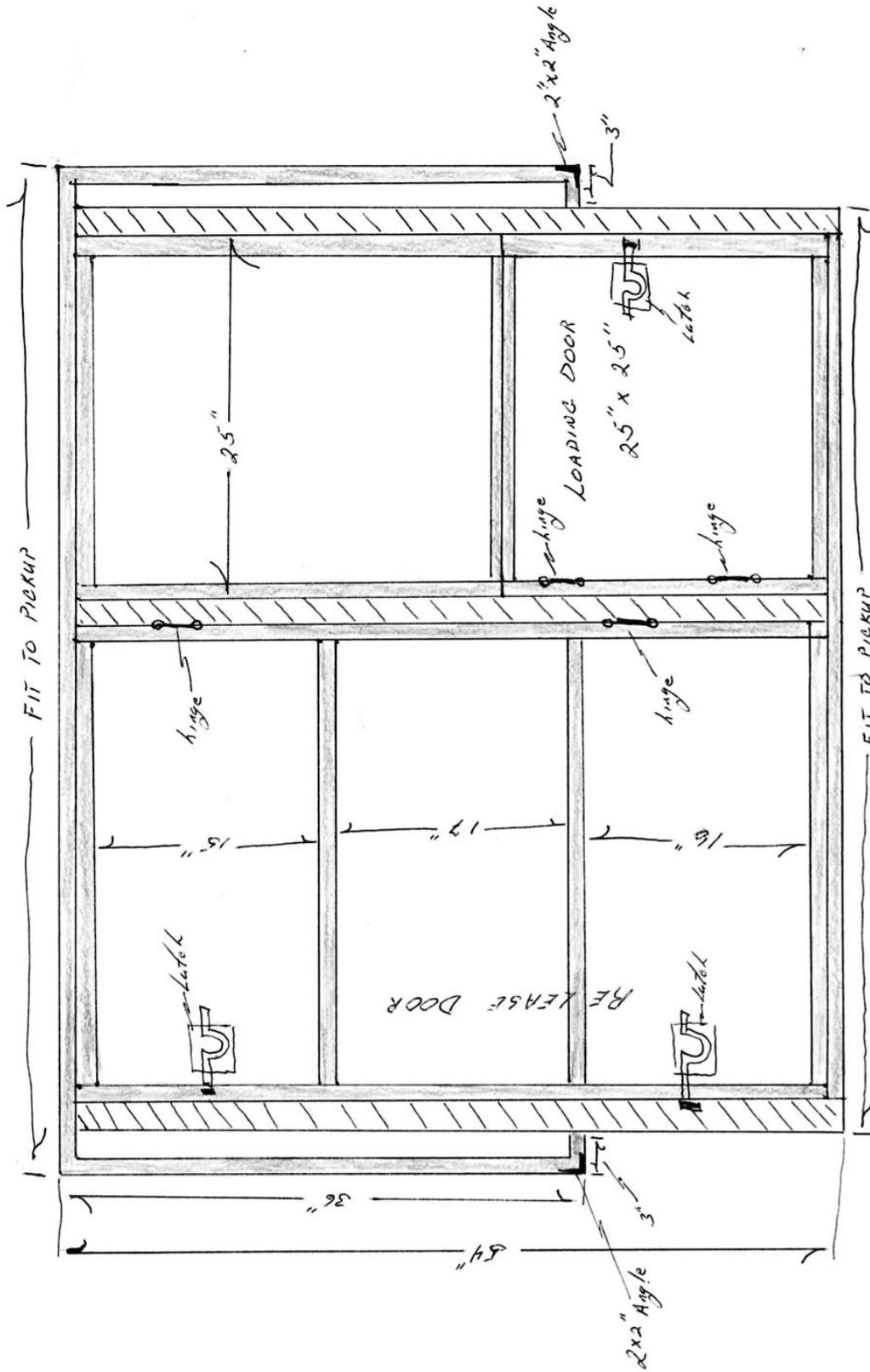
Sex			Age		
Color Tag#			Color Tag side		
Radiocollar color			Radiocollar freq.		
Condition		Withers	Ribs	Hips/Rump	
Horn basal circ. L			Horn basal circ. R		
LEFT HORN			RIGHT HORN		
Year	Length (cm)	Circumference (cm)	Year	Length (cm)	Circumference (cm)
1			1		
2			2		
3			3		
4			4		
5			5		
6			6		
7			7		
Time		Temperature	Time		Temperature
3 cc Ivermectin SC		5-7 cc LA-200 IM			2-3 cc BOSE IM/SC
Red top		Blue top	Green top		Purple top
Pharyngeal		Fecal	Ear swab		

APPENDIX 5
Plans – Oregon Sheep Transport Box

Additional Specifications:

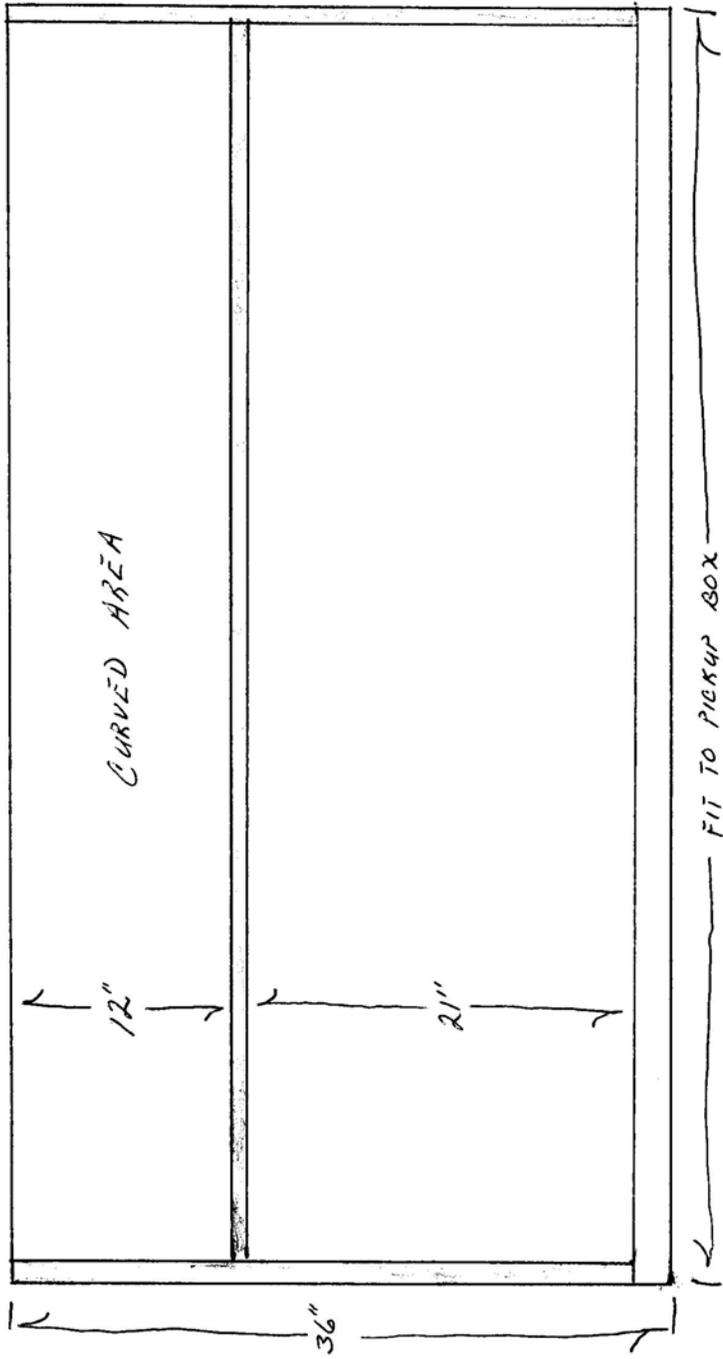
- Exterior Siding – coiled aluminum semi roofing (0.040 thick). Available from Reynolds Aluminum, Portland, OR (503)-283-4705. Seams only on corners and edges. Fastened on with large head 3/16” aluminum pop rivets or aluminum aircraft rivets. 4” spacing between rivets on flats. 3” spacing between rivets on edges and corners.
- Curved Front – 1” square tubing (any wall thickness) with 12” radius bend. Custom order from Carl-Built Inc., Manteca, CA, (209)-239-9100. Or any other vendor that has the ability to fabricate the radius in box tubing.
- Molding or Trim Strips on all exposed exterior siding edges.

REAR VIEW



1" x 1" Square Tube (.065 wall)  1" x 2" Rectangular Tube (.065 wall) 

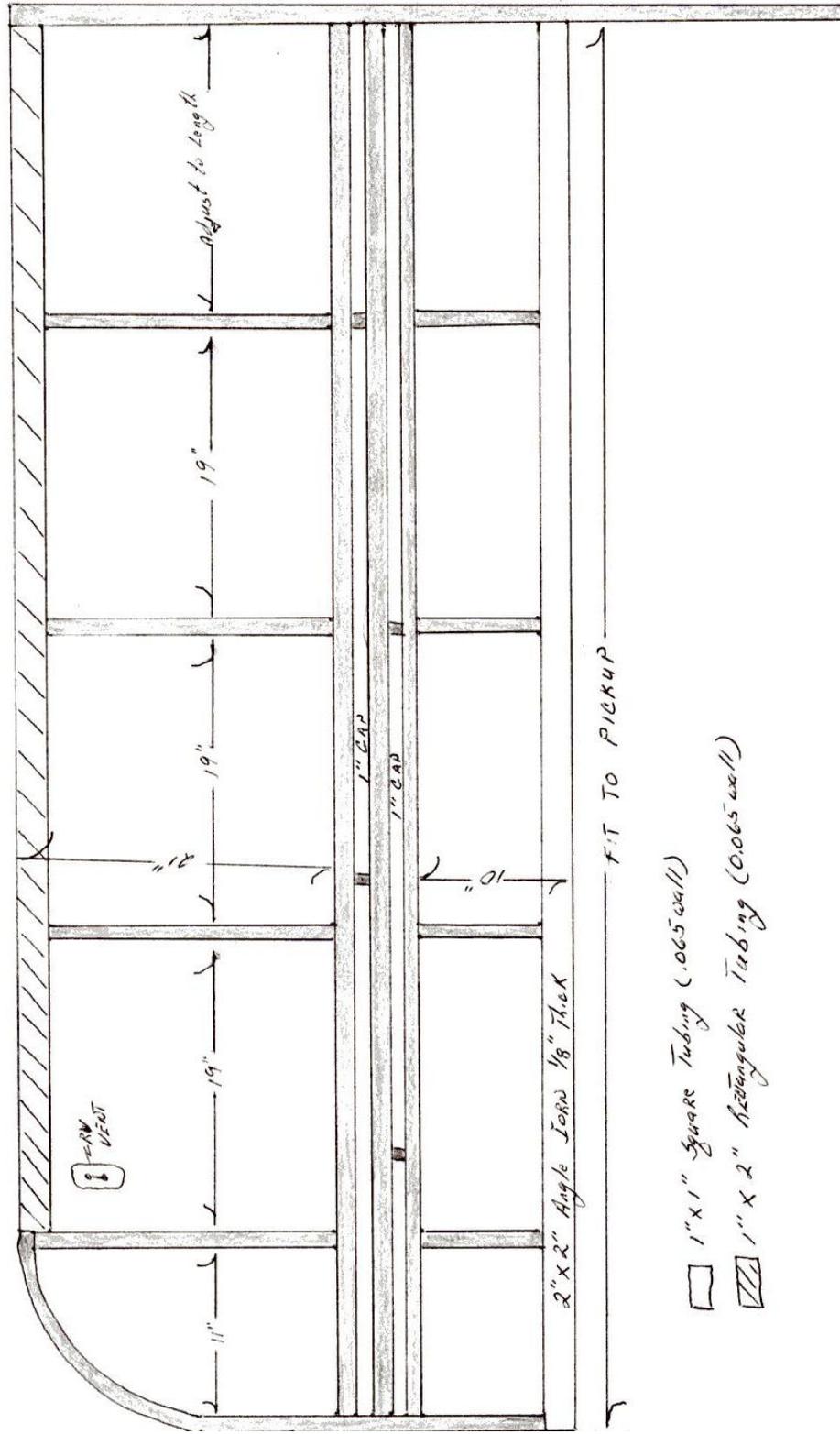
FRONT VIEW



1" X 1" SQUARE TUBING (0.065 WALL)

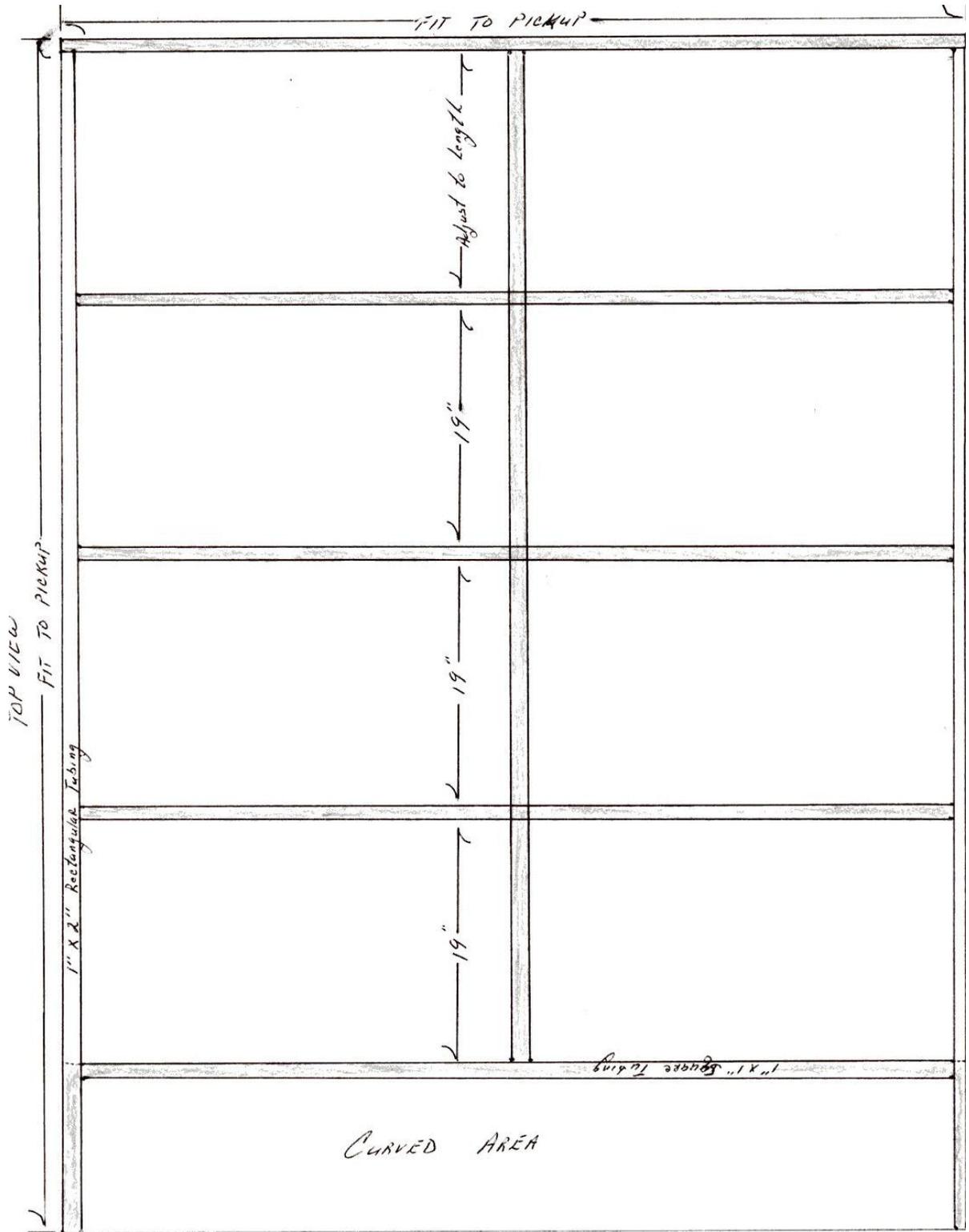
2" X 2" X 1/8" ANGLE IRON

SIDE VIEW

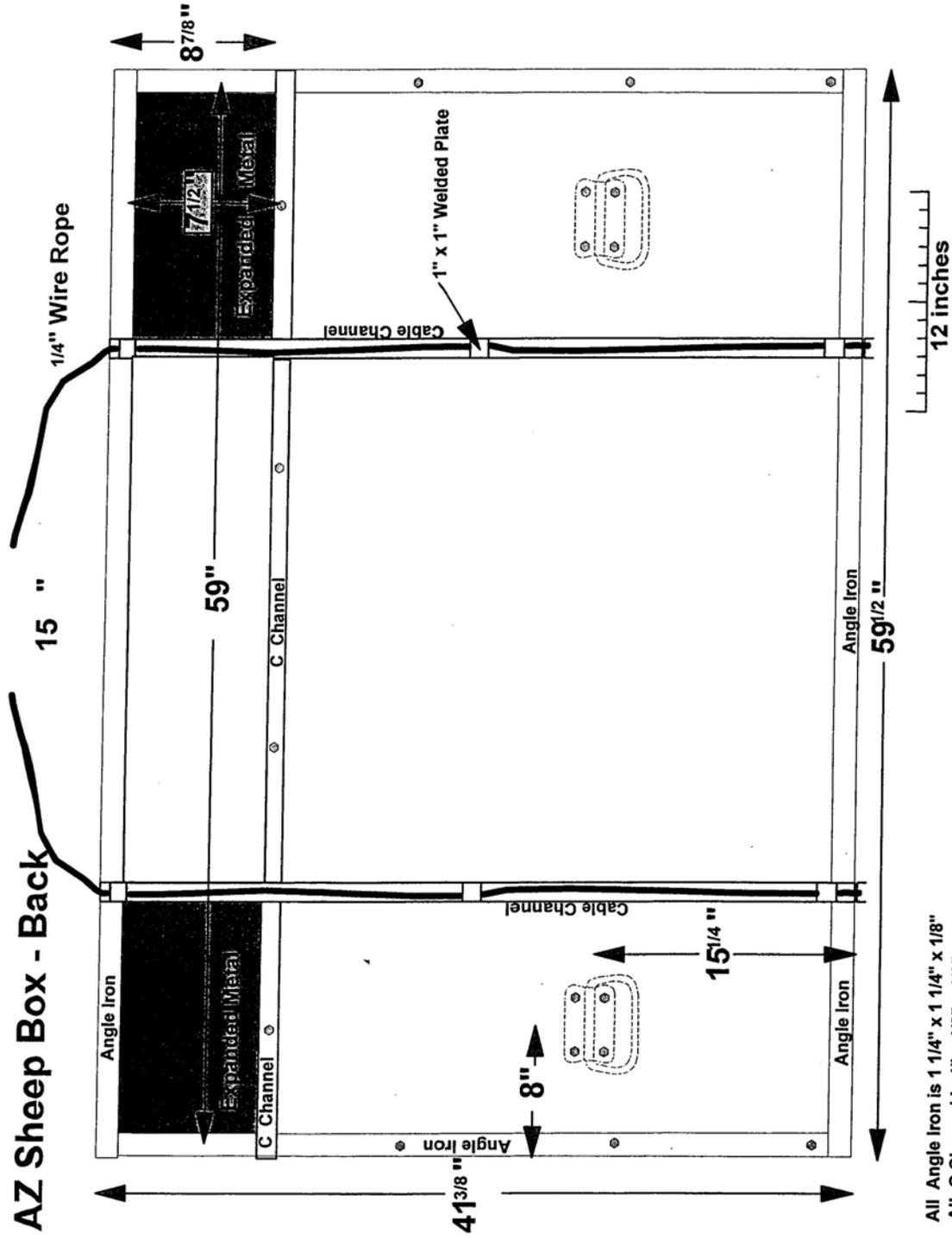


□ 1" X 1" Square Tubing (.065 wall)

▤ 1" X 2" Rectangular Tubing (.065 wall)

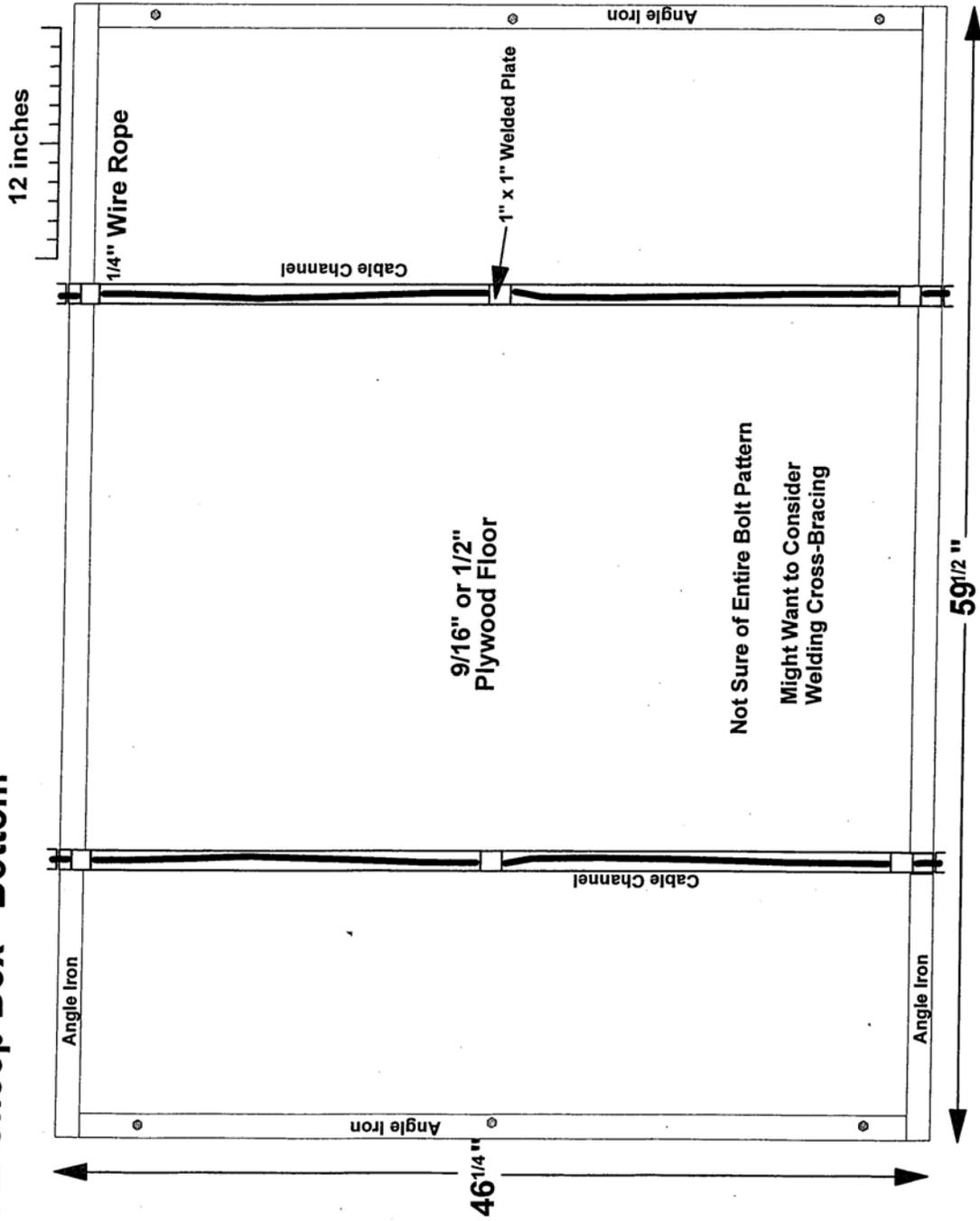


Plans - Arizona flight box

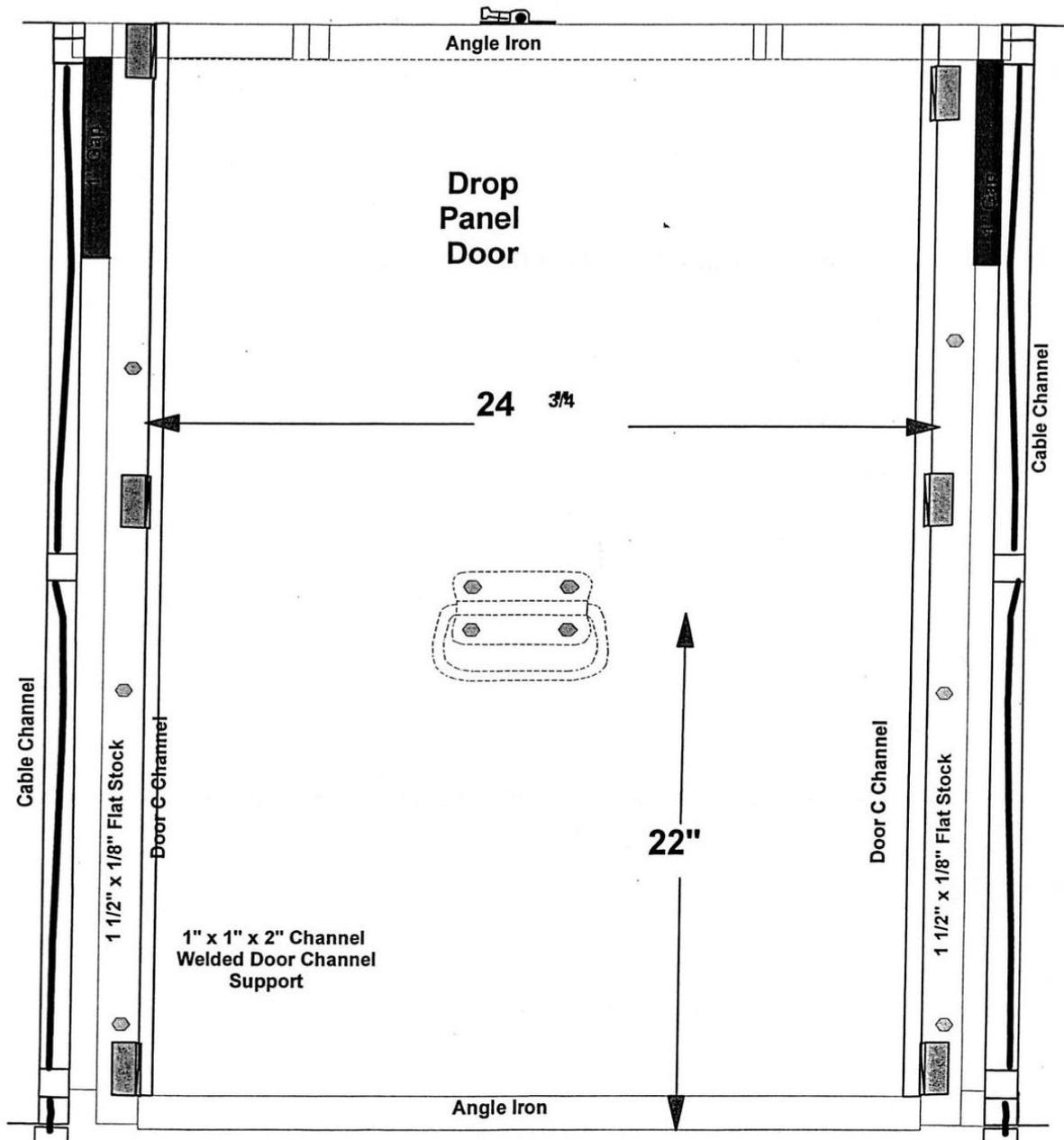


All Angle Iron is 1 1/4" x 1 1/4" x 1/8"
 All C Channel is 1" x 1/2" x 1/8"
 All Bolts are Panhead 1/4" x 1"

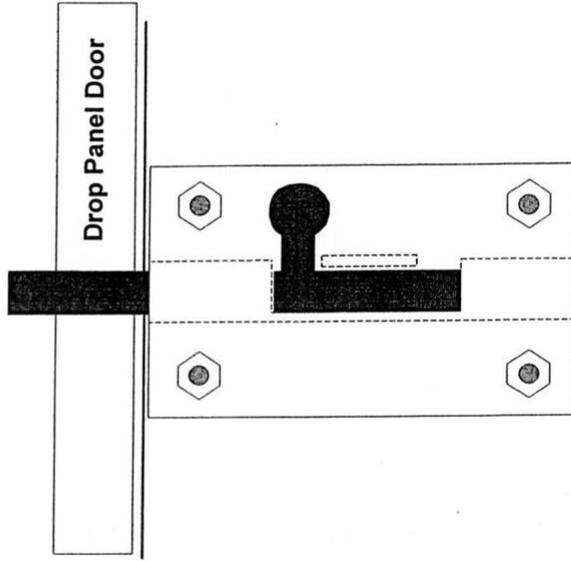
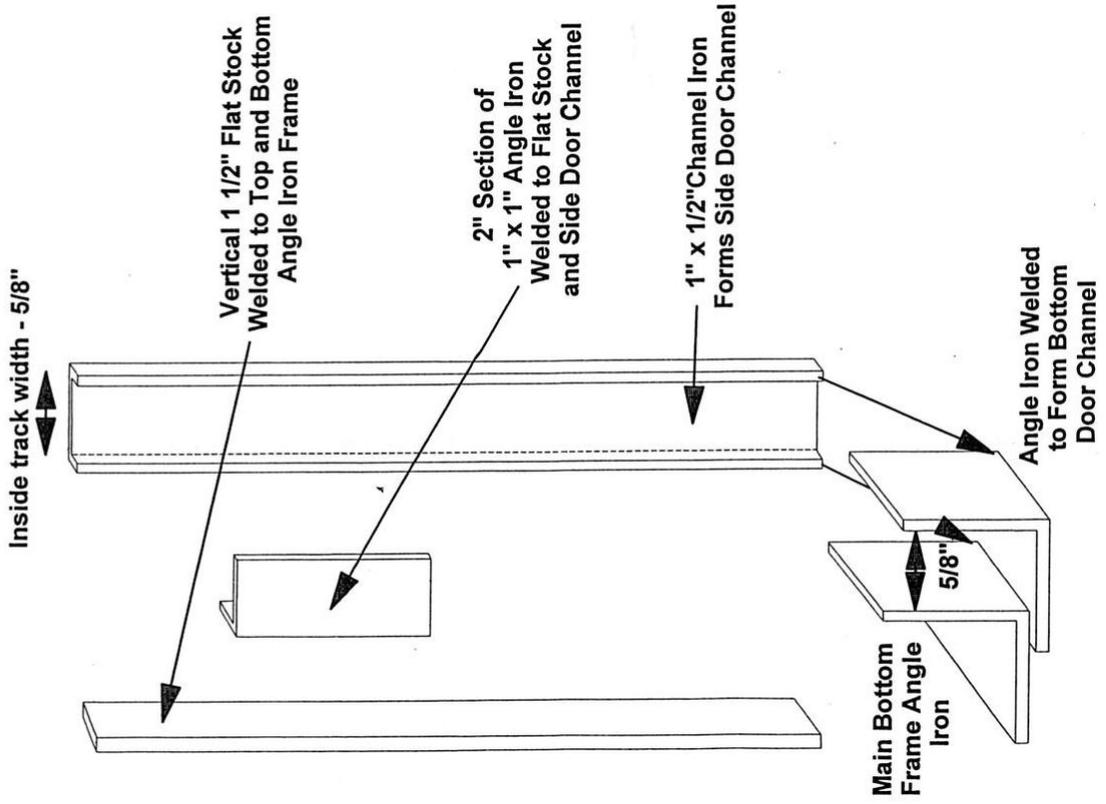
AZ Sheep Box - Bottom



AZ Sheep Box - Door

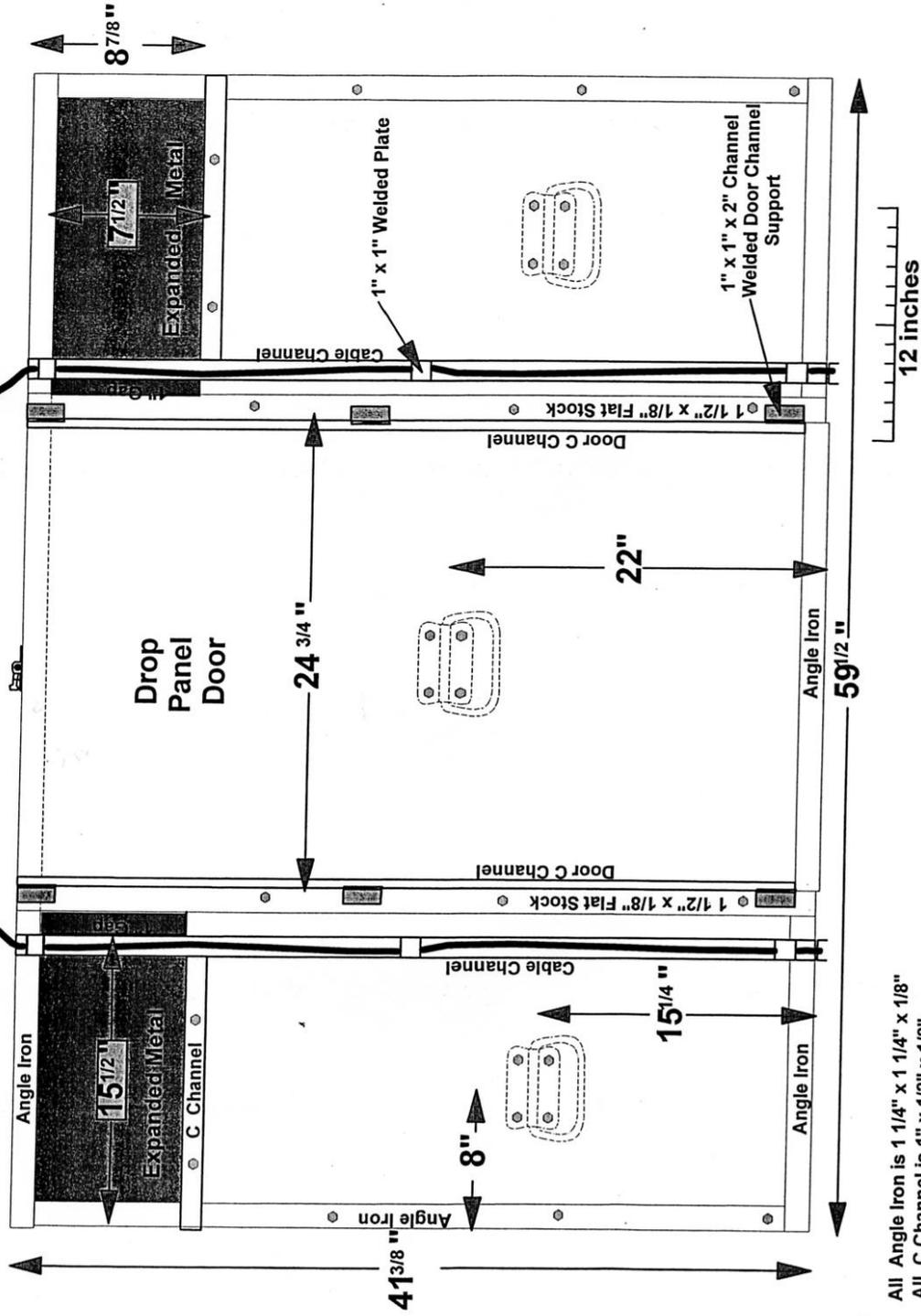


AZ Box - Door Details



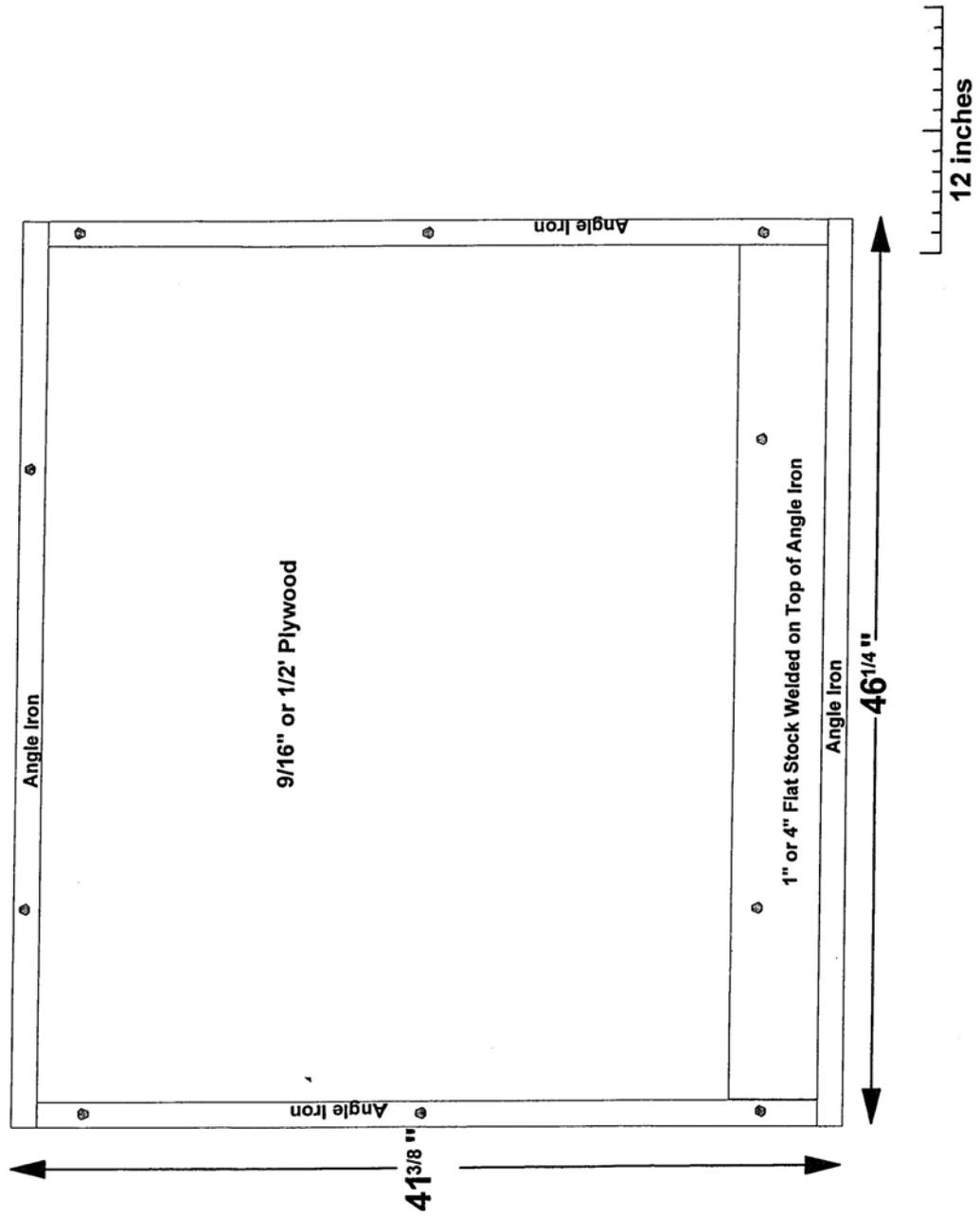
Top-Mounted Door Latch

AZ Sheep Box - Front



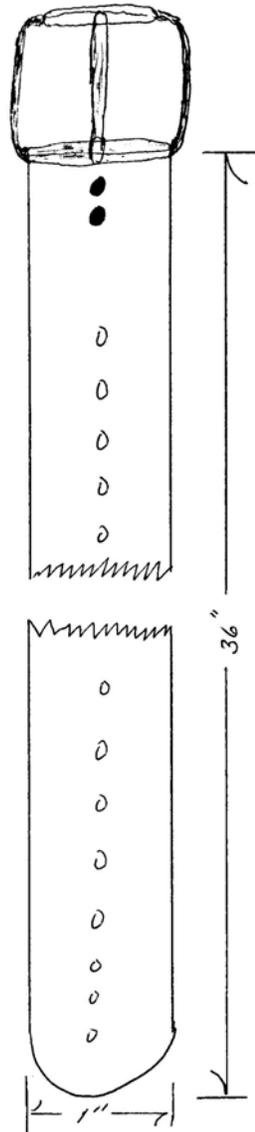
All Angle Iron is 1 1/4" x 1 1/4" x 1/8"
 All C Channel is 1" x 1/2" x 1/8"
 All Bolts are Panhead 1/4" x 1"

AZ Sheep Box - Side



APPENDIX 7

Design – Hobbles



- Material: Well Oiled Leather or Biothane

APPENDIX 8
Design – Blindfold

Descriptive Information:

1. Material is denim or nylon
2. Straps are $\frac{1}{2}$ or $\frac{3}{4}$ inches wide nylon webbing
3. Nylon quick release buckle sized to nylon webbing. Webbing strap on long end is 15 inches
4. Measurements shown are finished size

