APPENDIX VIII

ANIMAL CAPTURE AND HANDLING

Information on animal capture and handling was extracted from the "Handbook of Wildlife Chemical Immobilization" by Terry J. Kreeger (1996).

I. Legal Considerations – The possession and use of drugs used to capture wildlife is governed by both federal and state regulations. All drugs currently used to sedate or immobilize wild animals are prescription drugs and must be used by or on the order of a licensed veterinarian. To comply with this regulation, non-veterinarians should ensure a valid veterinarian-client-patient relationship exists. This requires a veterinarian must be involved in the process, but it does not necessarily mandate that a veterinarian be on site during the immobilization process. Non-veterinarians using prescription drugs should receive adequate training.

Some drugs used on wildlife are also classified as controlled drugs. Possession of controlled drugs requires a Drug Enforcement Agency registration number, special record keeping, and special storage requirements. If you have questions regarding the legalities of drug use, contact the Department's wildlife veterinarian.

II. Types of Drugs –

A. Paralytic Drugs – The neuromuscular blocking (NMB) or paralytic drugs are some of the earliest drugs used for the chemical immobilization of wildlife. Despite their long history of use, NMB drugs are generally inferior to modern drugs. There are two major deficiencies of NMB drugs. One is that NMB drugs have a very low safety margin and dosage errors of only 10% can result in either no effect (underdosing) or death by asphyxia (overdosing). Mortality rates as high as 70% have occurred. The second deficiency is that NMB drugs are virtually devoid of central nervous system effects because of their inability to cross the blood-brain barrier. Thus, an animal paralyzed with NMB drugs is conscious, aware of its surroundings, fully sensory, and, as such, can feel pain and experience psychogenic stress yet is physically unable to react. Because of these deficiencies, NMB drugs should be used judiciously.

There are, however, certain definite advantages to some NMB drugs. They are generally very fast-acting (3–5 min) and the duration of effect lasts only for a short while (15–30 min). Succinycholine, the most commonly used drug of this class, is also fairly safe for humans. Animals that have been given only

succinycholine and that have died or been euthanized using physical means (i.e., not other drugs) can be safely eaten by other animals, if needed. And lastly, succinycholine is extraordinarily cheap, perhaps the least expensive immobilizing agent available. This might explain why it is still in widespread use.

B. Tranquilizers/Sedatives – Tranquilizers are used primarily in wildlife immobilization as adjuncts to primary anesthetics (e.g., ketamine, carfentanil) to hasten and smooth induction and recovery and to reduce the amount of the primary agent required to achieve immobilization. Valium is used primarily for small mammals as an anticonvulsant adjunct to ketamine anesthesia and it is also an excellent muscle relaxant.

The alpha-adrenergic tranquilizers (e.g., xylazine or Rompun, medetomidine) are potent sedatives and can be completely antagonized. They are often combined with ketamine, Telazol, or carfentanil. By themselves, they are capable of heavily sedating animals, particularly ungulates, to the point of relatively safe handling. However, animals sedated with these tranquilizers generally can be aroused with stimulation and are capable of directed attack. Caution should always be exercised in such animals even though they appear harmless.

C. Dissociative Anesthetics – This group of drugs (ketamine, tiletamine) are characterized by producing a cataleptic state (a malleable rigidity of the limbs) in which the eyes remain open with intact corneal and light reflexes. Ketamine is probably one of the most widely used drugs for wildlife immobilization because of its efficacy and safety. Tiletamine is unavailable as a single product and it is combined in equal proportions with the diazepinone tranquilizer, zolazepam (e.g., Telazol).

When used singly, ketamine usually cause rough inductions and recoveries, and convulsions are not uncommon. Because of this, they are usually administered concurrently with tranquilizers or sedatives. There is no complete antagonist for ketamine or Telazol.

D. Opioid Anesthetics – The opioids have been used for animal immobilization since the 1960s and are the most potent drugs available for this purpose. The most commonly used opioid is carfentanil. A3080 is a new synthetic opioid not yet on the market, but early trials on ungulates are promising. A major advantage in the use of opioids is the availability of specific antagonists.

The potency of opioids, such as etorphine and carfentanil, is both an advantage and disadvantage. The advantage is the reduced volume of drug required for immobilization makes them the only class of drugs capable of remote immobilization of large animals. The disadvantage is that they are potentially toxic to humans. Death is almost always due to respiratory failure. Opioid immobilizing agents should never be used while working alone or without having

an antagonist immediately on hand. Anyone using these agents should be familiar with CPR.

III. Calculating Drug Dosages – It is essential to calculate drug dosages accurately in order to effectively anesthetize animals. Drug dosages in this text are given in the metric system as they are worldwide. Probably the only conversion that you need to remember is that 1 kilogram (kg) equals 2.2 pounds (lbs).

For example, consider immobilizing an animal that weighs 80 kg (176 lb) with Drug "X". The recommended dose of Drug X for this animal is 5 mg/kg. Drug X is available in a 100 mg/ml solution. First, calculate the total milligrams (mg) of drug needed for this animal by multiplying the animal's weight (80 kg) by the recommended drug dose (5 mg/kg):

mg Drug X needed = 80 kg x 5 mg/kg = 400 mg

Then calculate the volume of drug solution to withdraw from the bottle by dividing the needed total mg of Drug X (400 mg) by its concentration (100 mg/ml):

Volume = 400 mg ÷100 mg/ml = 4 ml

Four ml is the amount that you would withdraw from the vial to inject into the animal.

IV. Animal Capture

A. Have everything that you need with you –

Before you begin the immobilization procedure, be sure that you have all drugs and equipment that you may need. Fishing tackle boxes usually make good receptacles for all this and they come in a variety of sizes and shapes to suit almost all tastes. Vests with multiple pockets, such as a fly fishing or photographer's vest, can be used to carry most items and they free the hands to carry such things as dart guns and pole syringes.

B. Prepare dart(s) beforehand –

Have one or more darts loaded before you begin your approach. Be sure that all loaded darts are safely stored so as to prevent accidental injection; plastic test tubes or cigar holders make good holding devices.

C. Check darts and gun before using –

Always inspect your dart gun prior to use to insure that it is unloaded and the barrel clean and clear. If you are using any form of electronic sights, be sure that they are working (and always carry spare batteries!).

D. Don't load gun until ready to approach the animal –

Until you are actually in a position to approach and dart an animal, it is generally unnecessary to load your dart gun. At close ranges, dart guns can be lethal and they should always be treated like their bullet-firing counterparts.

E. Approach captive animals quietly and calmly –

Even if you are working with a captive animal restrained in a chute, or a trapped wild animal, you should approach it quietly and calmly. Do not make rapid or exaggerated movements that will panic the animal. If captive animals are accustomed to a routine such as feeding or cleaning, try to mimic that activity (at the same time of day) to allow a closer approach.

F. Use devices to approach free-ranging animals –

Wild animals can often be approached quite closely with a vehicle, but you must remain inside the vehicle even when taking a shot. If using a vehicle or helicopter to pursue and dart animals, try to limit the length of the chase.

G. Estimate distance and wind –

Many dart guns can be adjusted to deliver more or less propellant to the dart. Estimate the probable shooting distance that you expect to encounter, adjust the metering device, and use the power load appropriate for the distance and dart weight. However, be prepared to adjust these factors at the last moment; if in doubt, it is better not to shoot. Overpowered darts can cause severe wounds or death; underpowered darts can miss altogether (thus spooking the animal). Also be sure to consider wind speed, particularly with crosswinds, when using lightweight darts or shooting at long distances (>15 m).

H. Injection Administration Sites –

Immobilizing drugs are almost always administered intramuscularly (IM). The usual injection site is the large muscle masses of the hindlimb. Bears are usually injected in the shoulder.

I. Immobilization Signs –

Familiarity with the signs of anesthesia is essential – not knowing the depth of anesthesia can be lethal for both the animal and you! You can assess drug effect through changes in behavior, but to determine such effects, it is critical to be

familiar with the target species. Know what is normal and look for the abnormal. Once the animal is down, you need to assess the depth of anesthesia. Always exercise caution when checking a downed animal. Approach the animal slowly and quietly; approach dangerous animals from the rear and be sure you have an escape route. If the animal appears unconscious, check for ear twitch (touch inside of ear, ear twitches), pedal reflex (pinch toe, limb withdraws), swallowing reflex (pull tongue, release, animal swallows), palpebral reflex (touch eyelashes, animal blinks), and corneal reflex (touch cornea, animal blinks). If the animal has lost the ear twitch, it is probably at an appropriate stage of anesthesia for most field procedures.

J. Incomplete Immobilization –

If the animal is down but not fully immobilized, you should allow 10-15 minutes to elapse before giving booster doses. In general, it is often safe to re-administer 50% of the original dose with or without the tranquilizer. For example, you used 500 mg ketamine and 100 mg of xylazine to immobilize a deer. The dart bounced out almost immediately and 15 minutes later the deer was stumbling about or even lying down, but it would get up or walk away when you tried to approach it. A safe and effective booster dose in this case would be 250 mg ketamine and no more xylazine.

If no sign of drug effect is apparent after 20 minutes, you can assume that the animal probably received little or none of the original dose. If you are confident the drug(s) and dose(s) you originally selected were appropriate, then give the animal the same drug(s) and dose(s) again.

Animals can be kept immobilized for extended periods (several hours) with supplemental boosters of 33-50% of the initial immobilizing dose. This is particularly true when using ketamine. Where ketamine was given initially in combination with another agent, such as xylazine or promazine, usually only the ketamine needs to be given to maintain immobilization. Administer such doses when the animal shows initial signs of recovery (e.g., raises head, blinks, etc.).

V. Handling the Immobilized Animal

A. Position Body –

Ensure nothing impinges on breathing, i.e., neck straight, nose clear. Position ruminants sternally; if this is not possible, position on either side but watch for bloat. Most other animals can be placed on either side or sternally. The head should preferably be slightly lower than the thorax to avoid aspiration of fluids. Try to keep the animal on relatively flat ground to avoid occlusion of the trachea, pressure neuropathy, or circulatory impairment. If the animal is to remain immobilized for some time, roll the animal on its other side or sternally at least

every 60 min. It is preferable to roll ungulates across the sternum as opposed to across the back.

B. Cover eyes –

Covering the eyes protects them from harmful ultraviolet light from the sun, reduces drying, and prevents dirt and debris from entering them. Coating the eyes with a lubricant further prevents drying, however, some feel that eye ointments result in dirt and grit sticking to the eye. A saline wash (e.g., contact lens saline) can also be used. Covering the eyes also appears to further calm the animal even when it is effectively immobilized.

C. Hobble the legs –

This is particularly necessary with ungulates to avoid spontaneous kicking which may injure someone. Hobbles also prevent other human injuries or possible escape should the animal partially or spontaneously recover.

D. Check vital signs –

Once you have assured the animal's body position will not affect breathing, check its respiratory rate (RR). Respirations can be seen (watch the abdomen or chest), felt (place hand in front of nostrils), or heard (place ear by nostrils – a very sensitive technique). Slowed RRs are most likely drug-induced, but they can be caused by hypothermia. In cases of respiratory arrest or poor oxygenation, respiration can be supported mechanically or pharmacologically. Rapid RRs could indicate hyperthermia, bloat, aspiration, pulmonary edema, or shock.

Always carry a thermometer and use it continually throughout the immobilization period. Normal mammalian rectal temperatures range from 99.5º–104º F. You should probably take action to lower an animal's temperature if it is > 106º F. Also check for wounds, injuries, and general condition.

E. Recovery of the Immobilized Animal –

An animal should not be left unattended until it starts to recover from the immobilization. Ideally, you should remain with the animal until it can walk in a relatively coordinated manner (i.e., respond appropriately to objects, people, other animals), whether an antagonist was administered or not. At the minimum, you should stay with the animal until it can at least raise itself to a sternal position. Look around the recovery area for possible hazards such as sharp rocks and ledges. Either relocate the animal or stay with it through recovery to direct it away from such hazards. Keep the animal cool or warm, depending on weather conditions (i.e., out of the sun in summer, in the sun during winter), dry, and free from inter- or intraspecific harassment or aggression.

VI. Euthanasia –

Invariably, there will come a time when an animal must be euthanized either because it has been critically injured or it is terminally ill. If an animal needs to be euthanized, this should be done safely and effectively with some consideration for the dignity of the animal and the sensitivities of the public. Many methods of euthanasia, such as shooting and stunning, are effective and medically acceptable but are reprehensible to the public (or even other biologists!). Chemical euthanasia is generally the preferred method because it is safe, effective, and aesthetically acceptable.

Note: No animal that has been chemically immobilized and then euthanized by physical methods or one that has been directly euthanized via chemical methods can be used for human or animal food consumption.

A. Cervical Dislocation – Cervical dislocation can be used to euthanize birds, small rodents, and rabbits. For mice and rats, the thumb and index finger are placed on either side of the neck at the base of the skull. With the other hand, the hind limbs are quickly pulled, causing separation of the cervical vertebrae from the skull. For small rabbits, the head is held in one hand and the hind limbs in the other. The animal is stretched and the neck is hyperextended and dorsally twisted to separate the first cervical vertebra from the skull. For birds of poultry size or smaller, cervical dislocation is accomplished by stretching and twisting.

B. Decapitation – Decapitation is generally not acceptable due to animal (and public) distress.

C. Exsanguination – Exsanguination (bleeding to death) is acceptable only if the animal has been rendered unconscious by drugs or stunning. It is often a slow, messy, and unsightly process. Bilateral sectioning of the jugular or femoral veins can be effective, but often the blood flow slows after awhile. If possible, try to severe the major arteries leading from the heart by inserting a long-bladed knife into the junction of base of the neck and shoulder and slicing inwards and downwards.

D. Stunning – Stunning by a sharp blow to the head with a hard object can be used for smaller animals (< 5 kg). Stunning by a penetrating captive bolt can be used on larger animals including the largest hoofstock. The disadvantage of any method of stunning is that it may not cause death, so you must check that the animal is dead by monitoring heart rate, respiration, or pupillary reflex.

E. Gunshot – Gunshot is often the most practical, if not only, means of euthanizing wild animals. Ideally, the animal is under some sort of physical or chemical control so carefully-placed shots can be made. If the animal is not controlled, head or neck shots are preferable to heart or lung shots. If the animal is under physical control or chemically immobilized, the best target for shooting is at the

intersection of two imaginary lines connecting the ears with the contralateral eyes. A .22-caliber long rifle cartridge is adequate for animals < 200 lb if fired at a distance of < 1 foot. Large, heavy-skulled animals (e.g., bears) usually require more powerful cartridges. Whatever cartridge is used, remember that placement is more critical than caliber. Be sure that all personnel stand behind the shooter; bullets hitting bone can take off at unexpected angles. Place the muzzle of the gun as close to the animal as feasible and aim at juncture of the "X" connecting the ears and eyes. On large animals, or animals with heavy skulls, you may want to shoot at a point slightly off center of this imaginary intersection. Try to ensure the shot is placed as perpendicularly to the skull as possible; bullets fired at a shallow angle may bounce off thick skulls. Although euthanasia by gunshot (or penetrating captive bolt) is usually instantaneous, the animal may thrash and convulse for several seconds after the shot. Large ungulates can deliver bone-breaking kicks during this period, so wait several seconds after cessation of thrashing to handle the animal.

F. Chemical Methods – Several euthanasia products are formulated to include a barbituric acid derivative (usually sodium pentobarbital) with added local anesthetic agents (e.g., Beuthanasia®-D Special; FP-3®). These drugs are Schedule III controlled substances. Intravenous injection is the preferred route, although intraperitoneal and intrathoracic injections can be given to small animals and birds. Animals euthanized with barbiturate solutions must be cremated for disposal. It usually takes large volumes of commercial solution to euthanize an animal the size of an elk or moose (perhaps >100 ml!); potassium chloride may be preferred because of this.

Potassium chloride can be inexpensively obtained from chemical suppliers. Potassium chloride is also available in grocery stores as "light salt" which is a substitute for sodium chloride. To prepare, mix a solution of approximately 300 mg potassium chloride per ml of water. This solution must be given IV; cardiac arrest is quite rapid (< 30 sec) and should be verified by listening for heartbeat or feeling for a pulse.

VII. Equipment

A. Dart Guns – Dart guns propel darts by either the gas generated from a .22 caliber blank cartridge, compressed CO_2, or compressed atmospheric air. Effective ranges can be as far as 75 m, although 50 m is usually the farthest practical distance. Guns can be equipped with a variety of sights including adjustable open sights, rifle scopes, laser aiming devices, and light-intensifying scopes. Many professionals, especially those who dart animals from helicopters, prefer open sights.

The preferred dart gun/dart combination is a Dan-Inject adjustable CO_2 rifle equipped with a 0.50-caliber barrel that fires Pneu-Darts. This combination is the

most versatile and consistent system on the market. It is very expensive, however (>$1,600). A less expensive, but very good rifle is the Pneu-Dart 0.22-caliber adjustable rifle.

Pneu-Darts are the preferred darts even though they are not reusable. They are inexpensive, lightweight, quick to load, and accurate. All darts should be equipped with barbs so they stay in the animal long enough to discharge all the drug, and for easy retrieval once the animal is down. This is particularly true when using carfentanil; the easiest place to find the dart is in the animal as opposed to somewhere between where you shot it and where it went down! Darts can also be equipped with small radio transmitters enabling location of animals that have run off after being darted.

B. Equipment and Supply Checklist –

- Dart guns (.22-caliber blanks, $C0_2$, or compressed air)
- .22 charges (brown [lowest power], green, yellow, red [highest])
- CO_2 propellant
- Shotgun cleaning rod (to remove stuck or unused darts)
- Extra batteries for electronic sights
- Re-usable Powder Charge Darts
- Dart bodies (1, 2, 3, 5, 7 ml)
- Dart charges (1–3, 4–10 ml; keep dry)
- Dart needles
- Dart plungers
- Dart tailpieces
- Silicone lubricant (for dart plungers)
- Rod for pushing plunger through dart to lube
- Extra .22 adapters for Cap-Chur® guns
- Disposable Darts (powder and/or acid-base charged; 1, 2, 3, 5 ml)
- Compressed Air Darts
- Darts (2, 3, 5 ml)
- Dart needle sleeves or caps
- Tailpieces
- Coupler
- 20 ml syringe
- Plunger rod (for discharging reservoir)
- Pole Syringe
- Extra syringe barrels, parts
- Petroleum Jelly
- Marking pen, pencil
- Needles (25 ga x 0.75", 20 ga x 1", 18 ga x 1", 18 ga x 1.5", 16 ga x 1", 16 ga x 1.5")
- Syringes (1, 3, 5–6, 10–12, 20 ml)

- Blood collection tubes (with and without anticoagulant)
- Swiss Army knife/"leatherman"
- Pliers
- Cigar tubes (or other device to safely store loaded darts until used)
- Sterile water (for topping off darts)
- Propylene glycol (mix with drugs to act as antifreeze)
- Scalpel blades (for removing barbed darts)
- Flashlight (plus extra bulb and batteries)

C. List of Manufacturers and Major Distributors –

Animal Care Equipment and Services, Inc.
613 Leebert Way
Crestline, CA 92325 USA
Tel: 909-338-1791
(Distributor of animal capture equipment)

Animal Management Inc.
720 Eppley Road
Mechanicsburg, PA 17055-9786 USA
Tel: 800-745-8173
(Distributor of animal capture equipment)

Palmer Chemical & Equipment Co., Inc.
P.O. Box 867
Palmer Village
Douglasville, GA 30133 USA
Tel: 404-942-4395
(Dart guns, darts)

Pneu Dart, Inc.
P.O. Box 1415
Williamsport, PA 17703 USA
Tel: 717-323-2710
(Dart guns, darts)

Telinject USA, Inc.
9316 Soledad Canyon Road
Saugus, CA 91350 USA
Tel: 805-268-0915
(Dart guns, darts, blow pipes)

Wildlife Pharmaceuticals, Inc.
1401 Duff Drive
Suite 600
Fort Collins, CO 80524 USA
Tel: 970-484-5560
(Dart guns, darts, blow pipes, pole syringes)

Wiley & Sons, Inc.
Rte. 1 Box 303
Wills Point, TX 75169 USA
Tel: 903-848-7912)
(Distributor of animal capture equipment)

Zoolu Arms of Omaha
10315 Wright Street
Omaha, NE 68124 USA
(Dart guns, darts, blow pipes, pole syringes)

VIII. Drug Dosages –

BADGER (*Taxidea taxus*)
Weight: 4–12 kg
Recommended Drug: 4.4 mg/kg Telazol®
Antagonist: None
Alternative Drugs:
• 15 mg/kg ketamine plus 1 mg/kg xylazine
Comments: Badgers require care in drug administration because they struggle and resist handling; try to physically restrain the animal to insure accurate drug injection.

BEAR, BLACK (*Ursus americanus*)
Weight: 92–140 (f), 115–270 (m) kg
Recommended Drug: 4.4 mg/kg ketamine plus 2 mg/kg xylazine
Antagonist: 0.15 mg/kg yohimbine
Alternative Drugs:
• 7 mg/kg Telazol®
• 1.5 mg/kg ketamine plus 0.04 mg/kg medetomidine; antagonize with 0.2 mg/kg atipamezole
Comments: Anesthetic induction with Telazol® may take up to 20 min and recoveries may be prolonged. Recovery from ketamine-medetomidine after antagonism with atipamezole may be rapid – be prepared. Also, spontaneous recoveries *without* the antagonist may occur – watch carefully for signs of early recovery.

BEAR, GRIZZLY (*Ursus arctos*)
Weight: 100–325 kg
Recommended Drug: 8 mg/kg Telazol®
Antagonist: None
Alternative Drugs:
- 2 mg/kg Telazol® plus 0.06 mg/kg medetomidine; antagonize with 0.3 mg/kg atipamezole
- 11 mg/kg ketamine plus 11 mg/kg xylazine; antagonize with 0.125 mg/kg yohimbine
- 0.012 mg/kg carfentanil plus 0.3 mg/kg xylazine; antagonize with 100 mg naltrexone or naloxone per mg carfentanil given plus 0.125 mg/kg yohimbine

Comments: Spontaneous arousals may occur when ketamine-medetomidine is used; avoid loud or sharp noises; try to prevent vocalization of cubs when mother is immobilized.

BEAVER (*Castor canadensis*)
Weight: 12–25 kg
Recommended Drug: 10 mg/kg ketamine plus 1 mg/kg xylazine
Antagonist: None reported
Alternative Drugs:
- 11 mg/kg ketamine plus 0.22 mg/kg acepromazine
- 5 mg/kg Telazol®

BISON, AMERICAN (*Bison bison*)
Weight: 350–1,000 kg
Recommended Drug: 0.004 mg/kg carfentanil plus 0.07 mg/kg xylazine
Antagonist: 100 mg naltrexone or naloxone per mg carfentanil given plus 0.125 mg/kg yohimbine
Alternative Drugs:
- 4.4 mg/kg Telazol

BOBCAT (*Felis rufus*)
Weight: 4.1–15.3 kg
Recommended Drug: 10 mg/kg Telazol®
Antagonist: None
Alternative Drugs:
- 10 mg/kg ketamine plus 1.5 mg/kg xylazine
- 20 mg/kg ketamine plus 0.1 mg/kg acepromazine

COYOTE (*Canis latrans*)
Weight: 7–18 kg
Recommended Drug: 10 mg/kg Telazol®
Alternative Drugs:
- 10 mg/kg ketamine plus 0.1 mg/kg acepromazine
- 4 mg/kg ketamine plus 2 mg/kg xylazine, antagonize with 0.15 mg/kg yohimbine

DEER, MULE (*Odocoileus hemionus*)
Weight: 75–200 kg
Recommended Drug: 4.4 mg/kg Telazol® plus 2.2 mg/kg xylazine
Antagonist: 0.125 mg/kg yohimbine
Alternative Drugs:
- 7 mg/kg ketamine plus 0.7 mg/kg xylazine; antagonize with 0.125 mg/kg yohimbine
- 0.03 mg/kg carfentanil plus 0.7 mg/kg xylazine; antagonize with 100 mg naltrexone or naloxone per mg carfentanil given plus 0.125 mg/kg yohimbine
- 15 mg/kg Telazol®

Comments: When using ketamine-xylazine or Telazol®-xylazine for highly excited deer, the xylazine dose can be increased up to the dose of ketamine or Telazol® given (i.e., 7 mg/kg or 4.4 mg/kg, respectively).

DEER, WHITE-TAILED (*Odocoileus virginianus*)
Weight: 60–150 kg
Recommended Drug: 4.4 mg/kg Telazol® plus 2.2 mg/kg xylazine
Antagonist: 0.125 mg/kg yohimbine
Alternative Drugs:
- 7.5 mg/kg ketamine plus 1.5 mg/kg xylazine, antagonize with 0.125 mg/kg yohimbine
- 2 mg/kg ketamine plus 0.07 mg/kg medetomidine; antagonize with 0.35 mg/kg atipamezole

Comments: When using ketamine-xylazine or Telazol®-xylazine for highly excited deer, the xylazine dose can be increased up to the dose of ketamine or Telazol® given (i.e., 7.5 mg/kg or 4.4 mg/kg, respectively).

ELK, NORTH AMERICAN (*Cervus elaphus*)
Weight: 230–318 kg
Recommended Drug: 0.01 mg/kg carfentanil plus 0.1 mg/kg xylazine
Antagonist: 100 mg naltrexone or naloxone per mg carfentanil given plus 0.125 mg/kg yohimbine IV
Alternative Drugs:
- 2 mg/kg ketamine plus 0.07 mg/kg medetomidine; antagonize with 0.35 mg/kg atipamezole
- 3 mg/kg Telazol® plus 0.4 mg/kg xylazine; antagonize with 0.125 mg/kg yohimbine
- 4 mg/kg ketamine plus 2 mg/kg xylazine; antagonize with 0.125 mg/kg yohimbine

Comments: Monitor elk carefully for overheating or bloat. For highly excited elk, the carfentanil dose can be increased to 0.013 mg/kg; the xylazine dose remains the same (i.e., 0.1 mg/kg).

FISHER *Martes pennanti*)
Weight: 2.6–5.5 kg
Recommended Drug: 25 mg/kg ketamine plus 5 mg/kg xylazine
Antagonist: None reported
Alternative Drugs:
• 20 mg/kg ketamine plus 0.1 mg/kg acepromazine

FOX, RED (*Vulpes vulpes*)
Weight: 4.1–4.5 (f), 4.5–5.4 (m) kg
Recommended Drug: 10 mg/kg Telazol®
Alternative Drugs:
• 20 mg/kg ketamine plus 0.2 mg/kg acepromazine
• 20 mg/kg ketamine plus 1 mg/kg xylazine, antagonize with 0.15 mg/kg yohimbine
• 25 mg/kg ketamine plus 1 mg/kg midazolam
Comments: If using xylazine, wait at least 45 min after last ketamine injection before administering yohimbine.

FOX, SWIFT (*Vulpes velox*)
Weight: 1.8–3 kg
Recommended Drug: 10 mg/kg Telazol®
Alternative Drugs:
• 20 mg/kg ketamine plus 0.2 mg/kg acepromazine

GOAT, MOUNTAIN (*Oreamnos americanus*)
Weight: 46–140 kg
Recommended Drug: 1.5 mg/kg ketamine plus 0.07 mg/kg medetomidine
Antagonist: 0.35 mg/kg atipamezole; give 1/2 dose IV, 1/2 IM
Alternative Drugs:
• 2.75 mg carfentanil; antagonize with 100 mg naloxone or naltrexone per mg carfentanil given

HORSE, NORTH AMERICAN WILD (*Equus caballus*)
Weight: 250–530 kg
Recommended Drug: 0.02 mg/kg carfentanil plus 0.6 mg/kg xylazine
Antagonist: 100 mg naltrexone or naloxone per mg carfentanil given
Comments: Yohimbine must be administered to horses receiving xylazine.

LION, MOUNTAIN (*Felis concolor*)
Weight: 30–75 kg
Recommended Drug: 2 mg/kg ketamine plus 0.075 mg/kg medetomidine
Antagonist: 0.3 mg/kg atipamezole
Alternative Drugs:
• 8 mg/kg Telazol®
• 10 mg/kg ketamine plus 2 mg/kg xylazine; antagonize with 0.125 mg/kg yohimbine

LYNX, *Lynx canadensis*
Weight: 5.1–17.2 kg
Recommended Drug: 5 mg/kg Telazol®
Antagonist: None
Alternative Drugs:
- 10 mg/kg ketamine plus 2 mg/kg xylazine

MOOSE (*Alces alces*)
Weight: 400–600 kg
Recommended Drug: 0.01 mg/kg carfentanil
Antagonist: 100 mg naltrexone or naloxone per mg carfentanil given
Alternative Drugs:
- 1.5 mg/kg ketamine plus 0.06 mg/kg medetomidine; antagonize with 0.3 mg/kg atipamezole
- 4 mg/kg ketamine plus 1 mg/kg xylazine; antagonize with 0.25 mg/kg tolazoline
- 5 mg/kg Telazol®

Comments: Xylazine (0.1 mg/kg) may be added to the carfentanil to get better muscle relaxation; however, xylazine increases the possibility of regurgitation leading to aspiration and pneumonia.

PORCUPINE, NORTH AMERICAN (*Erethizon dorsatum*)
Weight: 3.5–10 kg
Recommended Drug: 10 mg/kg Telazol®
Antagonist: None

PRONGHORN (*Antilocapra americana*)
Weight: 40–50 kg
Recommended Drug: 0.05 mg/kg carfentanil plus 1 mg/kg xylazine
Antagonist: 100 mg naltrexone or naloxone per mg carfentanil given plus 0.125 mg/kg yohimbine
Comments: In general, pronghorn are extraordinarily difficult to immobilize; carfentanil and xylazine has been the only drug combination that has been shown to be effective.

RACCOON (*Procyon lotor*)
Weight: 2–12 kg
Recommended Drug: 20 mg/kg ketamine plus 4 mg/kg xylazine
Antagonist: 0.15 mg/kg yohimbine
Alternative Drugs:
- 20 mg/kg ketamine plus 0.1 mg/kg acepromazine
- 12 mg/kg Telazol®

SHEEP, BIGHORN (*Ovis canadensis*)
Weight: 65–150 kg
Recommended Drug: 0.03 mg/kg carfentanil plus 0.2 mg/kg xylazine
Antagonist: 100 mg naltrexone or naloxone per mg carfentanil given plus 0.125 mg/kg yohimbine
Comments: Bighorn sheep are very susceptible to capture myopathy and hyperthermia; careful monitoring of the animal is required. Sheep can be sensitive to xylazine; monitor carefully and always give an antagonist.

SKUNK, SPOTTED (*Spilogale spp.*)
Weight: 0.2–1 kg
Recommended Drug: 10 mg/kg Telazol®
Antagonist: None
Alternative Drugs:
- 15 mg/kg ketamine plus 0.2 mg/kg acepromazine

SKUNK, STRIPED, *Mephitis mephitis*
Weight: 2–3 kg
Recommended Drug: 10 mg/kg Telazol®
Antagonist: None
Alternative Drugs: 15 mg/kg ketamine plus 0.2 mg/kg acepromazine

WOLF, GRAY (*Canis lupus*)
Weight: 27–60 kg
Recommended Drug: 10 mg/kg ketamine plus 2 mg/kg xylazine
Antagonist: 0.15 mg/kg yohimbine
Alternative Drugs:
- 4 mg/kg ketamine plus 0.08 mg/kg medetomidine; antagonize with 0.4 mg/kg atipamezole
- 10 mg/kg Telazol® plus 1.5 mg/kg xylazine
- 10 mg/kg ketamine plus 0.15 mg/kg acepromazine

Comments: If using ketamine (or Telazol®) and xylazine, wait at least 45 min after last ketamine or Telazol® injection before administering yohimbine. Calm, captive wolves may be immobilized with 4 mg/kg ketamine plus 2 mg/kg xylazine. This combination is more readily antagonized by yohimbine than when higher doses of ketamine are used.

WOLVERINE (*Gulo gulo*)
Weight: 7–32 kg
Recommended Drug: 5 mg/kg ketamine plus 0.1 mg/kg medetomidine
Antagonist: 0.2 mg/kg atipamezole; give 1/2 dose IV, 1/2 IM
Alternative Drugs:
- 20 mg/kg ketamine plus 0.2 mg/kg acepromazine