# Monitoring Protocol for the Denali Caribou Herd, Denali National Park and Preserve, Alaska

## Standard Operating Procedure (SOP) # 1

## Techniques for Capturing, Handling, and Radiotracking Caribou

## Version 1.0

## Revision History Log:

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This Standard Operating Procedure explains the procedures for the capture and handling of caribou associated with deploying radiocollars and radiotracking instrumented individuals as part of the Monitoring Protocol for the Denali Caribou Herd, Denali National Park and Preserve (DENA), Alaska. Female caribou are captured by helicopter darting and radiocollared to monitor age-specific productivity and survival, determine seasonal distribution, and conduct annual herd composition surveys and population estimates. Females are captured to maintain a radiocollared sample representative of the herd's age structure, so that estimated vital rates are indicative of the population as a whole. Caribou are radiotracked at least 8 times per year to determine annual survival and seasonal distribution, and to aid in conducting assessments of productivity, herd censuses, and age/sex composition surveys.

# I. PLANNING

Caribou monitoring, as well as other radiotelemetry projects, are currently ongoing in DENA, so basic equipment for animal darting and radiotelemetry are available and park personnel are well aware of procedures for conducting such a program. In brief, any chemical immobilization/radiotelemetry project, like caribou monitoring, requires substantial planning, purchasing of equipment and supplies, and arranging of logistics well in advance of field operations.

## Appropriate experience and training of personnel

The capture and handling of wildlife carries with it the ethical responsibility that project staff are trained and have appropriate expertise to carry out darting operations safely, humanely, and efficiently. In addition to agency training requirements, it is essential that personnel conducting wildlife captures have sufficient supervised field experience with capture operations to ensure that they are equipped to handle contingencies that may arise. That experience can only be gained by working with an experienced mentor in the field.

## Aircraft logistics

All activities within this monitoring protocol require the use of aircraft and are thoroughly dependent on the few highly experienced helicopter and fixed-wing pilots that conduct this work. Appropriate aircraft support must be lined up well in advance of field

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activities and have proper authorizations. In addition, personnel involved in flight operations must meet agency training requirements.

**Radiofrequencies and radiocollars**

Radiofrequencies for telemetry are managed nationally through the National Wildlife Telemetry Frequency Management Database. An adequate number of radiofrequencies for the life of the project must be obtained through the appropriate channels, such as the NPS Regional Radio Coordinator, and renewed every 3 years. Once the frequencies are obtained, radiocollars can be ordered; commonly it takes about 2-3 months to receive radiocollars once an order is placed.

Radiocollars currently being used include Telonics MOD600s for adult females (standard power; mortality sensor [active 60bpm, inactive 120bpm, 4 hour delay]; single external antenna; CLM Collar [1/16 butyl/1/16 butyl; 2" wide, 14-26" adjustment range]; Cast-2 [end cast only]; Cold-temp tested) and MOD500s for 10-month-old calves (standard power, 15mSec pulse width; mortality sensor [active 60bpm, inactive 120bpm, 4 hour delay]; single external antenna; CLM Collar [1/16 butyl/1/16 butyl; 2" wide, 14-26" adjustment range]; Cast-2 [end cast only]; Cold-temp tested). Expected battery life of these radiocollars is 92 months and 60 months for the adult and calf versions, respectively, but the electronics are warrantied for only 3 years. Through substantial field experience, we have arrived at a protocol of replacing collars at 4-year intervals, and have had very few collar failures.

**Immobilizing drugs and antagonists**

Currently the drug of choice for immobilizing caribou in Alaska is carfentanil citrate. It

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is a Schedule II narcotic that is tightly regulated by the Drug Enforcement Adminstration (DEA) and can only be purchased by a person with the appropriate DEA certification. Also, DEA requires secure storage and exact accounting of any and all use of Schedule II narcotics, so accurate recordkeeping is essential. Further, carfentanil, as well as naltrexone hydrochloride (antagonist for carfentanil) and yohimbine hydrochloride (a xylazine antagonist), are only available from 1 company in the US - Wildlife Pharmaceuticals, Fort Collins, CO. Wildlife Pharmaceuticals requires a prescription from a veterinarian for all drug purchases.

Immobilizing drugs are extremely potent and hazardous to humans in the dosages commonly used for wildlife capture projects. It is imperative that capture personnel are knowledgeable about the drugs they are using and the appropriate precautions necessary to manage the risks associated with these drugs (Appendix 1).

Although carfentanil/xylazine is currently the drug combination of choice for chemical immobilization of caribou in Alaska, project leaders must keep aware of developments of new drugs that occasionally come available. Although carfentanil/xylazine has worked very well over the last couple of decades, it has major drawbacks, including hazards to humans, Schedule II classification, and expense. While a new drug or combination may arise that appears more suitable, it is important to remember that there is always a learning process involved in switching to a new drugging protocol and therefore any changes must be thoroughly researched and the advantages and disadvantages of the new drug protocol must be completely vetted before it is put into practice.

**Other equipment and supplies**

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In addition to radiocollars and drugs, a variety of equipment and supplies are necessary for the capture and handling of caribou, and for radiotracking operations including:

-dart rifle, darts, and appropriate charges;

-scale, weighing net, and weighing bar or tripod and come-a-long;

-A capture kit containing:

-collar tools and spare hardware;

-digital rectal thermometers;

-syringes, needles, and collection tubes for blood samples (It is convenient to place the blood collection supplies for 1 caribou [1 35ml syringe, 1 18x1in needle, 2 10ml serum tubes, 2 3ml EDTA tube] along with a tooth envelope, in individual whirlpaks);

-tools for tooth extraction and coin envelopes for extracted teeth; and

-syringes and needles for delivering antagonists and additional drugs if needed;

-A pistol of sufficient caliber for euthanizing caribou if necessary;

-a centrifuge, test tube racks, pipettes, etc. for processing blood samples; and

-telemetry receivers, antennas, and the associated cables and switchboxes.

## II. CARIBOU CAPTURE AND HANDLING

Caribou capture efforts in DENA primarily occur during mid- to late March when temperatures are usually warm enough for reasonable field operations but low enough to minimize concerns of overheating darted caribou and prior to late pregnancy. If necessary, female calves can be captured in April and adult females can be captured mid-September – mid-November. To ensure that data gathered is generally representative of the herd as a whole, it is

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necessary to evaluate the distribution of caribou prior to the capture effort by locating existing radiocollared caribou and to distribute capture of new individuals in a similar regional fashion.

**Age-structured sample**

Since 1986, we have maintained a sample of radiocollared females in the Denali Herd that is representative of the female age structure of the population, thus providing annual assessment of population vital rates faithful to the herd's age structure. The age-structured sample is maintained by recollaring individuals in the sample every 4 years prior to battery exhaustion and by recruiting yearling females into the sample on 1 May each year based on the ratio of female calves to adult females in the herd the previous September. These recruits come from a sample of 10-month-old females captured each March; the number of 10-month-olds to be captured can be determined by calculating the ratio of female calves to adult females in the previous September composition count and multiplying that by the number of females in the age-structured sample, then adding 2-3 additional 10-month-olds to account for mortalities that may occur between March captures and 1 May recruitment into the age-structured sample. Any additional individuals that do not become part of the age-structured sample provide additional information on productivity of 2 and 3 year-olds and then have their collars removed before they are 4 years of age. During periods of population decline, additional adult females have been captured to maintain the age-structured sample size, in that the radiocollared sample will decline with a declining population. Similarly, should the age-structured sample grow beyond reasonable size during a period of herd growth, the sample can be reduced by removing randomly selected individuals as needed. Once included, an individual remains in the age-structured sample until it dies or is removed to reduce the sample size.

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**Preparation for day of capture**

Prior to a day of captures, it is necessary to prepare equipment and supplies to complete captures of ≈ 10 caribou. We generally assemble and load 18 darts to begin the day; a comparable number of additional darts are pre-assembled and ready to be filled in the field, if necessary. A test tube rack is useful for holding darts as they are being filled both prior to departure and in the field. Prior to loading darts, review the human safety protocol (Appendix 1), make sure that a fresh vial of naltrexone and the appropriate syringe is close at hand, and that a coworker remains nearby throughout the entire drug loading process. Once darts are loaded, they are covered with plastic caps and are placed in a ventilated ammo can with handwarmers to keep the darts from freezing, if conditions warrant.

Loaded darts that are left at the end of the day can be used on the subsequent day, but they will lose potency over several days. Therefore, it is important to keep track of any leftover darts and make sure they are used first on the following day before other freshly-loaded darts. In cases where you are held up by inclement weather, drugs that have been loaded in darts for > 72 hours should be discarded.

During captures, it is important for the gunner to have some xylazine, both antagonists, and appropriate syringes and needles on their person, in case an individual caribou needs to be boosted with additional drug or is in distress requiring immediate administration of antagonists. Also, naltrexone tends to precipitate out of solution when cold and is difficult get back into solution, thus it must be kept warm in an inside coat pocket. Further, for drug safety purposes, all personnel on the helicopter crew, including the pilot, must have a vial of Naltrexone and the correct syringes/needles on their person in case of an accident with the carfentanil. For the

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gunner, a flyfishing vest can be useful in providing several pockets for drugs, syringes, etc. under a heavy coat.

**Capture procedures**

Caribou are captured with helicopter darting procedures that have been employed successfully in DENA areas for over 26 years. We generally use a Robinson R-44 helicopter and the capture crew consists of the pilot and gunner, and an additional person to assist with animal processing. A spotter plane, usually a PA-18 Supercub, works with the helicopter to locate caribou for capture, monitor darted caribou during induction, and check on caribou that have been darted within the past 2-3 days.

Adult female caribou are immobilized with a combination of carfentanil citrate and xylazine hydrochloride (3.9mg carfentanil and 100mg xylazine per dart), delivered via 3 ml Palmer CapChur syringe fitted with a 2.9 cm (1 1/8") barbed needle. Ten-month-old females receive reduced dosages (1.5 mg carfentanil and 40 mg xylazine per dart) delivered by 1-3 ml dart and 1.9 cm (3/4") barbed needle. Caribou are darted in the large muscle mass of the hindleg or shoulder preferably, while avoiding the top of the rump on adult females where fat reserves can hinder drug delivery and absorption. Darts are usually fired from a powder-fired Palmer dart rifle (brown or "very low" charges), but $CO_2$-powered pistols are occasionally used. It is crucial to have a cleaning rod within easy reach of the gunner in the helicopter to remove unused darts from the rifle, if necessary.

Once a caribou is darted, the helicopter crew makes sure that the spotter plane has the darted caribou in sight, then leaves the immediate vicinity and lands at a distance to minimize disturbance to the caribou group. It is very important to record exact times when caribou are

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darted and to account for any missed shots on a standard datasheet (Appendix 2), as well as noting initial observations of drug effect and timing of induction. The capture forms are the primary record of carfentanil use and required by DEA to account for every mg of carfentanil used. Accurate times recorded to at least the nearest 5 seconds are extremely important in making decisions regarding redarting caribou that are not sufficiently immobilized (see below).

The caribou is continuously monitored from the spotter plane, with regular reports to the helicopter as the caribou goes through the stages of induction. On occasion, the helicopter may be called in to keep the darted caribou and associates from entering trees or dangerous terrain, or from mixing with a large group where it is difficult to visually monitor the darted caribou, so it is important to maintain close communication between the 2 aircraft throughout the darting and induction period. Once the caribou goes down, the spotter plane alerts the helicopter crew and remains on sight until the handling crew has reached the immobilized caribou.

Occasionally a caribou is not adequately immobilized with the first dart, with its behavior ranging from no drug effect to obvious, but inadequate, effects (e.g., hackney gait, braced stance, ataxia, rising on approach of the helicopter, etc.). These situations require informed decision-making by the gunner on what actions to take, based largely on personal experience and critical observations of the affected caribou. A general rule of thumb is to redart the caribou after 8 minutes if no drug effect is observed and after 12 minutes if drug response is inadequate and the caribou does not appear to be progressing toward induction. However, the degree and progression, or lack thereof, of drug effect must be taken into consideration. It is generally better to redart an animal than it is to allow it to continue to struggle for more than a couple minutes. On a rare occasion, inadequately-dosed caribou can be approached and physically restrained without being redarted, but this depends on the animal's mobility and awareness, terrain

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characteristics, and available landing areas for the helicopter, as well as the physical abilities and confidence of the gunner and/or animal handler in pulling a caribou to the ground and restraining it until additional drug can be provided. Individuals that require physical restraint are given 10-30 mg xylazine IV or IN, resulting in adequate anesthesia within 2-3 minutes. In these cases, high body temperatures can be a problem and require close attention.

Once a caribou is immobilized, the helicopter crew returns to the area and lands within 15-30 m of the caribou; personnel are deployed to process the drugged caribou. Immediately upon arriving at the caribou, personnel position the caribou on its sternum, assess the state of immobilization and its physical well-being, take the animal's rectal temperature with a digital thermometer, and remove the dart placing it in a designated sharps container (e.g., a 1 L plastic water bottle appropriately marked for sharps disposal). In most cases, caribou will be able to maintain sternal recumbency with their heads up and eyes open at initial induction; to protect their eyes, they can be loosely blindfolded or turned so they are not facing directly into bright sunlight. If a caribou is adequately immobilized and its body temperature is < 41.7° C (107° F) and not rising noticeably toward that threshold, it can be fully processed as described below. If the body temperature ≥ 41.7° C (107° F), the animal must be quickly radiocollared and antagonist drugs delivered as quickly as possible, and other handling eliminated, because the drugged caribou cannot adequately thermoregulate. Thus the temperature will likely continue to increase and even short periods at such high temperatures can cause significant brain damage or death. Antagonizing the immobilizing drugs will return the individual's thermoregulatory function. If the body temperature is below the 41.7° C (107° F) threshold, but rising toward and likely to exceed it, then the handling crew must closely monitor the temperature, prepare antagonists for injection, proceed with handling activities in priority order, and administer

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antagonists if the reaches the temperature cutoff. Caribou that are adequately immobilized and within body temperature limits are processed through a standard handling protocol. The entire handling process from induction to delivery of the antagonists should take < 20 minutes in most cases.

**Identification and radiocollaring**

Each caribou is assigned a unique number to be used throughout its life. This number must not be the radiofrequency of the collar as each caribou may be refitted with new collars several times during its life. To date, we have used a unique number for each caribou composed of the last 2 digits of the year it was initially captured and a 3-digit sequential number (e.g., the next few caribou to be captured in DENA will be 13284, 13285, 13286, etc.).

Radiocollars are affixed snugly with just enough room to slide 3-4 fingers flat between the collar along the side of the caribou's neck and excess collar material is cut off with a sharp knife or small sheet metal shears. The neck circumferences of 10-month-olds do not increase much as they mature, and necks of adult females vary little throughout the year, thus a snug collar is much better than a loose one that flops around on the animal's neck.

**Other handling of immobilized caribou**

While a radiocollar is being fitted, other personnel can move forward with other processing. It is a good idea to prepare syringes with antagonists at the beginning of the handling protocol so that they can be delivered quickly should the caribou exhibit signs of distress. A 25-30ml blood sample is drawn, using a 35ml syringe and 18x1in needle, from each adult female via the cephalic vein for condition analyses, disease screening, and archival. Blood

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is immediately transferred from the syringe to appropriate blood collection tubes and the entire blood kit is labeled with the unique animal number, date, and time. For a 30ml blood sample, we use 2 10ml plain serum collection with clot separator (red/grey tops) and 2 3ml EDTA tubes (purple tops). EDTA tubes must be gently rocked back and forth several times to mix the anticoagulant with the blood. Blood samples must be kept warm enough to avoid freezing by immediately placing them inside your coat, then transferring them to a warm, insulated container (e.g. a small insulated bag with a water bottle or gel pack) in the helicopter.

Adults captured for the first time have a canine tooth extracted to determine age via cementum analysis. Although carfentanil and xylazine provide sufficient analgesia, we inject 1ml lidocaine/epinephrine to root depth around the tooth using an intraligature syringe fitted with a 27g dental needle to provide prolonged analgesia once the immobilizing drugs are antagonized. The tooth is loosened with a dental elevator and removed with dental forceps. The tooth is placed in a paper coin envelope, labeled with the animal's number and the date, and placed in the whirlpak with the blood samples for the individual.

Each caribou is weighed to the nearest 0.5 kg by placing them in a 5ft x 5ft weighing net and suspending them under a digital scale that is lifted with a weighing bar or via a come-a-along and lightweight tripod. Body measurements of interest can be taken; we are currently taking the following measurements:

-Skull length: linear measurement from back of skull to tip of skull at nares;

-Mandible length: linear measurement from back of ramus to tip of mandible at I1 incisors;

-Antler length: contour length from base to tip of main beam; each antler (note breakage);

-Antler points: total number of points for each antler (point > 1 in. long and < 1 in wide; note breakage);

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-Metatarsus length: linear measurement from proximal end of calcaneum to distal end of metatarses; and

-Hindfoot length: contour measurement from the proximal end of calcaneum to distal tip of hoof.

**Antagonists to immobilizing drugs**

Once processing is complete, carfentanil effects are antagonized with naltrexone hydrochloride dosed at 100mg/mg Carfentanil administered. Naltrexone is delivered ¼ IV and ¾ SC for the first dart, and entirely SC for any additional darts. Yohimbine hydrochloride is administered IV to antagonize xylazine effects at 0.11mg/kg (5mg/100lbs); no additional yohimbine is given to caribou darted more than once. Both antagonists are combined in 1 syringe for the IV injection and delivered after the SC dose. Caribou are usually able to stand, walk, or run within 2-5 minutes of receiving the antagonists.

**Euthanasia**

On rare occasion, individual caribou are injured during the capture process and must be euthanized. Since September 1992, we have conducted over 1,300 caribou captures using the immobilization protocol described here and have experienced 22 capture mortalities (1.7%). Of those, 5 individuals were injured during capture and were dispatched with large-caliber pistol (e.g. 357 Magnum, 44 Magnum) shots to the head. Although these are very rare events, it is essential that capture personnel are prepared to euthanize injured caribou when these situations arise.

**Specimen handling**

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Following a day of fieldwork, serum tubes are centrifuged for 15 minutes and the serum pipetted into 1.8ml cryovials. Serum and clots from the 2 blood collection tubes are labeled with the unique animal number, species (CBOU), herd designator (DENA), and date; placed in a whirlpack; and frozen. Whole blood from the EDTA tubes is transferred to cryovials, labeled, packaged in whirlpaks by individual, and frozen. Teeth in coin envelopes are labeled similarly and stored frozen.

## III. RADIOTRACKING

The goal of radiotracking is to determine the status (alive or dead) and location of each collared caribou during benchmark periods of the year. The status of individuals is used to evaluate survival patterns of adult females, while their locations are used to provide an assessment of the herd's seasonal distribution and aid in conducting population surveys. The equipment and methods of aerial radiotracking are well-established and have been described in detail elsewhere (e.g. Wolf Monitoring Protocol for the Central Alaska Monitoring Network SOP #2). Usually, radiotracking missions are conducted with PA-18 Supercub or similar aircraft by a pilot, who is adept at radiotracking, making observations, and recording the required data.

For this protocol, the minimum annual radiotracking schedule is:

1) 1 May: assess survival at the change in biological year on 1 May. In recent years this radiotracking has been conducted as "listen only" to detect mortalities but caribou are not located given that they are transitioning between winter ranges and calving locations, thus distribution at this time of year is of little interest.

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2) mid-May: locate individual radiocollared females to determine their productivity by observation of calves at heel, retained hard antlers, or distended udders. Distribution of parturient cows provides a reasonable assessment of calving distribution, although some individuals may still be moving toward their ultimate calving locations.

3) early June: determine postcalving distribution as part of postcalving census and composition survey.

4) late July: document survival and summer distribution.

5) late September: assess distribution for fall composition surveys, survival over the summer, and rutting distribution.

6) late November: determine survival and early winter distribution.

7) late January: document survival and midwinter distribution.

8) mid-March: ascertain survival and late winter distribution.

It is very important to locate all the caribou during each radiotracking bout in order to accurately determine the distribution and survival of these caribou. Usually, some caribou will be difficult to locate requiring additional effort for a small number of individuals, and invariably a few will be missed. However, these individuals commonly determine the extremes of the herd's distribution or died in areas where the radiosignal range is limited due to terrain. The number of missed animals needs to be kept to a minimum, and additional efforts must be made to locate them in the subsequent radiotracking bout or in association with other radiotracking that is occurring in the area (e.g., wolf relocation).

As radiocollared individuals are located, information on their status and location is recorded on a standard data sheet (Appendix 3). The data sheet is kept as a spreadsheet that can

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be easily updated as additional caribou are radiocollared or as mortalities are detected. Prior to any radiotracking, 5 fields are filled in and updated as necessary:

1) LAST LOCATION: a simple geographic descriptor for the region where the individual caribou was located on the previous radiotracking trip (e.g., Wigand, E Muddy, Birch Hills, etc.). Individuals that are missed on the previous bout are denoted here along with the last location and date;

2) FREQ: radiocollar frequency;

3) NO: unique animal number;

4) SEX: sex and age of individual (e.g., F3 = female 3 years-old); and

5) AS: individuals included in the age-structured sample of females are denoted with an "A".

Data collected during radiotracking is denoted in the 9 subsequent columns:

1) DATE: a radiotracking bout may take several days to complete and the range of dates is denoted at the top of the form. If 1 datasheet is used for an entire radiotracking bout, then the day that a specific caribou is located is denoted in this column;

2) LOCATION: a brief regional geographic descriptor of the caribou's current location;

3) GNO: group number: a sequential number assigned to each group observed. Several caribou often occur in the same group; thus the data beyond GNO only has to be denoted for the first caribou located in the group. For the remainder, denoting the group number is sufficient. Waypoints provided by the aircraft's GPS are good way of assigning group numbers;

4) TIME: time caribou was located;

5) MO: transmitter mode: 1 or A = active, 2 or M = mortality;

6) VI: visual on collared animal: 1 or I = collared individual observed, 2 or G = group observed, 3 = located but not observed, 4 = listened for but not heard;

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7) N: approximate group size;

8) COORDINATES: latitude and longitude from aircraft GPS; and

9) COMMENTS: any comments of interested can be added here or noted with a number here and written out below on the blank space at the bottom of the data sheet. In particular, observations associated with mortalities need to be noted here including disposition of the carcass, any obvious predator sign, helicopter landing considerations, etc. This information will be transferred a mortality record (Appendix 4) at the end of the radiotracking bout.

A mortality record (Appendix 4) is completed for each mortality. The top section of the mortality record is used to note information relevant to the initial detection of a mortality during radiotracking including the date, time, general location, coordinates, and a brief description of what was observed. The second section provides a place to record the last observation alive for a given individual once the mortality record has been forwarded to the principal investigator. Mortality records completed to this point are maintained in a file as a running compilation of mortalities that need to be investigated in the field. When a mortality is investigated in the field and the collar is recovered, the final block on the mortality record is completed with information on what was observed during that mortality investigation.

## IV. APPENDICES

**Appendix 1. Human Safety Protocol**

**Appendix 2. Caribou Capture Data Sheet.**

**Appendix 3. Caribou Radiotracking Data Sheet**

**Appendix 4. Caribou Mortality Record**

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## Appendix 1. HUMAN SAFETY PROTOCOL FOR USE OF CARFENTANIL IN CARIBOU IMMOBILIZATION – 6/09

Carfentanil citrate is a potent narcotic (about 10,000 times the clinical potency of morphine) that is very dangerous to humans. Human safety is absolutely critical and must be taken seriously. Toxic exposure can occur by accidental injection with a syringe or dart, by absorption through the mucous membranes of the mouth, eyes, or nose, or by absorption through broken skin. Never use carfentanil while working alone or without having an antagonist (Naltrexone) immediately at hand.

Xylazine hydrochloride is a tranquilizer added to the carfentanil to aid in induction of immobilization. Xylazine is known to reduce blood pressure in humans, but recovery is likely given appropriate medical attention, even with large doses.

### CURRENT DOSAGES

Adult females: 3.6 – 3.9mg carfentanil/100mg xylazine
10-month-old-calves 1.5mg carfentanil/40mg xylazine

### SYMPTOMS OF CARFENTANIL EXPOSURE

May include:

1. Dizziness, incoordination, lethargy, sedation,
2. Nausea, vomiting,
3. Pinpoint pupils,
4. Breathing slow, shallow or absent; respiratory arrest,
5. Cold, clammy skin; weak or imperceptible pulse,
6. Collapse, unconsciousness, and coma

### TREATMENT

1. If symptoms do not appear within 3 minutes of suspected contact with drug mixture, it is unlikely that treatment with an antagonist is required. **Thoroughly wash the area of suspected contact** and watch the individual for at least 30 minutes for the appearance of symptoms.
2. Should someone begin showing some of the above symptoms, follow this protocol:

**A. ADMINISTER ANTAGONIST**: Immediately upon recognition of symptoms, inject victim with **1ml of Naltrexone** from a clean, fresh vial. An intravenous injection is preferred; if you can't get in a vein quickly then administer IM into large muscle mass of arm or thigh, and then try to get into a vein with a second dose. Victim should be closely monitored for a response and CPR, if necessary, should be performed. Response should be rapid, just like that observed in ungulates. **If no response after 1 minute from IV injection (3 minutes from IM), give an additional 1ml of Naltrexone**. Continue this procedure until you get a response. Naltrexone is very safe for humans, so don't hesitate to give more if needed.

**B. MAINTAIN AIRWAY AND CIRCULATION**: Lay the victim down and ensure maintenance of a proper airway. Victim may vomit and laying him on left side with head slightly lower than body will allow vomit to drain. Perform CPR as necessary. Be aware that muscle rigidity may make CPR difficult or impossible, but antagonist should quickly alleviate this problem.

**C. ONCE STABILIZED, EVACUATE VICTIM AS SOON AS POSSIBLE TO NEAREST MEDICAL FACILITY**: Victim will require professional medical attention. Keep victim warm and treat for shock (on back, feet up, keep warm). Closely monitor victim and be prepared to administer additional Naltrexone if symptoms return. If possible, notify hospital en route with details of the accident including the drugs involved, some estimates of the likely amounts, and the treatment that has occurred. Upon arrival, be sure to take antagonists, field dart kit (small, clear kit), and this document into the hospital/clinic so staff can see the drugs that were involved and have the associated literature available.

### XYLAZINE EXPOSURE

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Symptoms of xylazine exposure include decreased respiratory and heart rate; sedation, dizziness, nausea; and hypothermia. Antagonists are not generally used to treat xylazine exposure in humans. However, yohimbine is used in human medicine. Depending on the situation, use of yohimbine can be considered; based on human applications a reasonable dose is 0.125mg/kg (5.7mg/100lbs) IV, IM

## HUMAN SAFETY GUIDELINES

**LOADING DARTS**:

1. Always wear medium weight rubber gloves to ensure against accidental exposure.
2. Always work in pairs. Have another person, briefed in the human exposure protocol, nearby while darts are being filled.
3. Have a fresh bottle of Naltrexone and a 1-ml or 3-ml syringe in plain view and show your partner where it is before your start filling darts.
4. Do not spray or spill drug when filling darts. Clean up any spills immediately and carefully to avoid contact with skin. Use the proper drug drawing techniques to ensure negative air pressure so drug does not seep from the vial.
5. Cover all darts with plastic tip covers. Place darts in metal ammo can, secured in the styrofoam block, pointing straight up.
6. Place syringes, needles, and empty vials in an appropriate "Bio-hazard Sharps Container" immediately upon completion. Mark partially used vials and use them prior to opening additional vials. Only 1 open vial at a time.
7. Upon completion of filling darts and stowing them properly in the ammo can, and prior to removing rubber gloves, thoroughly clean area used for loading darts. Turn rubber gloves inside out as you remove them. Discard gloves.
8. Plan ahead to avoid or minimize the need for loading darts in the field. If filling darts in the field is necessary, follow the same protocol as described here. Used syringes, needles and empty vials are to be placed in the "Used Dart" container until returning to the office, then disposed of properly. At least a quart of water should be readily available to flush drugs if they come in contact with personnel.

**SAFETY IN THE FIELD**

1. Prior beginning a capture effort, the crew leader will review safety and emergency procedures with the field crew, including the locations of Naltrexone antagonist in the gear and human safety and exposure protocol. Crew members should be familiar with and qualified to administer CPR should the need arise.
2. Exercise absolute firearm safety.
3. Darts remain in the ammo can until just prior to the actual darting run. Darts are not placed in the rifle until you are sure you are going to use it. Should a dart be placed in the rifle and then not fired, it must be removed immediately upon landing, refitted with a dart tip cover and replaced in the ammo can. A cleaning rod is always carried in the aircraft in easy reach to facilitate safe removal of darts from the rifle.
4. A bottle of Naltrexone and appropriate syringes/needles will be carried by every helicopter crew member including the pilot. Additional Naltrexone is carried in the field capture kit (grey tackle box). In cold weather, all Naltrexone must be kept warm to keep it from precipitating. Every crew member will be given a couple of syringes with needles to carry on their person. Additional syringes will be in the field capture kit, and the dart ammo can.
5. Removing the dart from a downed animal will be done with care to avoid contact with drug on the surface of the dart or on the animal's hide. Darts are immediately placed in the used dart container upon removal. The handling crew should avoid contact with the dart wound.

**DRUGS USED IN THE FIELD**

**1. Carfentanil** (3mg/ml; 10ml/vial): A powerful opioid used to immobilize large ungulates-info sheet attached.
**2. Xylazine** (100mg/ml; 50ml/vial): Alpha$_2$-adrenergic tranquilizer used in combination with carfentanil to smooth and speed induction, immobilization and recovery-info sheet attached.
**3. Naltrexone** (50mg/ml; 30ml/vial): Opioid antagonist used to counteract effects of carfentanil immobilization-info sheet attached.
**4. Yohimbine** (10mg/ml; 30ml vial): ): Alpha-adrenergic antagonist used to counteract effects of xylazine sedation-info sheet attached (used for caribou).

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## Appendix 2. Caribou Capture Data Sheet.

DATE _____

CARIBOU NO._____
SEX/AGE_____ SHOOTER_____CREW_____
R/C FREQ_____
SERIAL NO._____ AIR TEMP_____
MAGNET OFF?_____

LOC/GRP
SIZE_____LAT//LON_____

| DRUG/DOSE | SYR/NDL SIZE | LOCATION | TIME |
|---|---|---|---|
| MISSES _____ | | | |
| 1st HIT _____ | _____ | _____ | _____ |
| 2nd HIT*_____ | _____ | _____ | _____ |
| 3rd HIT* _____ | _____ | _____ | _____ |

**(ADD CARIBOU SKETCH)**

*explain need for 2 or more injections
VISIBLE EFFECT (1st instability) _____
ANIMAL DOWN _____

Drug Response (each dart): NONE INCOORD ATAXIA HACKGAIT PHYSRES STERNAL LATERAL

Drug Effect:: LIGHT 2 3 4 HEAVY EXPLAIN(Ext Darts. Stiffness/tremors, analgesia, salivation, etc)

Body Condition: Fat Good Poor With Calf? Y N Lactating? Y N

SAMPLES
TOOTH (C1)_____
BLOOD 2 RED_____1 PURP_____

EST. AGE_____

MEASUREMENTS
SKULL _____MAND_____
ANTLER LENGTH: L_____R_____
ANTLER POINTS: L_____R_____
METATARSAL _____HINDFOOT_____

BODYWEIGHT_____TARE_____
BW includes: collar??

**BODY TEMP**: INIT: TIME_____TEMP_____
FINAL: TIME____ ___TEMP_____

| REVERSAL | PHYS RES | STERNAL | LATERAL | TIME |
|---|---|---|---|---|
| Yohimbine (DOSE/RTE)_____ | | | | _____ |
| Naltrexone (DOSE/RTE)_____ | | | | _____ |
| MAINTAIN STERNAL POSTURE | | | | _____ |
| STANDING | | | | _____ |
| FULLY MOBILE | | | | _____ |

COMMENTS _____

_____

_____

_____

_____

_____

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## Appendix 3. Caribou Radiotracking Data Sheet

**DENA RT FORM – CARIBOU** PILOT/OBS_____ PLANE _____ DATE_____ **PAGE 1 OF 5**

Form revised 20 April 2009

| | LAST LOCATION | FREQ | NO. | SEX | AS | DATE | LOCATION | GNO | TIME | MO | VI | N | COORDINATES | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | E. MUDDY | **4.071** | **06010** | F3 | | | | | | | | | | |
| 2 | E. MUDDY | **4.101** | **03968** | F8 | A | | | | | | | | | |
| 3 | UU EUREKA CR. | **4.120** | **06016** | F3 | A | | | | | | | | | |
| 4 | N. BIRCH HILLS | **4.170** | **04984** | F13 | A | | | | | | | | | |
| 5 | SW BOOT LAKE | **4.221** | **08080** | FY | A | | | | | | | | | |
| 6 | WIGAND | **4.271** | **07018** | F2 | A | | | | | | | | | |
| 7 | WIGAND | **4.280** | **06012** | F3 | | | | | | | | | | |
| 8 | E TOE PETERS | **4.299** | **09127** | Fclf | | | | | | | | | | |
| 9 | WIGAND | **4.443** | **99916** | F9 | A | | | | | | | | | |
| 10 | E MYRTLE TOP | **4.575** | **09132** | Fclf | | | | | | | | | | |
| 11 | WIGAND | **4.930** | **04979** | F15 | A | | | | | | | | | |
| 12 | WIGAND | **4.960** | **09113** | Fclf | | | | | | | | | | |
| 13 | BIRCH CR | **5.230** | **05001** | F4 | A | | | | | | | | | |
| 14 | MOUTH MUDDY | **5.300** | **05991** | F9 | A | | | | | | | | | |
| 15 | WIGAND | **5.321** | **03965** | F10 | A | | | | | | | | | |
| 16 | W LOWER MUDDY | **5.340** | **05996** | F4 | A | | | | | | | | | |
| 17 | WIGAND | **5.349** | **08074** | FY | | | | | | | | | | |
| 18 | U W FK CARLSON | **5.361** | **09124** | Fclf | | | | | | | | | | |
| 19 | WIGAND | **5.419** | **99908** | F17 | A | | | | | | | | | |
| 20 | W LOWER MUDDY | **5.452** | **03962** | F18 | A | | | | | | | | | |

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## Appendix 4. Caribou Mortality Record

updated :11/2007

SPECIES: CARIBOU COW CARIBOU BULL

ANIMAL NUMBER_____

FREQUENCY_____

MORTALITY FIRST NOTED: (attach map!)

DATE:_____ TIME:_____ VISUAL: Y N

LOCATION:_____ Observer:____

GPS: _____ _____

DESCRIPTION (predator sign, tracks, terrain, landing spots):

---

LAST RECORD ALIVE:

DATE:_____ TIME:_____ VISUAL: Y N

LOCATION_____

---

MORTALITY INVESTIGATED:

DATE:_____ TIME:_____ OBSERVERS:_____

EVIDENCE OF A CARCASS?? YES NO

COLLAR RETRIEVED: YES NO SERIAL #:_____

APPARENT CAUSE OF DEATH_____

DESCRIPTION OF REMAINS, PREDATOR SIGN, ETC. **(FOR BULLS, BE SURE TO CONSIDER WHETHER THE COLLAR WAS DROPPED AND PROVIDE ANY EVIDENCE TO SUPPORT THAT CONCLUSION):**

SAMPLES COLLECTED: incisors mandible maxillae femur hind foot
marrow other

RECORDER:_____ DATE:_____

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