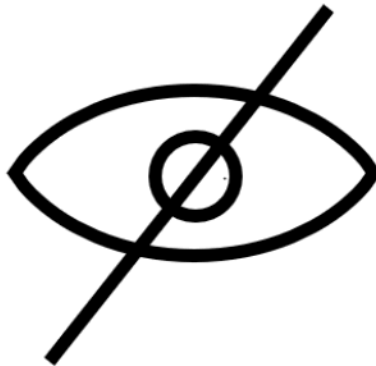




File: 292-30/LWR-2022-23358

WARNING

Sensitive Content



Dec trip	29 wolves removed All other 29 wolves were dispatched within seconds of first bullet impact All shotgun wolves (8) were dispatched immediately
Jan trip	<p>Day 1 2 wolves dispatched immediately with shotgun 3rd wolf dispatched with rifle; one shot further back, follow-up shot seconds later thru the chest.</p> <p>Day 2 Removed 7. 6 were immediate; 1 took <30 secs after first hit thru neck.</p> <p>Day 3 Removed 3; two were immediate, one was ~30 seconds.</p> <p>Day 4 4 removed; 2 head shots with buckshot (photos taken); two lung shots with rifle.</p> <p>Day 5 3 removed; 2 shotgun buckshot, 2 quick shots each. 3rd wolves was one rifle thru the lungs.</p> <p>23-Feb Removed 2 with the shotgun and buckshot. Immediate dispatch to the head neck area for both of them.</p> <p>24-Feb Removed 3 with the shotgun, 4 shots in total, all immediate deaths. Removed 2 with the rifle, both spine down through chest; dispatched immediately.</p> <p>25-Feb Removed one with the rifle; 2 shots to the chest. Quick dispatch. Removed 2 greys; 1 was 1 shot down thru spine and chest; 1 was spine and quick follow up shot to chest. Both quick dispatch.</p> <p>26-Feb Removed 5 with rifle; all were dispatched with one shot or quick follow-up shot. Removed 4; 3 with shotgun, 2 were immediate, 1 required follow-up shot 10 secs later. 1 with rifle, immediate dispatch/ Removed 1 with rifle; 2 quick shots and dispatched. Removed 5 with rifle; all were dispatched with one shot or quick follow-up shot.</p>
Mar.15	Removed 1 with rifle, 2 quick shots to chest.
Mar.16 (contractor shooting)	<p>Removed 8 -One with rifle thru heart/lungs (pics available, s.15; s.19 Shot 4, all were nearly immediate Shot 2 on lake, one was hit in back spine first but dispatched shortly after; other one was dispatched immediately. Shot 1, hit in shoulder first, dispatched ~15 sec later.</p>

DATES

Comments

1 shot on large male from above, down through spine and chest. Instant dispatch;
08-Jan 1 chest shot on 2nd wolf, dispatched immediately.

2 quick chest shots on first wolf, immediate dispatch; 2 wolves both 1 neck and 1 chest shot, immediate dispatch; 1 wolf hit in front shoulder, required two follow up shots seconds later, dispatch time less than 5-8 seconds; Next two wolves were
11-Jan both instant dispatches with one neck/head shot
1 wolf dispatched with one chest shot; 1 wolf dispatched with two quick chest
12-Jan shots.
1 wolf chest/shoulder shot, instant dispatch; 1 wolf hit in shoulder, required
14-Jan follow-up shot ~5 seconds later.
5 wolves dispatched with rifle, 3 were immediate neck/spine shots, 2 were
15-Jan multiple chest/body shots with dispatch times <5 seconds;
2 wolves immediate dispatch with one shot down through spine and into chest, 1
15-Jan wolf dispatched thru neck/back of head.
1 wolf chest shot, instant dispatch. 1 wolf hit in body, rolled in to thick conifer and
05-Feb died.
1 wolf hit in back, and quick follow up shot under a tree - 10 sec dispatch; 2nd
06-Feb wolf, 2 quick chest shots, rapid dispatch.
1 wolf immediate dispatch to neck/spine. 2 wolves dispatched with shotgun,
immediate dispatch head/neck shots; a 3rd wolf shot with rifle, 2 quick chest
07-Feb shots.
Removed 1 wolf head shot with shotgun, immediate dispatch. Removed 1 wolf,
two quick chest shots <5 secs to dispatch. Removed 1 wolf, three shots, one was
in shoulder and two in chest. Removed two wolves, 1 was two quick chest shots,
08-Feb 2nd was immediate dispatch down through spine and chest.
Removed 2, both with spine/chest shots, rapid dispatch. Removed 1 with three
rapid shots to chest. Removed 1 with one shot down through spine and chest,
10-Feb immediate dispatch.
Hit one wolf in shoulder, required 2 follow-up shots 15 seconds later in order to
dispatch; Removed 2 others with shots down thru spine and chest. Removed 1
with single shot to neck/spine, immediate dispatch. Removed 3 with shotgun, all
11-Feb pretty much instant or immediate follow-up and instant dispatch.
12-Feb Removed 6 wolves all with shotgun, all immediate dispatches with 1-2 shots.
4 removals all with rifle. First was two quick chest shots. 2nd was down through
spine and chest with quick follow-up shot to chest. 3rd was two quick chest shots,
21-Feb 4th was the same.
1 rifle shot down through spine and out through heart (pics taken), immediate
dispatch. 1 rifle shot through neck/spine, instant dispatch. 1 rifle shot 3 times in
22-Feb chest, 5 second dispatch.
4 with shotgun. All 4 were 1 chest shot followed by immediate head shot, rapid
dispatch. 1 dispatched with rifle, first shot in shoulder, quick follow up shot in
23-Feb chest, dispatch ~15 sec.

One quick rifle dispatch, two shots to chest. One rifle dispatch, 3 quick successive
shots to spine and chest. One immediate dispatch with 2 shotgun shots to
24-Feb neck/head. One immediate dispatch with 2 rifle shots to neck and chest.
One removed with rifle, 1 shot was a bit far back through spine and then a quick
follow up shot to head and immediate dispatch. One wolf shot with rifle, two
25-Feb shots through chest and shoulder.
26-Feb 1 removal with rifle, 2 quick chest shots, immediate dispatch.
18-Mar

DATES	Comments
Feb. 9	Removed 6 grays, all immediate dispatches at close range with rifle. Head/neck and chest shots, all dispatch times <5 seconds.
Feb.10	Removed 4 gray wolves; 1 required 3 quick shots <5 secs to dispatch; remaining 3 were all single shot immediate dispatches to chest or head. Removed 1 black and 4 grays - All were immediate kills with shots to spine/chest, except one shot high up on front shoulder, but was dispatched seconds later; Removed 2 grays on lake, both were immediate kills with two successive shots to chest; Removed 4 gray and one white - 4 were immediate kills with upper spine/chest shots, 1 was shot in lower spine followed by two successive shots to dispatch immediately.
Feb.14	
Feb.26	Removed large male with 2 quick chest shots. Immediate dispatch.
Feb.27	Removed one light gray with 2 quick shots, both to chest. Removed one black with upper spine shot followed immediately by 1 chest shot.
Feb.28	Removed 1 black female, 3 shots to chest. Removed 1 black wolf, 1 shot to chest.
Mar.1	Removed 1 gray, 2 quick shots to chest (photos taken)
Mar.9	Removed 1 light gray, 1 shot in chest, followed by 10 sec later by two quick follow up shots to chest.
Mar.10	Removed 2 black wolves, both were two quick chest shots, immediate dispatches.
Mar.16	Removed one black wolf, 1 shot to chest, 1 quick follow-up shot to kill it quickly. Removed 1 black female, head shot, instant dispatch. Removed 2 grays, 3 quick chest shots on one, 2 quick chest shots on the other. Removed 1 gray, one neck shot followed by chest shot, <10 sec dispatch.
Mar.17	Removed 1 gray, one shot to spine, follow up shot to chest, immediate dispatch.
Mar. 18	Removed 1 gray, one shot to neck/spine, follow up shot to chest.
Mar.19	Removed one gray with collar, 1 neck shot, instant dispatch. Removed one gray, 1 shot down through spine into chest, 1 follow-up shot in chest to ensure immediate dispatch. Removed one black collared wolf, 2 quick chest shots, <10 sec dispatch. Removed 1 black, single neck shot, immediate dispatch. Removed 1 black, 1 shot through spine into chest, and immediate follow up to chest. Removed one black with 2 immediate chest shots. Removed one large gray with 1 shot down thru spine, and one immediate shot to chest. Removed 1 gray with shoulder/chest shot, then follow up head shot. Removed three grays, all with 1 chest shot and 1 immediate follow-up chest shot
Mar.20	Removed 1 gray wolf with 1 head/neck shot, instant dispatch. Removed 1 gray wolf with one upper spine shot, and immediate follow up shot to chest. Removed 1 gray wolf with chest/shoulder shot and immediate follow up shot to neck.
Mar.22	Removed one black wolf with one shot down through spine into chest, instant dispatch.
Mar.29	Removed 1 black wolf with one upper spine shot, and 1 chest follow-up shot, <5 sec dispatch time.

DATES	Comments
Jan.9	1 chest shot on gray wolf, dispatched less than 5 seconds; 1 spine shot into the chest, and quick follow up shot on gray wolf - less than 2 secs; 2 shots into chest of gray wolf, less than 10 second dispatch.
Jan.10	1 shot through upper spine on gray wolf, instant; 1 shot thru chest on black wolf, rapid dispatch; 3 shots thru chest and spine on black wolf, less than 10 sec dispatch time; 1 shot on gray wolf thru spine into chest, one follow up shot thru chest - less than 10 sec dispatch.
Jan.11	1 black wolf, 2 shot in to chest - instant dispatch; 1 black wolf, 1 shot through spine, 2 thru chest - less than 10 secs dispatch time.
Jan.13	3 black wolves shot - 1 single shot thru spine down thru chest, instant; 1 shot 3 times through chest and neck, <10 sec dispatch time; 1 shot twice thru chest, <5 secs dispatch time.
Jan.14	Removed 1 black wolf, 1 shot thru upper spine, 1 shot thru chest; Removed 1 gray, 1 shot thru neck, instant dispatch.
Feb.1	1 gray wolf, shot once thru neck/spine, immediate follow up to chest - <3 sec dispatch time
Feb. 2	One gray wolf, one shot thru chest, follow up shot to head, <2 secs; One gray wolf shot thru upper spine and immediate follow up to chest, <5 secs dispatch; One black wolf with shotgun, 2 quick shots to head, instant dispatch; One black wolf with shotgun, also 2 quick shots to head, instant dispatch.



Ministry of
Forests, Lands and
Natural Resource Operations

**FISH, WILDLIFE AND HABITAT MANAGEMENT BRANCH
ANIMAL CARE APPLICATION FORM**

PLEASE TYPE

For office use: Date Received:

Project Number:

Project Title: Tweedsmuir-Entiako Wolf Reduction to Support Caribou Recovery

2. Starting Date: January 2020

Completion Date: March 31, 2020

3. Principal Investigator:

Name: s.15; s.19

Position: Pilot and President

Department/Organization: s.15; s.19

Region/Institution: n/a

Mailing Address: s.15; s.19

Phone: s.15; s.19

Fax: n/a

E-mail: s.15; s.19

Experience related to the described proposal:

s.15; s.19

4. Additional Investigators:

Name: s.15; s.19

Position: Secondary Pilot

Department/Organization: s.15; s.19

Region/Institution: n/a

Phone: s.15; s.19; s.22

Fax: n/a

E-mail: s.15; s.19; s.22

Experience related to the described proposal:

s.15; s.19

Name: s.15; s.19

Position: Primary Net-gunner and Shooter/Secondary Net-gunners and Shooters

Department/Organization: s.15; s.19

Experience related to the described proposal:

s.15; s.19; s.22

5. Project Proposal

Southern Mountain caribou are nationally listed as threatened in Canada and are Red-listed (Threatened or Endangered) in the Skeena Region of British Columbia (BC). The Tweedsmuir-Entiako caribou (TEC) herd is currently numbered between 150-200 animals and is rapidly declining (population growth rate of 0.89). Multiple lines of evidence suggest wolf populations are the proximate cause of decline in the TEC herd including:

- 70% of caribou mortalities between 2014-2018 were due to wolf predation
- Wolf densities in the area are estimated to be between 21-30 wolves/1000 km²

Through negotiations with the Province, an agreement has been made to initiate wolf control to support caribou recovery within the TEC treatment area boundary (see operational plan attached). The demographic indicators, along with the continued recession of habitat, have made the TEC herd a priority for this recovery action amongst the caribou herds. Wolf reduction will be conducted within an adaptive management framework, which will include monitoring caribou, wolves, and moose populations and habitat condition over the course of the program. This project proposal includes collaring individual caribou to monitor demographic response of the TEC to wolf reduction.

The reduction of wolves has been shown to be effective for reversing the trends of declining woodland caribou populations in BC. Reduction efforts must be intensive and be applied with the highest standards of scientific rigor and humaneness. Wolf reduction efforts in the TEC herd are expected to support recovery while the ultimate causes of population declines (i.e. habitat-related impacts) are addressed. Radio-collaring individual wolves from wolf packs greatly increases the efficacy of removing entire wolf packs over the course of the winter; complete pack removal is an objective of intensive wolf reduction programs.

*Operational plan for the Tweedsmuir-Entiako wolf reduction program is attached.

A. Background – Goals and Objectives:

Wolf reduction has been identified as an effective short-term management action for supporting the recovery of woodland caribou in BC.

The goals and objectives are to:

- 1) conduct net-gun aerial capture of individual wolves from all packs located within the TEC treatment area and deploy radio collars on 1-2 wolves per pack for the purpose of increasing the efficiency of aerial removal (euthanasia);
- 2) using radio collar locations to identify pack locations, euthanize (via aerial shooting) the majority of wolves (>80%) found within the treatment area and reduce the wolf density to below 3 wolves per 1000 km²;
- 3) conduct net-gun aerial capture of individual caribou to monitor response of the TEC population and inform adaptive management
- 4) implement scientific rigor and the highest possible standards for humaneness, and report out on all facets of the program

B. Key Expected Results and Management Implications:

- 1) Radio-collar deployment on individual wolves from the majority of wolf packs within the treatment area with biological sampling for health profiles.
- 2) Reduction of the majority (>80%) of wolves via aerial shooting
- 3) Simultaneous monitoring of caribou populations via radio-collaring to report population growth, adult female survival, and calf survival in response to wolf reduction
- 4) Ultimately, expecting positive caribou population growth on an annual basis (target 15% annually)

6. CCAC Invasiveness Category: (see Appendix A)

A ☐ B ☐ C ☐ D ☒

7. Species and Number of Animals Required: (include justification of numbers predicted to be used)

Species: Wolf (*Canis lupus*)

Number expected for 2020: approximately 7 radio collar deployments, up to 410 to be euthanized

The number of radio collars to be deployed is contingent on the number of wolf packs within the treatment area. It is estimated that there will be between 5-10 wolf packs within the TEC treatment area. Radio-collar deployment is generally non-selective but will be applied to adult wolves preferentially.

The number of wolves to be euthanized is also dependent on the number of wolves present within the treatment area. It is estimated that at approximately 410 wolves will be euthanized across the treatment area, however, this may be an overestimate as it is based on a snow track survey.

Justification for numbers: The number of wolves to be radio-collared is based on the estimated number of wolf packs in the treatment area. Having one wolf radio-collared within each pack greatly increases the efficacy of removing subsequent wolves from the pack. It is estimated that up to 410 wolves will be euthanized in order to achieve greater than 80% reduction rate required to support caribou recovery.

Species: Caribou (*Rangifer tarandus*)

Number expected for 2020: approximately 14 radio collar deployments.

The number of radio collars to be deployed is based on maintaining an approximate sample size of 35 collared animals in the TEC subpopulation. Currently there are approximately 18 active collars in the TEC and 14 collars have been purchased for deployment this winter.

8. Details of Capture, Handling and Surgical Procedures and Final Disposition:
(be detailed and SPECIFIC, attach additional pages, if necessary)

Please refer to Appendix B – CCAC guidelines on: the care and use of wildlife (2003) for techniques considered appropriate and other guidelines for handling and care.

Capture Technique:

Wolves will be captured for radio collar deployment via aerial net-gunning, and euthanasia will occur via aerial shooting. Caribou will also be captured for collar deployment via aerial net-gunning.

Helicopter captures and removal will take place between January and the end of March using aerial net gunning and physical restraint and aerial shooting. An H500D helicopter will be used to track and target wolves in snow-covered, sparsely treed habitats and frozen watercourses suitable for safe capture or removal. Deep, soft snow is preferred as it will slow the wolves down, make their movements more predictable, and reduce the risk of injury during capture, and increases the likelihood of accurate, humane shooting.

Net-gunning: The identified personnel s.15; s.19 will use a hand-held net gun to capture wolves and caribou for radio collar deployment. When a candidate animal has been selected in close proximity to a suitable capture location, the capture helicopter will approach the animal, haze it into a suitable nearby opening and on close approach (within 5–10 m), fire a 12' x 12' net over the front of the animal. Hazing time for caribou will not exceed the standards outlined by the Province, generally less than 5 minutes with close approach for capture under 2 minutes for caribou. Capture location will be selected in order to minimize risks to the crew and animal (i.e. avoiding open water, avalanche terrain, thin ice, wooded areas, steep terrain, etc.). A second net may be deployed in order to further entangle the wolf or caribou. Only one wolf or caribou will be captured at a time. Two net-guns with 4 or 5 detachable net canisters will be available to the net-gunner for each capture. This provides a backup net-gun and nets that can be used to reduce chase duration if the first net fails to adequately restrain the animal, or to further entangle the animal if the single net is not sufficient. Once the net is deployed the animal usually quickly trips and is wrapped up in the net, becoming immobile. The helicopter will immediately land to drop off the capture crew, and the net-gunner will restrain the wolf with a Y-pole around the neck before it can chew out of the net. If it is a caribou, the handlers and net-gunner will immediately restrain the caribou carefully using body weight without direct pressure on the thorax. For wolves, the handler will apply a catch-pole snare around the mouth of the wolf and tighten it until it is securely closed. The crew will then apply a muzzle or multiple wraps of strong duct tape to the mouth in order to eliminate the risk of a wolf biting any crew. A blindfold will then be applied to reduce stress to wolves and caribou. Hobbles will then be applied to the front and back legs of the animal as restraint to eliminate the possibility of the wolf or caribou escaping.

Shooting: The identified personnel s.15; s.19 will conduct the aerial removal (euthanasia) of wolves by use of high-powered rifle. The rifle will be a semi-automatic 7.62 x 39mm caliber using a red-dot scope for quick and accurate target acquisition. Polymer or lead-tipped, rapid expansion lead-core bullets will be used to maximize shot impact and ensure quick or immediate kill times. The rifle includes detachable magazines for quick reloading of the firearm, and a semi-automatic action allowing for a quick succession of shots if necessary. Wolves chosen to be shot will be hazed into open locations where the shot distance is no greater than 50 m, ensuring a high likelihood of accurate shot placement. Shot placement will preferentially be the back ~~cranium of the skull~~ (targeting the brain first and upper spinal cord) or the chest area (lungs and heart). ~~If immediate death does not occur following the first shot, follow-up shots will occur preferentially in the head, then neck, or chest area to ensure death.~~ Wolves will be visually observed from as close a distance as possible from a hovering helicopter for visual signs of movement (eg. respiratory effort and movement) to confirm death before moving on. Any animal that is shot and is not recumbent will be followed until the gunner is able to kill as quickly and humanely as possible. Humaneness will be documented by recording shot placement and kill times. Once a pack is eliminated, at least half of the wolves killed will be inspected on the ground, clearly documenting shot locations and providing photos to the project lead and provincial wildlife veterinarian.

Method of Handling:

Each wolf or caribou will be handled by an experienced handling crew. As described above, the net-gunner will be the first to engage with the animal after it has been entangled in the net. The net-gunner will use a Y-pole to pin the wolf to the ground by applying the Y-pole directly behind the animal's head. The handler will approach the wolf with the catch-pole, and secure the mouth shut using the catch pole snare. Once the catch-pole snare is confirmed to be secured, the crew will apply commercial dog muzzle and/or multiple wraps of duct tape around the wolf's muzzle to ensure it is unable to bite any crew. For caribou, the net-gunner and handler will immediately approach the animal, with the handler going to the back of the animal and applying weight carefully to secure the animal and the net-gunner working to untangle the net. A blindfold will then be applied to reduce visual stress to the wolf or caribou. Hobbles will then be applied by securing the right front leg to the right back leg, and the left front leg to the left back leg. The wolf or caribou will then be positioned to minimize discomfort (i.e. sternal or lateral recumbency, head slightly uphill, head free from deep snow). Once fully immobilized, the crew will assess

the wolf or caribou for any injuries that may have occurred during capture. The restraining process generally takes less than 2–3 minutes, at which point the radio-collaring and sampling procedures will occur. Small crews of two personnel will be used to minimize stress, and sudden movements or auditory stimuli will be kept to a minimum. To release the wolf or caribou, it is first pointed in a safe direction of travel away from the crew, helicopter, or any hazards. The catch-pole snare is securely attached around the mouth, at which point the muzzle or tape around the wolf's muzzle is carefully removed and the Y-pole is re-applied. The blindfold is then removed, followed by removal of the hobbles. ~~For wolves, and release of the catch-pole snare, and finally the Y-pole is lifted for wolves,~~ allowing the wolf or caribou to flee.

Other Procedures: (Marking method, Sampling)

Each wolf and caribou will be fitted with a satellite GPS radio-collar (Vectronics Vertex Lite). The radio collar will be applied by the most experienced crew member to ensure the correct fit. Radio-collars will be fitted to ensure comfort for the animal, while ensuring that they are not too loose as to slip off or cause irritation (generally two fingers fitted vertically). Radio-collars fitted on younger ~~animals-wolves-or-caribou~~, if necessary, will be slightly looser to allow for growth over the course of the winter. For wolves, satellite collars will be programmed to obtain positional fixes every 3–4 hours over the course of the winter to acquire up-to-date location information to support removal efforts. For caribou, satellite collars will be programmed to obtain position fixes twice a day during most seasons and up to 6 times a day during calving. Radio-collared wolves will either be left alive following the winter's removal efforts in order to collect further data and to support removal efforts the following winter, or they will be euthanized once all other pack members have been removed.

Biological samples will be taken by the crew as per standardized protocols while the wolf or caribou is immobilized. The total time associated with radio-collar attachment and sample collection takes less than 10 minutes for wolves and less than 15 minutes for caribou.

The radio-collars contain an internal tip switch to detect animal movement rates, and are programmed to send a mortality alert via email and text message if no movement is detected for a sustained period of time (12 hours). Immediate investigation of mortalities is not anticipated, although radio collars will be picked up as soon as logistically feasible and an investigation on cause of death will occur if possible. Collars include label plates instructing hunters/trappers to contact FLNRO if they harvest a collared wolf. This is to facilitate collar retrieval.

Additional data will be recorded and samples will be taken by the crew while the wolf is physically restrained. The crew will examine and sample captured wolves according to the standardized BC wolf sampling protocol:

- Age class using tooth eruption/wear/staining as an index (if visible under the tape)
- Sex
- Colour
- Pack size
- Location
- Body condition
- Photos
- Presence of old injuries or new capture-related injuries
- External parasite presence and prevalence
- From each wolf, 10 to 15 ml of blood will be withdrawn from the saphenous or cephalic vein for serological screening (parvovirus, Neospora, distemper), ensuring bleeding has stopped before releasing the animal
- Each wolf will be ear-tagged with a Rototag with a unique identifier number, and a 6 mm punch biopsy of the ear will be air-dried and archived for genetics
- At least 30 hairs with roots from the top of the shoulders from each wolf for genetic or other studies (e.g., stress assessment through cortisol levels, diet analysis with stable isotopes).
- Samples will be processed each evening and stored before shipping to the BC Wildlife Health Program.

Similarly, data will be recorded on the standard BC caribou capture form and samples will be taken by the crew while the caribou is physically restrained. This will include all necessary samples and data required by the *BC Caribou Research Capture Sampling Protocols*.

Contingency Plan: (what training, preparations and equipment are available in event of animal injury during capture or handling)

The following measures will be in place to reduce the risk of injury to wolves:

- 1) Capture crews are personnel with extensive experience in capturing, handling and shooting wild canids.

Commented

S.15;
S.19

Please add the weights

- 2) At least two out of three personnel are trained in first aid and CPR
- 3) Aerial net-gun captures will be conducted in deep, soft snow in ambient temperatures of between 0 to -25 C, on terrain consisting of flat or rolling terrain and not exposed ground or open water and animals will be assessed and monitored during physical restraint.
- 4) The capture crew will have a satellite phone to contact other experienced professionals and veterinarians for advice and guidance for any unusual circumstances that arise in the field
- 5) A firearm will be available for humane killing of any wolves badly injured during net-gun captures

Method of Euthanasia and Disposal Technique: (if necessary)

In the event of an animal being injured without a chance of survival after release, it will be euthanized humanely by high caliber gunshot to the brain. Carcasses may be left in the field unless brought back to the lab for examination or necropsy and disposal at the dump, s.18.1

**9. Details of Potentially Controversial Procedures and Justification:
(Include any expected morbidity and methods used to avoid)**

Animal welfare is of high priority for this project. All net-gun captures will occur following the procedures described above (and in the regional SOPs for aerial net-gun capture). Few complications have been observed using this protocol. Aerial shooting of wolves is considered the most effective and humane method of removing wolves in remote, expansive areas, with the ability to target without bycatch occurring (AVMA, 2013). All possible measures will be taken to ensure the ethical and humane removal of wolves.

10. Budget:

Funding sources applied for: Provincial Caribou Recovery Program

Are these peer reviewed? Yes (the region's wolf reduction programs have undergone internal and external reviews to measure effectiveness)

Status: Approved

11. Region:

The wolf reduction will occur within the TEC treatment area. The treatment boundary covers an area of approximately 15,786km² in the mountain caribou range of west-central British Columbia. The treatment area was identified due to the recovery urgency for this particular caribou herd.

12. Permit:

Is a permit required? Yes **Status:** Pending Decision

Please attach any permit documents to application.

Please send the completed BC Animal Care Form Application Form to the Permit & Authorization Service Bureau (PASB) along with a General Permit Application, detailed project proposal and permit fees (if applicable). For further information on how to apply, please visit the PASB website at <http://www.env.gov.bc.ca/pasb/> or call PASB at 1-866-433-7272 (to bypass phone tree push 231).

Approval of an Animal Care Application does not constitute approval of any application to handle wildlife. Applicants must also have a valid permit, issued under the Wildlife Act, before engaging in any such activity.

s.15; s.19

Principal Investigator's Signature

December 20, 2019
Date of Application

Appendix A:

Canadian Council on Animal Care: Categories of Invasiveness for Wildlife Studies

A. Methods used on most invertebrates or on live isolates

Possible examples: the use of tissue culture and tissues obtained at necropsy; the use of eggs, protozoa or other single-celled organisms; experiments involving containment, incision or other invasive procedures on metazoa.

B. Methods used which cause little or no discomfort or stress

Possible examples: observational studies in which the same individuals are not repeatedly observed so as to habituate or otherwise modify their behavior; census or other surveys which do not involve capture or marking individuals; non-invasive studies on animals that have been habituated to captivity; short periods of food and/or water deprivation equivalent to periods of abstinence in nature.

C. Methods which cause minor stress or pain of short duration

Possible examples: capture, using methods with little or no potential to cause injury and marking of animals for immediate release; long-term observational studies on free-ranging animals where the behaviour of individuals may be altered by repeated contact; brief restraint for blood or tissue sampling; short periods of restraint beyond that for simple observation or examination, but consistent with minimal distress; short periods of food and/or water deprivation which exceed periods of abstinence in nature; exposure to non-lethal levels of drugs or chemicals; low velocity darting and slow-injection darts with immobilization chemicals. Such procedures should not cause significant changes in the animal's appearance, in physiological parameters such as respiratory or cardiac rate, or fecal or urinary output, in social responses or in ability to survive.

Note: During or after Category C studies, animals must not show self-mutilation, anorexia, dehydration, hyperactivity, increased recumbency or dormancy, increased vocalization, aggressive-defensive behavior or demonstrate social withdrawal and self-isolation.

D. Methods which cause moderate to severe distress or discomfort

Possible examples: capture, using methods that have the potential to cause injury (e.g. Leg snares, leghold traps, high velocity darting and rapid-injection darts with immobilization chemicals, net gunning, etc.); maintenance of wild caught animals in captivity; translocation of wildlife to new habitats; major surgical procedures conducted under general anesthesia, with subsequent recovery; prolonged (several hours or more) periods of physical restraint; induction of behavioral stresses such as maternal deprivation, aggression, predator-prey interactions; procedures which cause severe, persistent or irreversible disruption of sensorimotor organization.

Other examples in captive animals include induction of anatomical and physiological abnormalities that will result in pain or distress; the exposure of an animal to noxious stimuli from which escape is impossible; the production of radiation sickness; exposure to drugs or chemicals at levels that impair physiological systems. (NB. Experiments described in this paragraph would be Category E if performed on wildlife immediately prior to release.)

Note: Procedures used in Category D studies should not cause prolonged or severe clinical distress as may be exhibited by a wide range of clinical signs, such as marked abnormalities in behavioral patterns or attitudes, the absence of grooming, dehydration, abnormal vocalization, prolonged anorexia, circulatory collapse, extreme lethargy or disinclination to move, and clinical signs of severe or advanced local or systemic infection, etc.

E. Procedures which cause severe pain near, at, or above the pain tolerance threshold of unanesthetized conscious animals

This Category of Invasiveness is not necessarily confined to surgical procedures, but may include exposure to noxious stimuli or agents whose effects are unknown; exposure to drugs or chemicals at levels that (may) markedly impair physiological systems and which cause death, severe pain, or extreme distress; behavioral studies about which the effects of the degree of distress are not known; environmental deprivation that has the potential to seriously jeopardize an animal's wellbeing; use of muscle relaxants or paralytic drugs without anesthetics; burn or trauma infliction on unanesthetized animals; a euthanasia method not approved by the CCAC; any procedures (e.g., the injection of noxious

agents or the induction of severe stress or shock) that will result in pain which approaches the pain tolerance threshold and cannot be relieved by analgesia (e.g., removal of teeth without analgesia, or when toxicity testing and experimentally-induced infectious disease studies have death as the endpoint), *capture methods with a high potential of causing severe injury that could result in severe chronic pain and/or death.*

Appendix B:

Canadian Council on Animal Care guidelines on: the care and use of wildlife (2003)

http://www.ccac.ca/english/gui_pol/GUFRAME.HTM
<http://www.ccac.ca/english/gdlines/wildlife/Wildlife.pdf>



**FISH, WILDLIFE AND HABITAT MANAGEMENT BRANCH
ANIMAL CARE APPLICATION FORM**

PLEASE TYPE

For office use: Date Received:

Project Number:

Project Title: Tweedsmuir-Entiako Wolf Reduction to Support Caribou Recovery

2. Starting Date: January 2020

Completion Date: March 31, 2020

3. Principal Investigator:

Name: s.15; s.19

Position: Pilot and President

Department/Organization: s.15; s.19

Region/Institution: n/a

Mailing Address: s.15; s.19

Phone: s.15; s.19

Fax: n/a

E-mail: s.15; s.19

Experience related to the described proposal:

s.15; s.19

4. Additional Investigators:

Name: s.15; s.19

Position: Secondary Pilot

Department/Organization: s.15; s.19

Region/Institution: n/a

Phone: s.15; s.19; s.22

Fax: n/a

E-mail: s.15; s.19; s.22

Experience related to the described proposal:

s.15; s.19

Name: s.15; s.19

Position: Primary Net-gunner and Shooter/Secondary Net-gunners and Shooters

Department/Organization: s.15; s.19

Experience related to the described proposal:

s.15; s.19; s.22

5. Project Proposal

Southern Mountain caribou are nationally listed as threatened in Canada and are Red-listed (Threatened or Endangered) in the Skeena Region of British Columbia (BC). The Tweedsmuir-Entiako caribou (TEC) herd is currently numbered between 150-200 animals and is rapidly declining (population growth rate of 0.89). Multiple lines of evidence suggest wolf populations are the proximate cause of decline in the TEC herd including:

- 70% of caribou mortalities between 2014-2018 were due to wolf predation
- Wolf densities in the area are estimated to be between 21-30 wolves/1000 km²

Through negotiations with the Province, an agreement has been made to initiate wolf control to support caribou recovery within the TEC treatment area boundary (see operational plan attached). The demographic indicators, along with the continued recession of habitat, have made the TEC herd a priority for this recovery action amongst the caribou herds. Wolf reduction will be conducted within an adaptive management framework, which will include monitoring caribou, wolves, and moose populations and habitat condition over the course of the program. This project proposal includes collaring individual caribou to monitor demographic response of the TEC to wolf reduction.

The reduction of wolves has been shown to be effective for reversing the trends of declining woodland caribou populations in BC. Reduction efforts must be intensive and be applied with the highest standards of scientific rigor and humaneness. Wolf reduction efforts in the TEC herd are expected to support recovery while the ultimate causes of population declines (i.e. habitat-related impacts) are addressed. Radio-collaring individual wolves from wolf packs greatly increases the efficacy of removing entire wolf packs over the course of the winter; complete pack removal is an objective of intensive wolf reduction programs.

*Operational plan for the Tweedsmuir-Entiako wolf reduction program is attached.

A. Background – Goals and Objectives:

Wolf reduction has been identified as an effective short-term management action for supporting the recovery of woodland caribou in BC.

The goals and objectives are to:

- 1) conduct net-gun aerial capture of individual wolves from all packs located within the TEC treatment area and deploy radio collars on 1-2 wolves per pack for the purpose of increasing the efficiency of aerial removal (euthanasia);
- 2) using radio collar locations to identify pack locations, euthanize (via aerial shooting) the majority of wolves (>80%) found within the treatment area and reduce the wolf density to below 3 wolves per 1000 km²;
- 3) conduct net-gun aerial capture of individual caribou to monitor response of the TEC population and inform adaptive management
- 4) implement scientific rigor and the highest possible standards for humaneness, and report out on all facets of the program

B. Key Expected Results and Management Implications:

- 1) Radio-collar deployment on individual wolves from the majority of wolf packs within the treatment area with biological sampling for health profiles.
- 2) Reduction of the majority (>80%) of wolves via aerial shooting
- 3) Simultaneous monitoring of caribou populations via radio-collaring to report population growth, adult female survival, and calf survival in response to wolf reduction
- 4) Ultimately, expecting positive caribou population growth on an annual basis (target 15% annually)

6. CCAC Invasiveness Category: (see Appendix A)

A ___ B ___ C ___ D x ___

7. Species and Number of Animals Required: (include justification of numbers predicted to be used)

Species: Wolf (*Canis lupus*)

Number expected for 2020: approximately 7 radio collar deployments, up to 410 to be euthanized

The number of radio collars to be deployed is contingent on the number of wolf packs within the treatment area. It is estimated that there will be between 5-10 wolf packs within the TEC treatment area. Radio-collar deployment is generally non-selective but will be applied to adult wolves preferentially.

The number of wolves to be euthanized is also dependent on the number of wolves present within the treatment area. It is estimated that at approximately 410 wolves will be euthanized across the treatment area, however, this may be an overestimate as it is based on a snow track survey.

Justification for numbers: The number of wolves to be radio-collared is based on the estimated number of wolf packs in the treatment area. Having one wolf radio-collared within each pack greatly increases the efficacy of removing subsequent wolves from the pack. It is estimated that up to 410 wolves will be euthanized in order to achieve greater than 80% reduction rate required to support caribou recovery.

Species: Caribou (*Rangifer tarandus*)

Number expected for 2020: approximately 14 radio collar deployments.

The number of radio collars to be deployed is based on maintaining an approximate sample size of 35 collared animals in the TEC subpopulation. Currently there are approximately 18 active collars in the TEC and 14 collars have been purchased for deployment this winter.

8. Details of Capture, Handling and Surgical Procedures and Final Disposition:
(be detailed and SPECIFIC, attach additional pages, if necessary)

Please refer to Appendix B – CCAC guidelines on: the care and use of wildlife (2003) for techniques considered appropriate and other guidelines for handling and care.

Capture Technique:

Wolves will be captured for radio collar deployment via aerial net-gunning, and euthanasia will occur via aerial shooting. Caribou will also be captured for collar deployment via aerial net-gunning.

Helicopter captures and removal will take place between January and the end of March using aerial net gunning and physical restraint and aerial shooting. An H500D helicopter will be used to track and target wolves in snow-covered, sparsely treed habitats and frozen watercourses suitable for safe capture or removal. Deep, soft snow is preferred as it will slow the wolves down, make their movements more predictable, and reduce the risk of injury during capture, and increases the likelihood of accurate, humane shooting.

Net-gunning: The identified personnel ^{s.15; s.19} will use a hand-held net gun to capture wolves and caribou for radio collar deployment. When a candidate animal has been selected in close proximity to a suitable capture location, the capture helicopter will approach the animal, haze it into a suitable nearby opening and on close approach (within 5–10 m), fire a 12' x 12' net over the front of the animal. Hazing time for caribou will not exceed the standards outlined by the Province, generally less than 5 minutes with close approach for capture under 2 minutes for caribou. Capture location will be selected in order to minimize risks to the crew and animal (i.e. avoiding open water, avalanche terrain, thin ice, wooded areas, steep terrain, etc.). A second net may be deployed in order to further entangle the wolf or caribou. Only one wolf or caribou will be captured at a time. Two net-guns with 4 or 5 detachable net canisters will be available to the net-gunner for each capture. This provides a backup net-gun and nets that can be used to reduce chase duration if the first net fails to adequately restrain the animal, or to further entangle the animal if the single net is not sufficient. Once the net is deployed the animal usually quickly trips and is wrapped up in the net, becoming immobile. The helicopter will immediately land to drop off the capture crew, and the net-gunner will restrain the wolf with a Y-pole around the neck before it can chew out of the net. If it is a caribou, the handlers and net-gunner will immediately restrain the caribou carefully using body weight without direct pressure on the thorax. For wolves, the handler will apply a catch-pole snare around the mouth of the wolf and tighten it until it is securely closed. The crew will then apply a muzzle or multiple wraps of strong duct tape to the mouth in order to eliminate the risk of a wolf biting any crew. A blindfold will then be applied to reduce stress to wolves and caribou. Hobbles will then be applied to the front and back legs of the animal as restraint to eliminate the possibility of the wolf or caribou escaping.

Shooting: The identified personnel ^{s.15; s.19} will conduct the aerial removal (euthanasia) of wolves by use of high-powered rifle. The rifle will be a semi-automatic 7.62 x 39mm caliber using a red-dot scope for quick and accurate target acquisition. Polymer or lead-tipped, rapid expansion lead-core bullets will be used to maximize shot impact and ensure quick or immediate kill times. The rifle includes detachable magazines for quick reloading of the firearm, and a semi-automatic action allowing for a quick succession of shots if necessary. Wolves chosen to be shot will be hazed into open locations where the shot distance is no greater than 50 m, ensuring a high likelihood of accurate shot placement. Shot placement will preferentially be the cranium (targeting the brain first and upper spinal cord) or the chest area (lungs and heart). If immediate death is not observed following the first shot, follow-up shots will occur preferentially in the head, then neck, or chest area to ensure death. Wolves will be visually observed from as close a distance as possible from a hovering helicopter for visual signs of movement (eg. respiratory effort and movement) to confirm death before moving on. Any animal that is shot and is not recumbent will be followed until the gunner is able to kill as quickly and humanely as possible. Humaneness will be documented by recording shot placement and kill times. Once a pack is eliminated, at least half of the wolves killed will be inspected on the ground, clearly documenting shot locations and providing photos to the project lead and provincial wildlife veterinarian.

Method of Handling:

Each wolf or caribou will be handled by an experienced handling crew. As described above, the net-gunner will be the first to engage with the animal after it has been entangled in the net. The net-gunner will use a Y-pole to pin the wolf to the ground by applying the Y-pole directly behind the animal's head. The handler will approach the wolf with the catch-pole, and secure the mouth shut using the catch pole snare. Once the catch-pole snare is confirmed to be secured, the crew will apply commercial dog muzzle and/or multiple wraps of duct tape around the wolf's muzzle to ensure it is unable to bite any crew. For caribou, the net-gunner and handler will immediately approach the animal, with the handler going to the back of the animal and applying weight carefully to secure the animal and the net-gunner working to untangle the net. A blindfold will then be applied to reduce visual stress to the wolf or caribou. Hobbles will then be applied by securing the right front leg to the right back leg, and the left front leg to the left back leg. The wolf or caribou will then be positioned to minimize discomfort (i.e. sternal or lateral recumbency, head slightly uphill, head free from deep snow). Once fully immobilized, the crew will assess the wolf or caribou for any injuries that may have occurred during capture. The restraining process generally takes

less than 2–3 minutes, at which point the radio-collaring and sampling procedures will occur. Small crews of two personnel will be used to minimize stress, and sudden movements or auditory stimuli will be kept to a minimum. To release the wolf or caribou, it is first pointed in a safe direction of travel away from the crew, helicopter, or any hazards. The catch-pole snare is securely attached around the mouth, at which point the muzzle or tape around the wolf's muzzle is carefully removed and the Y-pole is re-applied. The blindfold is then removed, followed by removal of the hobbles. For wolves, release of the catch-pole snare, and finally the Y-pole is lifted.

Other Procedures: (Marking method, Sampling)

Each wolf and caribou will be fitted with a satellite GPS radio-collar (Caribou = Vectronics Vertex Lite 2D =680 g, Wolves = Vectronics Vertex Lite 2D =680 g). The radio collar will be applied by the most experienced crew member to ensure the correct fit. Radio-collars will be fitted to ensure comfort for the animal, while ensuring that they are not too loose as to slip off or cause irritation (generally two fingers fitted vertically). Radio-collars fitted on younger animals, if necessary, will be slightly looser to allow for growth over the course of the winter. For wolves, satellite collars will be programmed to obtain positional fixes every 3–4 hours over the course of the winter to acquire up-to-date location information to support removal efforts. For caribou, satellite collars will be programmed to obtain position fixes twice a day during most seasons and up to 6 times a day during calving. Radio-collared wolves will either be left alive following the winter's removal efforts in order to collect further data and to support removal efforts the following winter, or they will be euthanized once all other pack members have been removed.

Biological samples will be taken by the crew as per standardized protocols while the wolf or caribou is immobilized. The total time associated with radio-collar attachment and sample collection takes less than 10 minutes for wolves and less than 15 minutes for caribou.

The radio-collars contain an internal tip switch to detect animal movement rates, and are programmed to send a mortality alert via email and text message if no movement is detected for a sustained period of time (12 hours). Immediate investigation of mortalities is not anticipated, although radio collars will be picked up as soon as logistically feasible and an investigation on cause of death will occur if possible. Collars include label plates instructing hunters/trappers to contact FLNRO if they harvest a collared wolf. This is to facilitate collar retrieval.

Additional data will be recorded and samples will be taken by the crew while the wolf is physically restrained. The crew will examine and sample captured wolves according to the standardized BC wolf sampling protocol:

- Age class using tooth eruption/wear/staining as an index (if visible under the tape)
- Sex
- Colour
- Pack size
- Location
- Body condition
- Photos
- Presence of old injuries or new capture-related injuries
- External parasite presence and prevalence
- From each wolf, 10 to 15 ml of blood will be withdrawn from the saphenous or cephalic vein for serological screening (parvovirus, Neospora, distemper), ensuring bleeding has stopped before releasing the animal
- Each wolf will be ear-tagged with a Rototag with a unique identifier number, and a 6 mm punch biopsy of the ear will be air-dried and archived for genetics
- At least 30 hairs with roots from the top of the shoulders from each wolf for genetic or other studies (e.g., stress assessment through cortisol levels, diet analysis with stable isotopes).
- Samples will be processed each evening and stored before shipping to the BC Wildlife Health Program.

Similarly, data will be recorded on the standard BC caribou capture form and samples will be taken by the crew while the caribou is physically restrained. This will include all necessary samples and data required by the *BC Caribou Research Capture Sampling Protocols*.

Contingency Plan: (what training, preparations and equipment are available in event of animal injury during capture or handling)

The following measures will be in place to reduce the risk of injury to wolves:

- 1) Capture crews are personnel with extensive experience in capturing, handling and shooting wild canids.
- 2) At least two out of three personnel are trained in first aid and CPR

- 3) Aerial net-gun captures will be conducted in deep, soft snow in ambient temperatures of between 0 to -25 C, on terrain consisting of flat or rolling terrain and not exposed ground or open water and animals will be assessed and monitored during physical restraint.
- 4) The capture crew will have a satellite phone to contact other experienced professionals and veterinarians for advice and guidance for any unusual circumstances that arise in the field
- 5) A firearm will be available for humane killing of any wolves badly injured during net-gun captures

Method of Euthanasia and Disposal Technique: (if necessary)

In the event of an animal being injured without a chance of survival after release, it will be euthanized humanely by high caliber gunshot to the brain. Carcasses may be left in the field unless brought back to the lab for examination or necropsy and disposal at the dump, s.18.1

**9. Details of Potentially Controversial Procedures and Justification:
(Include any expected morbidity and methods used to avoid)**

Animal welfare is of high priority for this project. All net-gun captures will occur following the procedures described above (and in the regional SOPs for aerial net-gun capture). Few complications have been observed using this protocol. Aerial shooting of wolves is considered the most effective and humane method of removing wolves in remote, expansive areas, with the ability to target without bycatch occurring (AVMA, 2013). All possible measures will be taken to ensure the ethical and humane removal of wolves.

10. Budget:

Funding sources applied for: Provincial Caribou Recovery Program

Are these peer reviewed? Yes (the region's wolf reduction programs have undergone internal and external reviews to measure effectiveness)

Status: Approved

11. Region:

The wolf reduction will occur within the TEC treatment area. The treatment boundary covers an area of approximately 15,786km² in the mountain caribou range of west-central British Columbia. The treatment area was identified due to the recovery urgency for this particular caribou herd.

12. Permit:

Is a permit required? Yes **Status:** Pending Decision

Please attach any permit documents to application.

Please send the completed BC Animal Care Form Application Form to the Permit & Authorization Service Bureau (PASB) along with a General Permit Application, detailed project proposal and permit fees (if applicable). For further information on how to apply, please visit the PASB website at <http://www.env.gov.bc.ca/pasb/> or call PASB at 1-866-433-7272 (to bypass phone tree push 231).

Approval of an Animal Care Application does not constitute approval of any application to handle wildlife. Applicants must also have a valid permit, issued under the Wildlife Act, before engaging in any such activity.

Principal Investigator's Signature _____

December 20, 2019 _____
Date of Application

Appendix A:

Canadian Council on Animal Care: Categories of Invasiveness for Wildlife Studies

A. Methods used on most invertebrates or on live isolates

Possible examples: the use of tissue culture and tissues obtained at necropsy; the use of eggs, protozoa or other single-celled organisms; experiments involving containment, incision or other invasive procedures on metazoa.

B. Methods used which cause little or no discomfort or stress

Possible examples: observational studies in which the same individuals are not repeatedly observed so as to habituate or otherwise modify their behavior; census or other surveys which do not involve capture or marking individuals; non-invasive studies on animals that have been habituated to captivity; short periods of food and/or water deprivation equivalent to periods of abstinence in nature.

C. Methods which cause minor stress or pain of short duration

Possible examples: capture, using methods with little or no potential to cause injury and marking of animals for immediate release; long-term observational studies on free-ranging animals where the behaviour of individuals may be altered by repeated contact; brief restraint for blood or tissue sampling; short periods of restraint beyond that for simple observation or examination, but consistent with minimal distress; short periods of food and/or water deprivation which exceed periods of abstinence in nature; exposure to non-lethal levels of drugs or chemicals; low velocity darting and slow-injection darts with immobilization chemicals. Such procedures should not cause significant changes in the animal's appearance, in physiological parameters such as respiratory or cardiac rate, or fecal or urinary output, in social responses or *in ability to survive*.

Note: During or after Category C studies, animals must not show self-mutilation, anorexia, dehydration, hyperactivity, increased recumbency or dormancy, increased vocalization, aggressive-defensive behavior or demonstrate social withdrawal and self-isolation.

D. Methods which cause moderate to severe distress or discomfort

Possible examples: capture, using methods that have the potential to cause injury (e.g. Leg snares, leghold traps, high velocity darting and rapid-injection darts with immobilization chemicals, net gunning, etc.); maintenance of wild caught animals in captivity; translocation of wildlife to new habitats; major surgical procedures conducted under general anesthesia, with subsequent recovery; prolonged (several hours or more) periods of physical restraint; induction of behavioral stresses such as maternal deprivation, aggression, predator-prey interactions; procedures which cause severe, persistent or irreversible disruption of sensorimotor organization.

Other examples *in captive animals* include induction of anatomical and physiological abnormalities that will result in pain or distress; the exposure of an animal to noxious stimuli from which escape is impossible; the production of radiation sickness; exposure to drugs or chemicals at levels that impair physiological systems. (NB. Experiments described in this paragraph would be Category E if performed on wildlife immediately prior to release.)

Note: Procedures used in Category D studies should not cause prolonged or severe clinical distress as may be exhibited by a wide range of clinical signs, such as marked abnormalities in behavioral patterns or attitudes, the absence of grooming, dehydration, abnormal vocalization, prolonged anorexia, circulatory collapse, extreme lethargy or disinclination to move, and clinical signs of severe or advanced local or systemic infection, etc.

E. Procedures which cause severe pain near, at, or above the pain tolerance threshold of unanesthetized conscious animals

This Category of Invasiveness is not necessarily confined to surgical procedures, but may include exposure to noxious stimuli or agents whose effects are unknown; exposure to drugs or chemicals at levels that (may) markedly impair physiological systems and which cause death, severe pain, or extreme distress; behavioral studies about which the effects of the degree of distress are not known; *environmental deprivation that has the potential to seriously jeopardize an animal's wellbeing*; use of muscle relaxants or paralytic drugs without anesthetics; burn or trauma infliction on unanesthetized animals; a euthanasia method not approved by the CCAC; any procedures (e.g., the injection of noxious agents or the induction of severe stress or shock) that will result in pain which approaches the pain tolerance threshold and cannot be relieved by analgesia (e.g., removal of teeth without analgesia, or when toxicity testing and experimentally-induced infectious disease studies have death as the endpoint), *capture methods with a high potential of causing severe injury that could result in severe chronic pain and/or death*.

Appendix B:

Canadian Council on Animal Care guidelines on: the care and use of wildlife (2003)

http://www.ccac.ca/english/gui_pol/GUFRAME.HTM
<http://www.ccac.ca/english/gdlines/wildlife/Wildlife.pdf>



Ministry of
Forests, Lands and
Natural Resource Operations

**FISH, WILDLIFE AND HABITAT MANAGEMENT BRANCH
ANIMAL CARE APPLICATION FORM**

PLEASE TYPE

For office use: Date Received: _____ Project Number: _____

Project Title: Tweedsmuir-Entiako Caribou Capture and Wolf Reduction to Support Caribou Recovery

2. Starting Date: January 2021

Completion Date: March 31, 2021

3. Principal Investigator:

Name: [NAME]

Mailing Address: [ADDRESS]

Position: [POSITION]

Department/Organization: [ORGANIZATION]

Region/Institution: [XX]

Phone: [XX]

Fax: [XX]

E-mail: [XX]

Experience related to the described proposal:

[Insert information once contractor is awarded- should be chosen mid-late December]

4. Additional Investigators:

Name: [NAME]

Position: [POSITION]

Department/Organization: [DEPARTMENT]

Region/Institution: n/a

Phone: [XX]

Fax: [XX]

E-mail: [XX]

Experience related to the described proposal:

[Insert information once contractor is awarded- should be chosen mid-late December]

Name: [NAME]

Position: [POSITION]

Department/Organization: [DEPARTMENT]

Region/Institution: n/a

Experience related to the described proposal:

[Insert information once contractor is awarded- should be chosen mid-late December]

5. Project Proposal

Southern Mountain caribou are nationally listed as threatened in Canada and are Red-listed (Threatened or Endangered) in the Skeena Region of British Columbia (BC). The Tweedsmuir-Entiako caribou (TEC) herd is currently numbered between 150-200 animals and is rapidly declining (population growth rate of 0.89). Multiple lines of evidence suggest wolf predation is the proximate cause of decline in the TEC herd including:

- 70% of caribou mortalities between 2014-2018 were due to wolf predation
- Wolf densities in the area are estimated to be between 21-30 wolves/1000 km²

Through negotiations with the Province, an agreement has been made to initiate wolf reduction to support caribou recovery within the TEC treatment area boundary (see operational plan attached). The demographic indicators, along with the continued recession of habitat, have made the TEC herd a priority for this recovery action amongst the caribou herds. Wolf reduction will be conducted within an adaptive management framework, which will include monitoring caribou, wolves, and moose populations and habitat condition over the course of the program. This project proposal includes collaring individual caribou to monitor demographic response of the TEC to wolf reduction.

The reduction of wolves has been shown to be effective for reversing the trends of some declining woodland caribou populations in BC. Reduction efforts must be intensive and be applied with the highest standards of scientific rigor and humaneness. Wolf reduction efforts in the TEC herd are expected to support recovery while the ultimate causes of population declines (i.e. habitat-related impacts) are addressed. Radio-collaring individual wolves from wolf packs greatly increases the efficacy of removing entire wolf packs over the course of the winter; complete pack removal is an objective of intensive wolf reduction programs.

*Operational plan for the Tweedsmuir-Entiako wolf reduction program is attached.

A. Background – Goals and Objectives:

Wolf reduction has been identified as an effective short-term management action for supporting the recovery of woodland caribou in BC.

The goals and objectives of this project are to:

- 1) conduct net-gun aerial capture of individual wolves from all packs located within the TEC treatment area to deploy radio collars and health sample 1-2 wolves per pack for the purpose of increasing the efficiency of aerial removal (euthanasia);
- 2) using radio collar locations to identify pack locations, euthanize (via aerial shooting) the majority of wolves (>80%) found within the treatment area and reduce the wolf density to below 3 wolves per 1000 km²;
- 3) conduct net-gun aerial capture of individual caribou to deploy radio collars and health sample to monitor response of the TEC population and inform adaptive management
- 4) implement scientific rigor and the highest possible standards for humaneness, and report out on all facets of the program

B. Key Expected Results and Management Implications:

- 1) Radio-collar deployment on individual wolves from the majority of wolf packs within the treatment area with biological sampling for health profiles.
- 2) Reduction of the majority (>80%) of wolves via aerial shooting
- 3) Simultaneous monitoring of caribou populations via radio-collaring to report population growth, health parameters, adult female survival, and calf survival in response to wolf reduction
- 4) Ultimately, expecting positive caribou population growth on an annual basis (target 15% annually)

6. CCAC Invasiveness Category: (see Appendix A)

A ____ B ____ C ____ D x ____

7. Species and Number of Animals Required: (include justification of numbers predicted to be used)

Species: Wolf (*Canis lupus*)

Number expected for 2021: approximately 7 radio collar deployments, up to [XX] to be euthanized

The number of radio collars to be deployed is contingent on the number of wolf packs within the treatment area. It is estimated that there will be between 5-10 wolf packs within the TEC treatment area. Radio-collar deployment is generally non-selective but will be applied to adult wolves preferentially and both sexes are expected to be captured.

The number of wolves to be euthanized is also dependent on the number of wolves present within the treatment area. It is estimated that at approximately [XX] wolves will be euthanized across the treatment area, however, this may be an overestimate as it is based on a snow track survey.

Justification for numbers: The number of wolves to be radio-collared is based on the estimated number of wolf packs in the treatment area. Having at least one wolf radio-collared within each pack greatly increases the efficacy of removing subsequent wolves from the pack. It is estimated that up to [XX] wolves will be euthanized in order to achieve greater than 80% reduction rate, and less than 3 wolves per 1000 km², that is required to support caribou recovery.

Species: Caribou (*Rangifer tarandus*)

Number expected for 2021: approximately 18 radio collar deployments.

The number of radio collars to be deployed is based on maintaining an approximate sample size of 35 collared animals in the TEC subpopulation. Currently there are approximately 19 active collars in the TEC and 18 collars have been purchased for deployment this winter. We will be capturing primarily female caribou.

8. Details of Capture, Handling and Surgical Procedures and Final Disposition:
(be detailed and SPECIFIC, attach additional pages, if necessary)

Please refer to Appendix B – CCAC guidelines on: the care and use of wildlife (2003) for techniques considered appropriate and other guidelines for handling and care.

Capture Technique:

Wolves will be captured for radio collar deployment via aerial net-gunning, and euthanasia will occur via aerial shooting. Caribou will be captured for collar deployment via aerial net-gunning.

Helicopter captures and removal will take place between January and the end of March using aerial net gunning and physical restraint and aerial shooting. An [XX] helicopter will be used to track and target wolves in snow-covered, sparsely treed habitats and frozen watercourses suitable for safe capture or removal. Deep, soft snow is preferred as it will slow animals, make their movements more predictable, and reduce the risk of injury during capture, and increases the likelihood of accurate, humane shooting.

Net-gunning – Wolves and Caribou: The identified personnel ([NAMES]) will use a hand-held net gun to capture wolves and caribou for radio collar deployment and health sampling. When a candidate animal has been selected in close proximity to a suitable capture location, the capture helicopter will approach the animal, haze it into a suitable nearby opening and on close approach (within 5–10 m), fire a 12' x 12' net over the front of the animal. Hazing time for wolves is difficult to limit but for caribou will not exceed the standards outlined by the Province, generally less than 5 minutes with close approach for capture under 2 minutes for wolves or caribou. Capture location will be selected in order to minimize risks to the crew and animal (i.e. avoiding open water, avalanche terrain, thin ice, wooded areas, steep terrain, etc.). A second net may be deployed in order to further entangle the wolf or caribou. Only one wolf or caribou will be captured at a time. Two net-guns with 4 or 5 detachable net

canisters will be available to the net-gunner for each capture. This provides a backup net-gun and nets that can be used to reduce chase duration if the first net fails to adequately restrain the animal, or to further entangle the animal if the single net is not sufficient. Once the net is deployed the animal usually quickly trips and is wrapped up in the net, becoming immobile. The helicopter will immediately land to drop off the capture crew, and the net-gunner will restrain the wolf with a Y-pole around the neck before it can chew out of the net. If it is a caribou, the handlers and net-gunner will immediately restrain the caribou carefully using body weight without direct pressure on the thorax and careful handling of the neck and head. For wolves, the handler will apply a catch-pole snare around the mouth of the wolf and tighten it until it is securely closed. The crew will then apply a muzzle or multiple wraps of strong duct tape to the mouth in order to eliminate the risk of a wolf biting the crew. A blindfold will then be applied to reduce stress to wolves and caribou. Hobbles will then be applied to the front and back legs of the animal as restraint to eliminate the possibility of the wolf or caribou escaping.

Shooting - Wolves: The identified personnel ([NAME]) will conduct the aerial removal (euthanasia) of wolves by use of high-powered rifle. The rifle will be a semi-automatic 7.62 x 39mm caliber using a red-dot scope for quick and accurate target acquisition. Polymer or lead-tipped, rapid expansion lead-core bullets will be used to maximize shot impact and ensure quick or immediate kill times. Non lead bullets of this caliber will be used if available. The rifle includes detachable magazines for quick reloading of the firearm, and a semi-automatic action allowing for a quick succession of shots if necessary. Wolves chosen to be shot will be hazed into open locations where the shot distance is no greater than 50 m, ensuring a high likelihood of accurate shot placement. Shot placement will preferentially be the cranium (targeting the brain first and upper spinal cord) or the chest area (lungs and heart). If immediate death is not observed following the first shot, follow-up shots will occur as soon as possible and preferentially in the head, then neck, or chest area to ensure death. Wolves will be visually observed from as close a distance as possible from a hovering helicopter for visual signs of movement (eg. respiratory effort and movement) to confirm death before moving on. Any animal that is shot and is not recumbent will be followed until the gunner is able to kill as quickly and humanely as possible. Humaneness will be documented by recording time, number and shot placement and time of death. Once a pack is eliminated, at least half of the wolves killed will be inspected on the ground, clearly documenting shot locations and providing photos to the project lead and provincial wildlife veterinarian.

Method of Handling:

Each wolf or caribou will be handled by an experienced handling crew. As described above, the net-gunner will be the first to engage with the animal after it has been entangled in the net.

For wolves: The net-gunner will use a Y-pole to pin the wolf to the ground by applying the Y-pole directly behind the animal's head. The handler will approach the wolf with the catch-pole, and secure the mouth closed using the catch pole snare. Once the catch-pole snare is confirmed to be secured, the crew will apply a commercial dog muzzle and/or multiple wraps of duct tape around the wolf's muzzle to ensure it is unable to bite and blindfold the animal. The wolf will then be hobbled.

For caribou: The net-gunner and handler will immediately approach the animal, with the handler going to the back of the animal and applying weight carefully to secure the animal and the net-gunner working to untangle the net. A blindfold will then be applied to reduce visual stress and the neck and head carefully restrained. Hobbles will then be applied by securing the right front leg to the right back leg, and the left front leg to the left back leg.

For wolves and caribou: The net will be removed from the wolf or caribou which will then be positioned to minimize discomfort (i.e. sternal or lateral recumbency, head slightly uphill, head free from deep snow). Once fully immobilized, the crew will assess the wolf or caribou for any injuries that may have occurred during capture. The restraining process generally takes less than 2–3 minutes, at which point the radio-collaring and sampling procedures will occur. Small crews of two personnel will be used to minimize stress, and sudden movements or auditory stimuli will be kept to a minimum. To release the wolf or caribou, it is first pointed in a safe direction of travel away from the crew, helicopter, or any hazards.

For wolves: Once sampling and collaring is completed, the catch-pole snare is securely attached around the mouth, at which point the muzzle or tape around the wolf's muzzle is carefully removed and the Y-pole is re-applied. The blindfold is removed, the hobbles are removed, and the catch-pole is released, and finally the Y-pole is lifted.

For caribou: Once sampling and collaring is completed, the blindfold is removed, followed by removal of the hobbles.

Other Procedures: (Marking method, Sampling)

Each wolf and caribou will be fitted with a satellite GPS radio-collar (Caribou = Vectronics Vertex Lite 2D =680 g, Wolves = Vectronics Vertex Lite 2D =680 g). The radio collar will be applied by the most experienced crew

s.15;
s.19

Commented : Please confirm collar weight for wolves and caribou

member to ensure the correct fit. Radio-collars will be fitted to ensure comfort for the animal, while ensuring that they are not too loose as to slip off or cause irritation (generally two fingers fitted vertically). Radio-collars fitted on younger animals, if necessary, will be slightly looser to allow for growth. For wolves, satellite collars will be programmed to obtain positional fixes every 3–4 hours over the course of the winter to acquire up-to-date location information to support reduction efforts. For caribou, satellite collars will be programmed to obtain position fixes twice a day during most seasons and up to 6 times a day during calving. Radio-collared wolves will either be left alive following the winter's removal efforts in order to collect further data and to support removal efforts the following winter, or they will be euthanized once all other pack members have been removed.

Biological samples will be taken by the crew as per standardized protocols while the wolf or caribou is immobilized. The total time associated with radio-collar attachment and sample collection takes less than 10 minutes for wolves and less than 15 minutes for caribou.

The radio-collars contain an internal tip switch to detect animal movement rates, and are programmed to send a mortality alert via email and text message if no movement is detected for a sustained period of time (12 hours). Immediate investigation of mortalities is not anticipated for wolves, although radio collars will be picked up as soon as logistically feasible and an investigation on cause of death will occur if possible. Caribou mortalities will be investigated as per a standardized protocol by Ministry staff. Collars include label plates instructing hunters/trappers to contact FLNRO if they harvest a collared wolf or a collar is found.

Additional data will be recorded and samples will be taken by the handling crew while animals are physically restrained according to the standardized BC wolf and caribou sampling protocols (add protocol as appendix):

For wolves:

- Age class using tooth eruption/wear/staining as an index (if visible under the tape)
- Sex
- Colour
- Pack size
- Location
- Body condition
- Photos
- Presence of old injuries or new capture-related injuries
- External parasite presence and prevalence
- From each wolf, 10 to 15 ml of blood will be withdrawn from the saphenous or cephalic vein for serological screening (parvovirus, Neospora, distemper), ensuring bleeding has stopped before releasing the animal
- Each wolf may be ear-tagged with a unique identifier number, and a 6 mm punch biopsy of the ear will be air-dried and archived for genetics
- Approximately 100 hairs with roots from the top of the shoulders from each wolf for genetic or other studies (e.g., stress assessment through cortisol levels, diet analysis with stable isotopes).
- Samples will be processed each evening and stored before shipping to the BC Wildlife Health Program.

For caribou:

Similarly, data will be recorded on the standard BC caribou capture form and samples will be taken by the crew while the caribou is physically restrained. This will include all samples and data required by the *BC Caribou Research Capture Sampling Protocols*.

Contingency Plan: (what training, preparations and equipment are available in event of animal injury during capture or handling)

The following measures will be in place to reduce the risk of injury to wolves:

- 1) Capture crews are personnel with extensive experience in capturing, handling and shooting wild canids.
- 2) At least two out of three personnel are trained in first aid and CPR
- 3) Aerial net-gun captures will be conducted in deep, soft snow in ambient temperatures of between 0 to -25 C, on terrain consisting of flat or rolling terrain and not exposed ground or open water and animals will be assessed and monitored during physical restraint.
- 4) The capture crew will have a satellite phone to contact other experienced professionals and veterinarians for advice and guidance for any unusual circumstances that arise in the field
- 5) A firearm will be available for humane killing of any wolves or caribou badly injured during net-gun captures

Method of Euthanasia and Disposal Technique: (if necessary)

In the event of an animal being injured without a chance of survival after release, it will be euthanized humanely by high caliber gunshot to the brain. Wolf carcasses may be left in the field unless brought back to the lab for examination or necropsy and disposal at the dump, s.18.1 Caribou deaths will be documented and followed by full necropsy and sampling if possible.

9. Details of Potentially Controversial Procedures and Justification:
(Include any expected morbidity and methods used to avoid)

Animal welfare is of high priority for this project. All net-gun captures will occur following the procedures described above (and in the regional SOPs for aerial net-gun capture). Few complications have been observed using this protocol. Aerial shooting of wolves is considered the most effective and humane method of removing wolves in remote, expansive areas, with the ability to target without bycatch occurring (AVMA, 2013). All possible measures will be taken to ensure the ethical and humane removal of wolves.

10. Budget:

Funding sources applied for: Provincial Caribou Recovery Program

Are these peer reviewed? Yes (the region's wolf reduction programs have undergone internal and external reviews to measure effectiveness)

Status: Approved

11. Region:

The wolf reduction and caribou capture will occur within the TEC treatment area. The treatment boundary covers an area of approximately 15,786 km² in the mountain caribou range of west-central British Columbia. The treatment area was identified due to the recovery urgency for this particular caribou herd.

12. Permit:

Is a permit required? Yes **Status:** Pending Decision

Please attach any permit documents to application.

Please send the completed BC Animal Care Form Application Form to the Permit & Authorization Service Bureau (PASB) along with a General Permit Application, detailed project proposal and permit fees (if applicable). For further information on how to apply, please visit the PASB website at <http://www.env.gov.bc.ca/pasb/> or call PASB at 1-866-433-7272 (to bypass phone tree push 231).

Approval of an Animal Care Application does not constitute approval of any application to handle wildlife. Applicants must also have a valid permit, issued under the Wildlife Act, before engaging in any such activity.

Principal Investigator's Signature

Date of Application

Appendix A:

Canadian Council on Animal Care: Categories of Invasiveness for Wildlife Studies

A. Methods used on most invertebrates or on live isolates

Possible examples: the use of tissue culture and tissues obtained at necropsy; the use of eggs, protozoa or other single-celled organisms; experiments involving containment, incision or other invasive procedures on metazoa.

B. Methods used which cause little or no discomfort or stress

Possible examples: observational studies in which the same individuals are not repeatedly observed so as to habituate or otherwise modify their behavior; census or other surveys which do not involve capture or marking individuals; non-invasive studies on animals that have been habituated to captivity; short periods of food and/or water deprivation equivalent to periods of abstinence in nature.

C. Methods which cause minor stress or pain of short duration

Possible examples: capture, using methods with little or no potential to cause injury and marking of animals for immediate release; long-term observational studies on free-ranging animals where the behaviour of individuals may be altered by repeated contact; brief restraint for blood or tissue sampling; short periods of restraint beyond that for simple observation or examination, but consistent with minimal distress; short periods of food and/or water deprivation which exceed periods of abstinence in nature; exposure to non-lethal levels of drugs or chemicals; low velocity darting and slow-injection darts with immobilization chemicals. Such procedures should not cause significant changes in the animal's appearance, in physiological parameters such as respiratory or cardiac rate, or fecal or urinary output, in social responses or *in ability to survive*.

Note: During or after Category C studies, animals must not show self-mutilation, anorexia, dehydration, hyperactivity, increased recumbency or dormancy, increased vocalization, aggressive-defensive behavior or demonstrate social withdrawal and self-isolation.

D. Methods which cause moderate to severe distress or discomfort

Possible examples: capture, using methods that have the potential to cause injury (e.g. Leg snares, leghold traps, high velocity darting and rapid-injection darts with immobilization chemicals, net gunning, etc.); maintenance of wild caught animals in captivity; translocation of wildlife to new habitats; major surgical procedures conducted under general anesthesia, with subsequent recovery; prolonged (several hours or more) periods of physical restraint; induction of behavioral stresses such as maternal deprivation, aggression, predator-prey interactions; procedures which cause severe, persistent or irreversible disruption of sensorimotor organization.

Other examples *in captive animals* include induction of anatomical and physiological abnormalities that will result in pain or distress; the exposure of an animal to noxious stimuli from which escape is impossible; the production of radiation sickness; exposure to drugs or chemicals at levels that impair physiological systems. (NB. Experiments described in this paragraph would be Category E if performed on wildlife immediately prior to release.)

Note: Procedures used in Category D studies should not cause prolonged or severe clinical distress as may be exhibited by a wide range of clinical signs, such as marked abnormalities in behavioral patterns or attitudes, the absence of grooming, dehydration, abnormal vocalization, prolonged anorexia, circulatory collapse, extreme lethargy or disinclination to move, and clinical signs of severe or advanced local or systemic infection, etc.

E. Procedures which cause severe pain near, at, or above the pain tolerance threshold of unanesthetized conscious animals

This Category of Invasiveness is not necessarily confined to surgical procedures, but may include exposure to noxious stimuli or agents whose effects are unknown; exposure to drugs or chemicals at

levels that (may) markedly impair physiological systems and which cause death, severe pain, or extreme distress; behavioral studies about which the effects of the degree of distress are not known; *environmental deprivation that has the potential to seriously jeopardize an animal's wellbeing*; use of muscle relaxants or paralytic drugs without anesthetics; burn or trauma infliction on unanesthetized animals; a euthanasia method not approved by the CCAC; any procedures (e.g., the injection of noxious agents or the induction of severe stress or shock) that will result in pain which approaches the pain tolerance threshold and cannot be relieved by analgesia (e.g., removal of teeth without analgesia, or when toxicity testing and experimentally-induced infectious disease studies have death as the endpoint), *capture methods with a high potential of causing severe injury that could result in severe chronic pain and/or death*.

Appendix B:

Canadian Council on Animal Care guidelines on: the care and use of wildlife (2003)

http://www.ccac.ca/english/gui_pol/GUFRAME.HTM
<http://www.ccac.ca/english/gdlines/wildlife/Wildlife.pdf>



**FISH, WILDLIFE AND HABITAT MANAGEMENT BRANCH
ANIMAL CARE APPLICATION FORM**

PLEASE TYPE

For office use: Date Received:

Project Number:

Project Title: Itcha-Ilgachuz, Quesnel Highland & Tweedsmuir-Entiako Caribou Capture and Wolf Reduction in Itcha-Ilgachuz & Tweedsmuir-Entiako to Support Caribou Recovery

2. Starting Date: February 2021

Completion Date: March 31, 2021

3. Principal Investigator:

Name: s.15; s.19

Position:

s.15; s.19

Department/Organization:

Region/Institution: n/a

s.15; s.19

Mailing Address:

Phone:

Fax: n/a

E-mail:

Experience related to the described proposal:

s.15; s.19

n/a.

4. Additional Investigators:

a) Secondary Pilots

Name: s.15; s.19

Position: Secondary Pilot

Department/Organization: s.15; s.19

Region/Institution: n/a

Experience related to the described proposal:

s.15; s.19

s.15; s.19; s.22

c) Net Gunners

Name: s.15; s.19

Position: Primary Net-gunners and Shooters

Department/Organization: s.15; s.19

Region/Institution: n/a

Experience related to the described proposal

s.15; s.19; s.22

5. Project Proposal

The Itcha-Ilgachuz caribou population is currently designated as Threatened in schedule 1 of the federal Species at Risk Act. The Itcha-Ilgachuz caribou have been regularly monitored since 1985 with population surveys generally occurring in June, shortly after the calving period when the majority of adult female caribou utilize alpine habitat in the Itcha and Ilgachuz mountain ranges. The Itcha-Ilgachuz caribou population has declined steeply since the herd's population peak in 2003. In June 2019, population inventory for this herd reported a sightability corrected population estimate of 385 caribou. The finite population growth rate (λ , or λ) describes the proportional change in population size over a discrete time period. From 2018-2019, λ for the Itcha-Ilgachuz herd was 0.604, which indicates a 40% decline in the herd from 2018 (N=637) to 2019 (N=385). The 2018-19 adult female survival rate was 80%. This is below the threshold of adult female survival of 88% associated with

stable caribou populations. The average annual rate of decline over the past 10 years (2009-2019) is 23.2%, while the average rate of decline over the past three years (2017-2019) is 33.4%, suggesting that the rate of decline may be accelerating. Given the three-year average rate of decline, it is possible the herd will be functionally extirpated (<20 animals) from the Chilcotin in eight years, although this may be sooner if the decline continues to accelerate. Following the first year of wolf reduction efforts for this herd in February 2020, Itcha-Ilgachuz population surveys in June 2020 recorded an overall increase in population size (N=508), primarily observed with increased calf numbers (30% of population estimate).

The Tweedsmuir-Entiako caribou (TEC) are a subpopulation of the Northern group of Southern Mountain caribou and are federally designated as “threatened” meaning they are at risk of extirpation if limiting factors are not reversed. The TEC herd has been declining over the past few decades and is currently estimated at 150-200 individuals, down from an estimated 600 individuals in 1963. Annual population surveys, adult female mortality rates, late winter calf recruitment rates, and population growth rates suggest a rapidly declining TEC population with a high proportion of female mortality caused by wolf predation. Between 2014-2018, the population growth rate for the TEC subpopulation was 0.89, which is indicative of a rapidly declining population. Additionally, the cumulative population growth rate since data has been available suggests that the current population has declined by approximately 32% since the 1980s. The estimated annual female mortality rate from collared TEC females between 2014-2018 was 21.4, which is considered high. Almost half of the 2015-2018 mortalities of radio-collared female caribou occurred during the winter and wolf predation accounted for 70% of mortalities during the same period. In contrast, confirmed predation mortalities between 1983-2009 were more equally attributed to bears and wolves and confirmed wolf mortalities were evenly spread throughout seasons. Following the first year of wolf reductions for this herd in February - March 2020, the TEC calf survey in June 2020 observed an increase in calf numbers from 30 calves: 100 cows in 2019, to 45 calves: 100 cows in 2020. Since predator reduction occurred in the later winter, we have observed high calf survival and very-low mortality on collared cows over the summer and fall.

Consistent with other research examining woodland caribou mortality predation is considered to be the proximate cause in the observed decline of the Itcha-Ilgachuz and Tweedsmuir caribou, with wolves considered to be the primary predator responsible for herd decline. The reduction of wolves has been shown to be effective for reversing the trends of declining woodland caribou populations in BC. Reduction efforts must be intensive and applied with the highest standards of scientific rigor and humaneness. The wolf reduction efforts in the Itcha-Ilgachuz and Tweedsmuir caribou herd are expected to support recovery while the ultimate causes of population declines (i.e. habitat-related impacts) are addressed. Radio-collaring individual wolves from wolf packs greatly increases the efficacy of removing entire wolf packs over the course of the winter; complete pack removal is an objective of intensive wolf reduction programs. Concurrent with aerial wolf reduction and collaring efforts, caribou will also be captured and radio-collared for ongoing population monitoring purposes.

*Operational plan for the Itcha-Ilgachuz and Tweedsmuir-Entiako wolf reduction program is attached.

The Quesnel Highland caribou population is currently considered stable. The Quesnel Highland caribou have been regularly monitored in the Cariboo Region with population surveys generally occurring in March, when the majority of caribou utilize alpine habitat in the Quesnel Highland high elevation mountain ranges. The Quesnel Highland caribou population has not been equipped with GPS radio-collars, which will allow for accurate sightability correction factors to be applied for population estimation, as well as providing fine scale habitat use and determination of cause-specific mortality for these herds. Concurrent with capture and radio-collaring of Barkerville and Wells Gray North caribou populations in the Quesnel Highlands, wolves overlapping these herds will be captured and equipped with radio-collars to allow regional managers determine spatial overlap and caribou-wolf dynamics in this area.

A. Background – Goals and Objectives:

Wolf reduction has been identified as an effective short-term management action for supporting the recovery of woodland caribou in BC.

The goals and objectives of this project are to:

- 1) conduct net-gun aerial capture of individual wolves from all packs located within the Itcha-Ilgachuz and TEC treatment area to deploy radio collars and health sample 1-2 wolves per pack for the purpose of increasing the efficiency of aerial removal (euthanasia);
- 2) using radio collar locations to identify pack locations, euthanize (via aerial shooting) the majority of wolves (>80%) found within the treatment area and reduce the wolf density to below 3 wolves per 1000 km²;

- 3) conduct net-gun aerial capture of individual caribou to deploy radio collars and health sample to monitor response of the Itcha-Ilgachuz and TEC population and inform adaptive management
- 4) implement scientific rigor and the highest possible standards for humaneness, and report out on all facets of the program

B. Key Expected Results and Management Implications:

- 1) Radio-collar deployment on individual wolves from the majority of wolf packs within the treatment areas with biological sampling for health profiles.
- 2) Reduction of the majority (>80%) of wolves via aerial shooting
- 3) Simultaneous monitoring of caribou populations via radio-collaring to report population growth, health parameters, adult female survival, and calf survival in response to wolf reduction
- 4) Ultimately, expecting positive caribou population growth on an annual basis (target 15% annually)

6. CCAC Invasiveness Category: (see Appendix A)

A ____ B ____ C ____ D **x** ____

7. Species and Number of Animals Required: (include justification of numbers predicted to be used)

Species: Wolf (*Canis lupus*)

Number expected for 2021: approximately 31 radio collar deployments (13 in Itcha-Ilgachuz, 12 in Quesnel Highland and 6 in Tweedsmuir-Entiako), up to 200 to be euthanized

The number of radio collars to be deployed is contingent on the number of wolf packs within the treatment area. It is estimated that there will be between 10-15 packs within the Itcha-Ilgachuz and 5-10 wolf packs within the TEC treatment area. Radio-collar deployment is generally non-selective but will be applied to adult wolves preferentially and of both sexes.

The number of wolves to be euthanized is also dependent on the number of wolves present within the treatment area. It is estimated that at least 75-150 wolves will be euthanized across both treatment areas.

Justification for numbers: The number of wolves to be radio-collared is based on the estimated number of wolf packs in the treatment area. Having at least one wolf radio-collared within each pack greatly increases the efficacy of removing subsequent wolves from the pack. It is estimated that at least 75-150 wolves will be euthanized from both treatment areas in order to achieve greater than 80% reduction rate required to support caribou recovery.

Species: Caribou (*Rangifer tarandus*)

Number expected for 2021: approximately 78 radio collar deployments (35 in Itcha-Ilgachuz, 33 in Quesnel Highlands and 10 in Tweedsmuir-Entiako).

The number of radio collars to be deployed is based on maintaining an approximate sample size in both study areas of a desired number. We will be capturing primarily female caribou.

8. Details of Capture, Handling and Surgical Procedures and Final Disposition: (be detailed and SPECIFIC, attach additional pages, if necessary)

Please refer to Appendix B – CCAC guidelines on: the care and use of wildlife (2003) for techniques considered appropriate and other guidelines for handling and care.

Capture Technique:

Wolves will be captured for radio collar deployment via aerial net-gunning, and euthanasia will occur via aerial shooting. Caribou will be captured for collar deployment via aerial net-gunning.

Helicopter captures and removal will take place between January and the end of March using aerial net gunning and physical restraint and aerial shooting. An MD500D helicopter will be used to track and target wolves in snow-covered, sparsely treed habitats and frozen watercourses suitable for safe capture or removal. Deep, soft snow is preferred as it will slow animals, make their movements more predictable, and reduce the risk of injury during capture, and increases the likelihood of accurate, humane shooting.

Net-gunning – Wolves and Caribou: The identified personnel^{s.15; s.19} will use a hand-held net gun to capture wolves and caribou for radio collar deployment and health sampling. When a candidate animal has been selected in close proximity to a suitable capture location, the capture helicopter will approach the animal, haze it into a suitable nearby opening and on close approach (within 5–10 m), fire a 12' x 12' net over the front of the animal. Hazing time for wolves is difficult to limit but for caribou, will not exceed the standards required by the Province and recommended by Wildlife Health, generally less than 5 minutes with close approach for capture under 2 minutes for wolves or caribou. Capture location will be selected in order to minimize risks to the crew and animal (i.e. avoiding open water, avalanche terrain, thin ice, wooded areas, steep terrain, etc.). A second net may be deployed in order to further entangle the wolf or caribou. Only one wolf or caribou will be captured at a time. Two net-guns with 4 or 5 detachable net canisters will be available to the net-gunner for each capture. This provides a backup net-gun and nets that can be used to reduce chase duration if the first net fails to adequately restrain the animal, or to further entangle the animal if the single net is not sufficient. Once the net is deployed the animal usually quickly trips and is wrapped up in the net, becoming immobile. The helicopter will immediately land to drop off the capture crew, and the net-gunner will restrain the wolf with a Y-pole around the neck before it can chew out of the net. If a caribou, the handlers and net-gunner will immediately restrain the caribou carefully using body weight without direct pressure on the thorax and careful handling of the neck and head. For wolves, the handler will apply a catch-pole snare around the mouth of the wolf and tighten it until it is securely closed. The crew will then apply a muzzle or multiple wraps of strong duct tape to the mouth in order to eliminate the risk of a wolf biting the crew. A blindfold will then be applied to reduce stress to wolves and caribou. Hobbles will then be applied to the front and back legs of the animal as restraint to eliminate the possibility of the wolf or caribou escaping.

Shooting - Wolves: The identified personnel^{s.15; s.19} will conduct the aerial removal (euthanasia) of wolves by use of high-powered rifle. The rifle will be a semi-automatic 7.62 x 39mm caliber using a red-dot scope for quick and accurate target acquisition. Polymer or lead-tipped, rapid expansion lead-core bullets will be used to maximize shot impact and ensure quick or immediate kill times. Non lead bullets of this caliber will be used if available to reduce the use of lead and habitat contamination. The rifle includes detachable magazines for quick reloading of the firearm, and a semi-automatic action allowing for a quick succession of shots if necessary. Wolves chosen to be shot will be hazed into open locations where the shot distance is no greater than 50 m, ensuring a high likelihood of accurate shot placement. Shot placement will preferentially be the cranium (targeting the brain first and upper spinal cord) or the chest area (lungs and heart). If immediate death is not observed following the first shot, follow-up shots will occur as soon as possible and preferentially in the head, then neck, or chest area to ensure death. Wolves will be visually observed from as close a distance as possible from the hovering helicopter for visual signs of movement (eg. respiratory effort and movement) to confirm death before moving on. Any animal that is shot and is not recumbent will be followed until the gunner is able to kill as quickly and humanely as possible. Humaneness will be documented by recording time, number of and shot placement and time of death. Once a pack is eliminated, at least half of the wolves killed will be inspected on the ground, clearly documenting shot locations and providing standardized photographs to the project lead and provincial wildlife veterinarian. These documentation (time, number of shots, shot placement and photographs will be provided to the lead and veterinarian at the completion of the project.

Method of Handling:

Each wolf or caribou will be handled by an experienced handling crew. As described above, the net-gunner will be the first to engage with the animal after it has been entangled in the net.

For wolves: The net-gunner will use a Y-pole to pin the wolf to the ground by applying the Y-pole directly behind the animal's head. The handler will approach the wolf with the catch-pole, and secure the mouth closed using the catch pole snare. Once the catch-pole snare is confirmed to be secured, the crew will apply a commercial dog muzzle and/or multiple wraps of duct tape around the wolf's muzzle to ensure it is unable to bite and blindfold the animal. The wolf will then be hobbled as described above.

For caribou: The net-gunner and handler will immediately approach the animal, with the handler going to the back of the animal and applying weight carefully on the rump to secure the animal and help the net-gunner to untangle

the net. A blindfold will then be applied to reduce visual stress and the neck and head carefully restrained. Hobbles will then be applied by securing the right front leg to the right back leg, and the left front leg to the left back leg. Rectal body temperature will be taken immediately following restraint. Animals showing evidence of extreme stress (body temperatures above 41°C, open mouth breathing and tremors, in poor body condition) will be released immediately after basic sampling if possible or none at all. Animals with previous injuries not considered survivable will be euthanized by gunshot to the head.

For wolves and caribou: The net(s) will be removed from the wolf or caribou which will then be positioned to minimize discomfort (i.e. sternal or lateral recumbency, head slightly uphill, head free from deep snow). Once fully immobilized, the crew will assess the wolf or caribou for any injuries that may have occurred during capture and confirm the animal's general health and sex. The restraining process generally takes less than 2–3 minutes, at which point the radio-collaring and sampling procedures will begin. Small crews of two personnel will be used to minimize stress, and sudden movements or auditory stimuli will be kept to a minimum. To release the wolf or caribou, it is first pointed in a safe direction of travel away from the crew, helicopter, or any hazards.

For wolves: Once sampling and collaring is completed, the catch-pole snare is securely attached around the mouth, at which point the muzzle or tape around the wolf's muzzle is carefully removed and the Y-pole is re-applied. The blindfold is removed, the hobbles are removed, and the catch-pole is released, and finally the Y-pole is lifted.

For caribou: Once sampling and collaring is completed, the animal is positioned to rise in a direction away from the team, the blindfold is removed, followed by removal of the hobbles.

Other Procedures: (Marking method, Sampling)

Each wolf and caribou will be fitted with a satellite GPS radio-collar (Caribou = Vectronics Vertex Lite 2D =1700 g, Wolves = Vectronics Vertex Lite 2D =1500 g). The radio collar will be applied by the most experienced crew member to ensure the correct fit. Radio-collars will be fitted to ensure comfort for the animal, while ensuring that they are not too loose as to slip off or cause irritation (generally two fingers fitted vertically). Radio-collars fitted on younger animals, if necessary, will be slightly looser to allow for growth. For wolves, satellite collars will be programmed to obtain positional fixes every 3–4 hours over the course of the winter to acquire up-to-date location information to support reduction efforts. For caribou, satellite collars will be programmed to obtain position fixes twice a day during most seasons and up to 6 times a day during calving. Radio-collared wolves will either be left alive following the winter's removal efforts in order to collect further data and to support removal efforts the following winter, or they will be euthanized once all other pack members have been removed.

Biological samples will be taken by the crew as per standardized Wildlife Health Program protocols while the wolf or caribou is immobilized. The total time associated with radio-collar attachment and sample collection takes less than 10 minutes for wolves and less than 15 minutes for caribou.

The radio-collars contain an internal tip switch to detect animal movement rates, and are programmed to send a mortality alert via email and text message if no movement is detected for a sustained period of time (12 hours). Immediate investigation of mortalities is not anticipated for wolves, although radio collars will be picked up as soon as logistically feasible and an investigation on cause of death will occur if possible. Caribou mortalities will be investigated as per the standardized Wildlife Health Program protocol by Ministry staff. Collars include label plates instructing hunters/trappers to contact FLNRO if they harvest a collared wolf or a collar is found.

Additional data will be recorded and samples will be taken by the handling crew while animals are physically restrained according to the standardized BC wolf and caribou sampling protocols (Appendix C):

For wolves:

- Age class using tooth eruption/wear/staining as an index (if visible under the tape)
- Sex
- Colour
- Pack size
- Location
- Body condition
- Photos
- Presence of old injuries or new capture-related injuries
- External parasite presence and prevalence

- From each wolf, 10 to 15 ml of blood will be withdrawn from the saphenous or cephalic vein for serological screening (parvovirus, Neospora, distemper), ensuring bleeding has stopped before releasing the animal
- Each wolf may be ear-tagged with a unique identifier number, and a 6 mm punch biopsy of the ear will be air-dried and archived for genetics
- Approximately 100 hairs with roots from the top of the shoulders from each wolf for genetic or other studies (e.g., stress assessment through cortisol levels, diet analysis with stable isotopes).

For caribou:

- Similarly, data will be recorded on the standard BC caribou capture form and samples will be taken by the crew while the caribou is physically restrained. This will include all samples and data required by the *BC Caribou Research Capture Sampling Protocols*. Samples will be processed each evening and stored before shipping to the BC Wildlife Health Program.

Contingency Plan: (what training, preparations and equipment are available in event of animal injury during capture or handling)

The following measures will be in place to reduce the risk of injury to wolves:

- 1) Capture crews are personnel with extensive experience in capturing, handling and shooting wild canids.
- 2) At least two out of three personnel are trained in first aid and CPR and avalanche safety?
- 3) Aerial net-gun captures will be conducted in deep, soft snow in ambient temperatures of between 0 to -25 C, on terrain consisting of flat or rolling terrain and not exposed ground or open water and animals will be assessed and monitored during physical restraint.
- 4) The capture crew will have a satellite phone to contact other experienced professionals and veterinarians for advice and guidance for any unusual circumstances that arise in the field
- 5) A firearm will be available for humane killing of any wolves or caribou badly injured during net-gun captures
- 6) While mortalities can occur with capture operations any mortality must be investigated and if the mortality rate exceeds 2% the operation must cease and the wildlife veterinarian and project lead contacted immediately.

Method of Euthanasia and Disposal Technique: (if necessary)

In the event of an animal being injured without a chance of survival after release, it will be euthanized humanely by high caliber gunshot to the brain and samples taken to confirm cause of death. Wolf carcasses may be sampled and left in the field unless brought back to the lab for examination or necropsy and disposal at the dump, s.18.1

Caribou deaths will be documented and followed by full necropsy and

sampling if possible.

9. Details of Potentially Controversial Procedures and Justification: (Include any expected morbidity and methods used to avoid)

Animal welfare is of high priority for this project. All net-gun captures will occur following the procedures described above (and in the regional SOPs for aerial net-gun capture). Few complications have been observed using this protocol. Aerial shooting of wolves is considered the most effective and humane method of removing wolves in remote, expansive areas, with the ability to target without bycatch occurring (AVMA, 2013). All possible measures will be taken to ensure the ethical and humane removal of wolves.

10. Budget:

Funding sources applied for: Provincial Caribou Recovery Program

Are these peer reviewed? Yes (the region's wolf reduction programs have undergone internal and external reviews to measure effectiveness)

Status: Approved

11. Region:

The wolf reduction and caribou capture will occur within the TEC treatment area. The treatment boundary covers an area of approximately 15,786 km² in the mountain caribou range of west-central British Columbia. The treatment area was identified due to the recovery urgency for this particular caribou herd.

12. Permit:

Is a permit required? Yes **Status:** Pending Decision

Please attach any permit documents to application.

Please send the completed BC Animal Care Form Application Form to the Permit & Authorization Service Bureau (PASB) along with a General Permit Application, detailed project proposal and permit fees (if applicable). For further information on how to apply, please visit the PASB website at <http://www.env.gov.bc.ca/pasb/> or call PASB at 1-866-433-7272 (to bypass phone tree push 231).

Approval of an Animal Care Application does not constitute approval of any application to handle wildlife. Applicants must also have a valid permit, issued under the Wildlife Act, before engaging in any such activity.

s.15; s.19

Principal Investigator's Signature

February 04, 2021

Date of Application

Appendix A:

Canadian Council on Animal Care: Categories of Invasiveness for Wildlife Studies

A. Methods used on most invertebrates or on live isolates

Possible examples: the use of tissue culture and tissues obtained at necropsy; the use of eggs, protozoa or other single-celled organisms; experiments involving containment, incision or other invasive procedures on metazoa.

B. Methods used which cause little or no discomfort or stress

Possible examples: observational studies in which the same individuals are not repeatedly observed so as to habituate or otherwise modify their behavior; census or other surveys which do not involve capture or marking individuals; non-invasive studies on animals that have been habituated to captivity; short periods of food and/or water deprivation equivalent to periods of abstinence in nature.

C. Methods which cause minor stress or pain of short duration

Possible examples: capture, using methods with little or no potential to cause injury and marking of animals for immediate release; long-term observational studies on free-ranging animals where the behaviour of individuals may be altered by repeated contact; brief restraint for blood or tissue sampling; short periods of restraint beyond that for simple observation or examination, but consistent with minimal distress; short periods of food and/or water deprivation which exceed periods of abstinence in nature; exposure to non-lethal levels of drugs or chemicals; low velocity darting and slow-injection darts with immobilization chemicals. Such procedures should not cause significant changes in the animal's

appearance, in physiological parameters such as respiratory or cardiac rate, or fecal or urinary output, in social responses or *in ability to survive*.

Note: During or after Category C studies, animals must not show self-mutilation, anorexia, dehydration, hyperactivity, increased recumbency or dormancy, increased vocalization, aggressive-defensive behavior or demonstrate social withdrawal and self-isolation.

D. Methods which cause moderate to severe distress or discomfort

Possible examples: capture, using methods that have the potential to cause injury (e.g. Leg snares, leghold traps, high velocity darting and rapid-injection darts with immobilization chemicals, net gunning, etc.); maintenance of wild caught animals in captivity; translocation of wildlife to new habitats; major surgical procedures conducted under general anesthesia, with subsequent recovery; prolonged (several hours or more) periods of physical restraint; induction of behavioral stresses such as maternal deprivation, aggression, predator-prey interactions; procedures which cause severe, persistent or irreversible disruption of sensorimotor organization.

Other examples *in captive animals* include induction of anatomical and physiological abnormalities that will result in pain or distress; the exposure of an animal to noxious stimuli from which escape is impossible; the production of radiation sickness; exposure to drugs or chemicals at levels that impair physiological systems. (NB. Experiments described in this paragraph would be Category E if performed on wildlife immediately prior to release.)

Note: Procedures used in Category D studies should not cause prolonged or severe clinical distress as may be exhibited by a wide range of clinical signs, such as marked abnormalities in behavioral patterns or attitudes, the absence of grooming, dehydration, abnormal vocalization, prolonged anorexia, circulatory collapse, extreme lethargy or disinclination to move, and clinical signs of severe or advanced local or systemic infection, etc.

E. Procedures which cause severe pain near, at, or above the pain tolerance threshold of unanesthetized conscious animals

This Category of Invasiveness is not necessarily confined to surgical procedures, but may include exposure to noxious stimuli or agents whose effects are unknown; exposure to drugs or chemicals at levels that (may) markedly impair physiological systems and which cause death, severe pain, or extreme distress; behavioral studies about which the effects of the degree of distress are not known; *environmental deprivation that has the potential to seriously jeopardize an animal's wellbeing*; use of muscle relaxants or paralytic drugs without anesthetics; burn or trauma infliction on unanesthetized animals; a euthanasia method not approved by the CCAC; any procedures (e.g., the injection of noxious agents or the induction of severe stress or shock) that will result in pain which approaches the pain tolerance threshold and cannot be relieved by analgesia (e.g., removal of teeth without analgesia, or when toxicity testing and experimentally-induced infectious disease studies have death as the endpoint), *capture methods with a high potential of causing severe injury that could result in severe chronic pain and/or death.*

Appendix B:

Canadian Council on Animal Care guidelines on: the care and use of wildlife (2003)

http://www.ccac.ca/english/gui_pol/GUFRAME.HTM
<http://www.ccac.ca/english/gdlines/wildlife/Wildlife.pdf>

Appendix C:

BC Caribou and Wolf Sampling Protocols



BC Caribou Research
Capture Sampling Pro



BC Wolf Capture
Sampling Protocols_C

British Columbia Wolf Health Assessment and Sampling Protocols

General Considerations

Any animal capture creates risk so animal welfare is critical at all stages of animal capture and sampling. Minimizing hazing time (of groups and individuals), limiting the duration of intense pursuit (< 2 minutes), restricting capture to cooler weather (e.g. $\leq -10^{\circ}\text{C}$), and quick and efficient handling (< 15 minutes) are key to reducing the risk of injury or complications such as capture myopathy, even in wolves.

Recommendations for Time/Temperature Cut-offs and Sampling Priority

The collection of a complete set of biological samples from each live-captured animal is an obligation, a high priority research need, and protocols have been designed to balance this need with animal welfare.

An experienced capture/handling team can collar, tag, collect all samples, and perform a basic health assessment on a properly restrained animal in ≤ 15 minutes. However, capture teams must be able to recognize signs of distress in captured animals and immobilized animals. If distress occurs, partial sampling or immediate release may be required. Body temperature, animal behaviour, and handling time should be used to guide decision making (See Table 1).

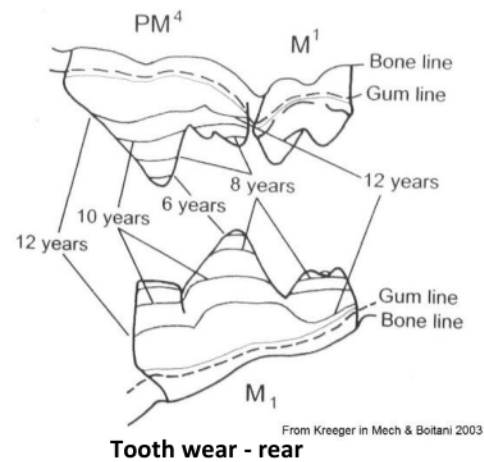
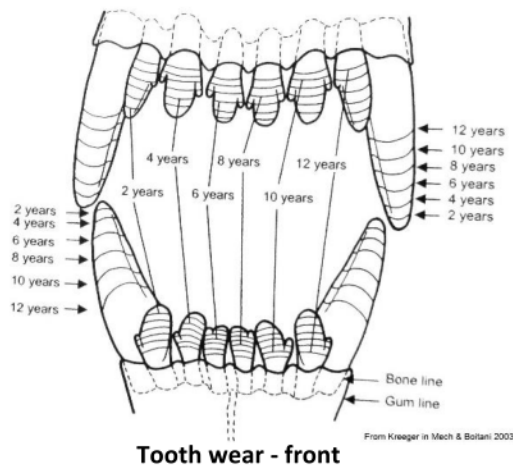
Table 1. Decision Matrix for Sampling Wolves

Rectal Temperature	Recommended Sampling Strategy	Recommended Handling Time
$\leq 41^{\circ}\text{C}/105.8^{\circ}\text{F}$	Full collar/ear tag and sample collection protocol	Aim ≤ 15 minutes
$41-41.5^{\circ}\text{C}/105.8-106.7^{\circ}\text{F}$	Collar/ear tag and collect blood and hair only	Do not exceed 10 minutes
$> 41.5^{\circ}\text{C}/106.7^{\circ}\text{F}$	Collar/ear tag and collect hair only	Release immediately

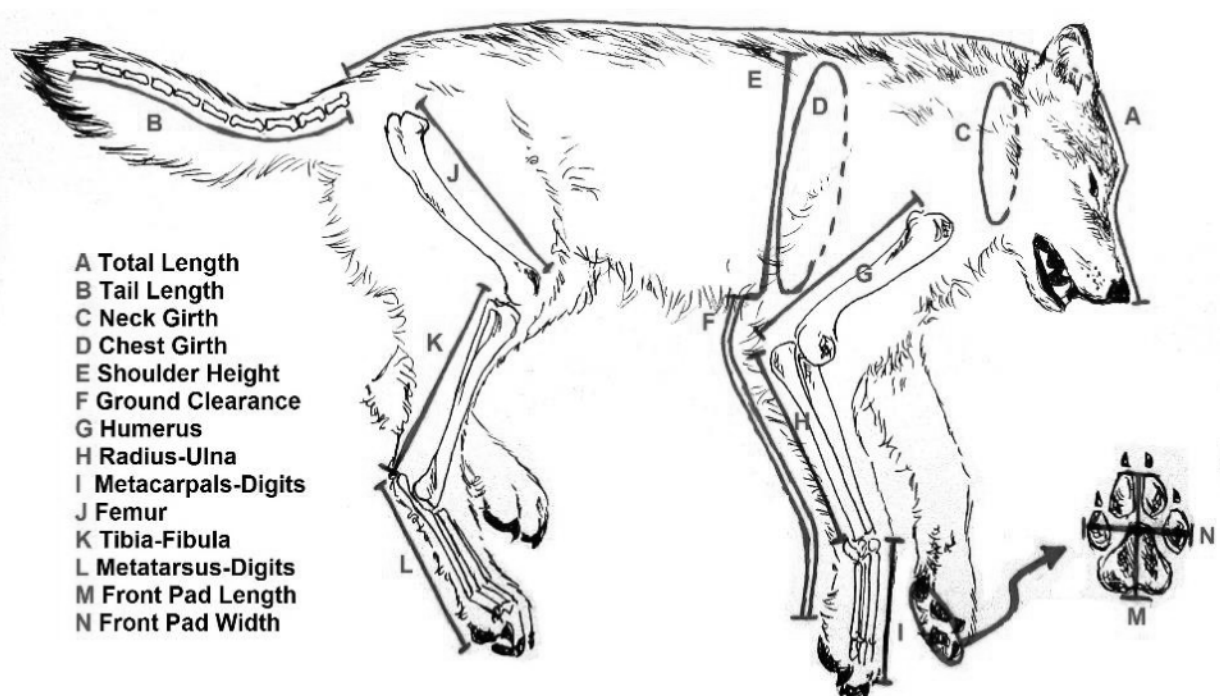
- **Ensure you wear disposable gloves when handling wolves.** *Echinococcus granulosus* is a zoonotic tapeworm that can cause severe disease. The eggs are transmitted through wolf feces so be aware.
- Depending on restraint method the animal may require muzzling. A dog muzzle is far more humane than duct tape to prevent biting and is easier to remove and apply.
- Using a blindfold will protect the eyes and reduce stress.
- Take the rectal temperature immediately after the wolf is either physically restrained or chemically immobilized.
- If not immobilized, excessive struggling may increase body temperature and lead to modifying sampling.
- To increase handling efficiency, the role of each team member should be clearly defined prior to capture and the most experienced team member should take blood when handling times are limited.

Estimating Age

AGE CLASS	PATTERN OF TOOTH WEAR	FIELD AGE
Pup	All deciduous teeth; delicate, white teeth have little wear.	< 1Year
Yearling	Most adult teeth erupted; after 6 - 8 months permanent canine teeth are present, white with little or no wear.	1 Year
Adult	All teeth are showing wear and staining. There may be some damage so examine all teeth in mouth.	2-6 Years
Aged	All teeth are worn, possibly to the gumline and may be heavily stained, damaged or missing. Wolves very rarely live this long.	7+ Years



Morphometrics measurements



Assessment of Body Condition

Evaluate the body condition of each animal using overall appearance and loin profile.



EMACIATED



POOR



FAIR



GOOD +

Sample Collection Protocols

Each sampling kit contains:

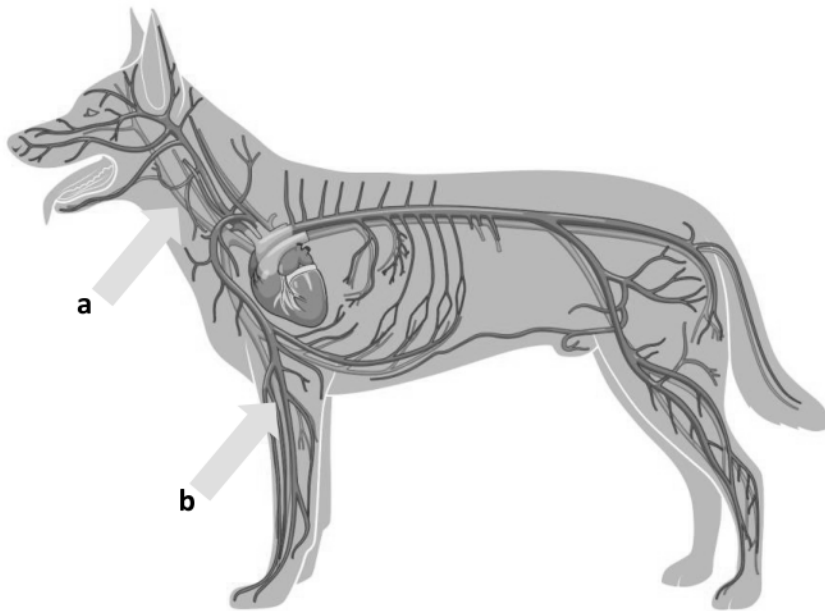
- 2 x 5.0 ml Gold top (SST) collection tubes - for serum
- 2 x 20 G 0.75 inch, plastic hub needles
- 1 x 10 ml syringe
- 1 x small coin envelope for biopsy punch
- 1 x small coin envelope for hair
- 1 x disposable 6 mm biopsy punch - can use for both ears in same animal

Sample Collection

To increase handling and sampling efficiency, the role of each team member should be clearly defined prior to capture.

Blood Collection

- **Blood is the most important sample to collect from each animal.**
- **Training and experience are required to collect blood. The most experienced team member should oversee blood collection by new staff and should take blood when handling times are limited.**
- The quality of data obtained from blood samples will be compromised by improper collection, handling, processing, and storage. Please ensure blood protocols are followed.
- Head control and proper positioning (head and neck not bent or twisted) are especially important if taking blood samples from the jugular vein. Other veins may also be used for blood collection (see below).
- Each kit has all supplies and blood tubes for completing the collection.
- Ensure the blood collection tubes are at 18-25 °C prior to use. **NOTE:** all blood tubes should be kept at this temperature to avoid temperature shock to the blood cells. If the tubes are removed from the sample bag and placed in your pocket prior to sampling temperature shock can be avoided.
- Blood is collected using a needle and syringe at **EITHER:** a) jugular vein or b) the cephalic vein (front leg).



Location for blood sampling from the a) jugular vein or b) cephalic vein (blue lines).

- The vein must be held off by a hand on the neck or tourniquet on the leg to build up pressure and locate the vein.
- Hold the needle with the bevel up and insert carefully beside or above the vein and puncture the vein. Once the vein is punctured blood is seen in the needle hub and the blood can then be pulled into the syringe. Slowly pull past the 10 ml mark to ensure that enough blood is collected to fill all tubes.
- There is an extra needle in each kit if needed. Please secure used needles in a crush proof, puncture proof sharps container and syringes without needles can be disposed of in a sealed garbage bag.

Blood Transfer to Sample Collection Tubes

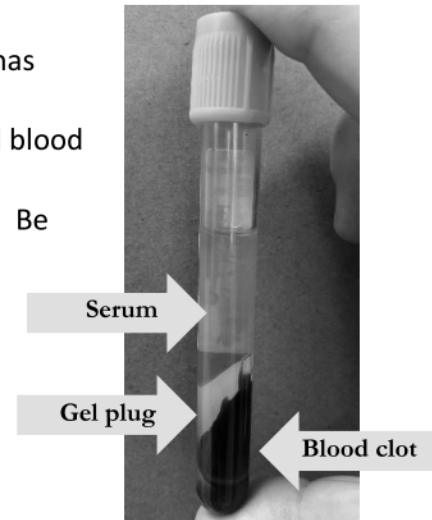
- The blood collection tubes are in the kit in a BUNDLE with an elastic band. They are under negative pressure.
- To prevent hemolysis (the rupture of red blood cells turning serum pink or red), do not squirt/force blood into collection tubes. Instead, once the syringe is full, carefully insert the needle through the end and negative pressure will passively draw the blood from the needle/syringe into the collection tube.
- If the vacuum has been compromised, blood can be gently and slowly injected along the sides of the tube.
- **ONCE FILLED, HANDLE BLOOD TUBES WITH CARE: PLACE UPRIGHT IN A COOLER IN THE HELICOPTER, PROTECT FROM SHAKING, ROUGH HANDLING, DIRECT SUNLIGHT, FREEZING, AND HEAT.**



Post Field Processing and Storage

Gold Top (SST) Serum Tubes

- Once back from the field, centrifuge gold top tubes for 15 minutes after blood has clotted and within 12 hours of collection.
- After centrifuging, serum (clear, yellowish liquid) will be separated from clotted blood by the gel plug.
- If the gel does not separate the serum from the blood clot, you need to re-spin. Be sure to balance the blood tubes, (i.e. the same volume of blood in paired tubes in the centrifuge).
- *****Freeze the *SPUN* gold tops (minimum -20 °C) and ship to Nanaimo for sub-sampling. Do not decant the serum into cryovials, we will do that at the lab.**
- Freeze/thaw can degrade serum samples and is required for sub sampling if larger cryovials are used. To minimize freeze/thaw cycles, the WLH staff will sub-sample the serum from the gold tops once received in Nanaimo.
- Ensure the gold tops are still labelled with the correct WLH ID and species.



Skin Biopsy

- Use the 6 mm biopsy punch to collect skin sample for DNA archive.
- Avoid large blood vessels in the ear, use a site near the centre of the ear flap and close to the head.
- The punch blade is very sharp. Use an old piece of radio collar belt or folded paper placed on the back of the ear to protect your fingers.
- Transfer each ear biopsy into the **PAPER ENVELOPE** provided in the kit.
- Record the number of biopsies collected.
- Air dry (in envelope) **at room temperature**, do not store in plastic bags. If very wet, use a new envelope
- Biopsy sample envelope is labelled with: WLH ID, study area, species, body site of collection, and date.
- Store skin biopsies at room temperature, protected from heat, light, and moisture.
- **DO NOT FREEZE SKIN BIOPSIES.**
- Dispose of used punches in a crush proof, puncture proof sharps container.

Hair

- **PLUCK** hair from the **TOP OF THE SHOULDER** where skin is as dry and as free of contaminants (blood, dirt etc.) as possible.
- Use needle nose pliers, hemostats or a Leatherman to obtain undamaged, intact hairs with roots.
- Place hair (more is better) in the small paper envelope provided.
- Ensure hair samples are dry before long-term storage.
- Wet or damp hair samples should be gently blotted (not wiped) with paper towel immediately on return from the field then air dried before transferring to a new envelope for long-term storage.

- Air dry wet or damp hair samples out of direct sunlight and protected from heat (i.e. NOT near a wood stove, hot windowsill, on a truck dashboard etc.).
- Hair samples are labelled with: WLH ID, study area, species, and date. Also note on labels if samples were collected from wet or dirty animals.
- For long-term storage keep hair samples at room temperature in a dry, white, paper envelope protected from heat, light, and moisture.
- Silica desiccant can be kept in the same general storage container (i.e. if storing many envelopes containing hair in a larger Rubbermaid etc.).
- **DO NOT FREEZE HAIR SAMPLES.**

External Parasites OR Other Abnormalities

- Take photos.
- Collect a sample of any external parasites (e.g. different life stages if present) if noted and collect other samples according to what you see – take notes.
- In the field, ectoparasites can be temporarily placed in any small container if well sealed.
- Back at the lab, transfer unusual or unidentified specimens into cryovial(s) or screw-top specimen containers with 70% ETOH (Ratio of 10 parts ethanol:1-part parasite).
- Engorged ticks should NOT be stored in ethanol.
- Label containers with WLH ID, study area, species, parasite type, body location recovered, and date.
- Store all vials at room temperature, protected from heat and light.

**FOR HEALTH-RELATED QUESTIONS DURING CAPTURE OPERATIONS
OR
FOR ANY QUESTIONS RELATED TO SAMPLE COLLECTION, HANDLING, PROCESSING, AND STORAGE
CONTACT**

s.15; s.19

Sample Shipping Instructions

ALL SAMPLES MUST BE RETURNED TO:

Wildlife Health Program

Attention: s.15; s.19

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

s.15; s.19

This includes sample kits that are not used this season. Please do not keep unused kits for “extra” sampling supplies. Return unused kits so that we can keep track of WLH IDs.

- Frozen samples **MUST** remain frozen during transport or their use is compromised.
- Appropriate insulated shipping containers and icepacks and can be purchased at low cost from ULINE.ca or contact the Wildlife Health Program.
- **Please notify** the Wildlife Health Lab in Nanaimo **BEFORE** samples are shipped
s.15; s.19
- **Try to ship samples on Monday or Tuesday, never past Wednesday.**

Shipping Checklist

- Copy of completed capture form
- 2 x spun gold top tubes with serum separated by the gel plug. **FROZEN**
- 1 x small envelope with skin biopsy. **ROOM TEMPERATURE, DO NOT FREEZE**
- 1 x small envelope with plucked hair from shoulder. **ROOM TEMPERATURE, DO NOT FREEZE**
- Parasites in cryovial(s) or similar if collected. **EMPTY vial or 70% ETOH, ROOM TEMPERATURE, DO NOT FREEZE**

British Columbia Caribou Health Assessment and Sampling Protocols

Net Gun Captures

This is a companion document to the current BC Caribou Research Capture Data Form and MUST be reviewed prior to any caribou captures as it is modified on a regular basis.

General Considerations

The net-gun capture of free-ranging caribou creates risk to both crew and caribou. A focus on safety and animal welfare is critical at all stages of animal capture and sampling. Minimizing hazing time (of groups and individuals), limiting the duration of intense pursuit (< 2 minutes), restricting operations to cooler weather (< 10 °C), and quick and efficient handling (< 15 minutes) are key to reducing the risk of injury or complications such as capture myopathy.

Recommendations for Time/Temperature Cut-offs and Sampling Priority

The collection of a complete set of biological samples from each live-captured caribou is an obligation, a high priority research need, and protocols have been designed to balance this need with animal welfare. An experienced capture/handling team can collar, tag, collect all samples, and perform a basic health assessment on a properly restrained, net-gunned caribou in ≤ 15 minutes. However, capture teams must be able to recognize signs of distress in animals. If distress occurs, partial sampling or immediate release may be required. Body temperature, animal behaviour, and handling time should be used to guide decision making (See Table 1).

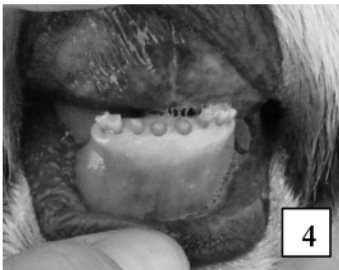
Table 1. Decision Matrix for Sampling Free-Ranging Caribou Captured by Net-Gun

Rectal Temperature	Recommended Sampling Strategy	Recommended Handling Time
≤ 41°C/ 105.8 °F	Full collar/ear tag and sample collection protocol	Aim ≤ 15 minutes
41-41.5°C/105.8-106.7°F	Collar/ear tag and collect blood and hair only	Do not exceed 10 minutes
> 41.5 °C/106.7°F	Collar/ear tag and collect hair only	Release immediately

- Rectal temperature should be taken with a digital thermometer immediately after a caribou is hobbled and blindfolded. Most net-gunned caribou captured in cooler weather, after an acceptable chase time will have rectal temperatures ≤ 41°C/105.8°F.
- Excessive struggling may increase body temperature and lead to modifying sampling.
- If an animal must be released, fecal samples may be collected off snow.
- To increase handling efficiency, the role of each team member should be clearly defined prior to capture and the most experienced team member should take blood when handling times are limited.

Estimating Age

AGE CLASS	PATTERN OF INCISOR WEAR	FIELD AGE
Subadult	Very white teeth with rounded caps (little or no wear)	2-3 Years (Picture 1)
Adult	First incisors are flattening, and second incisors are beginning to wear.	4-5 Years (Picture 2)
Adult	All teeth in the incisor bar are flattening and appear to be a straight line across the top of the teeth.	6-7 Years (Picture 3)
Old Adult	All teeth in the incisor bar are flattened significantly (all teeth appear significantly shorter than 6-7 year old)	8-9 Years (No Picture)
Old Adult	All teeth in the incisor bar are stubs (shorter still)	10-11 Years (Picture 4)
Old Adult	All teeth in the incisor bar are worn to the gum line	12+ Years (Picture 5)



Modified After: Cattet, M.R.L. (2011) Government of Northwest Territories, Wildlife Care Committee Standard Operating Procedure (SOP) for Capture, Handling and Release of Caribou. Version 2-2011. Picture 5.s.15 Government of BC.

Assessment of Body Condition

Evaluate the body condition of each live-captured caribou **USING BOTH** the standardized CARMA condition score and a general assessment technique. Use your hands to feel the spine and other prominent bones to ensure the correct assessment.

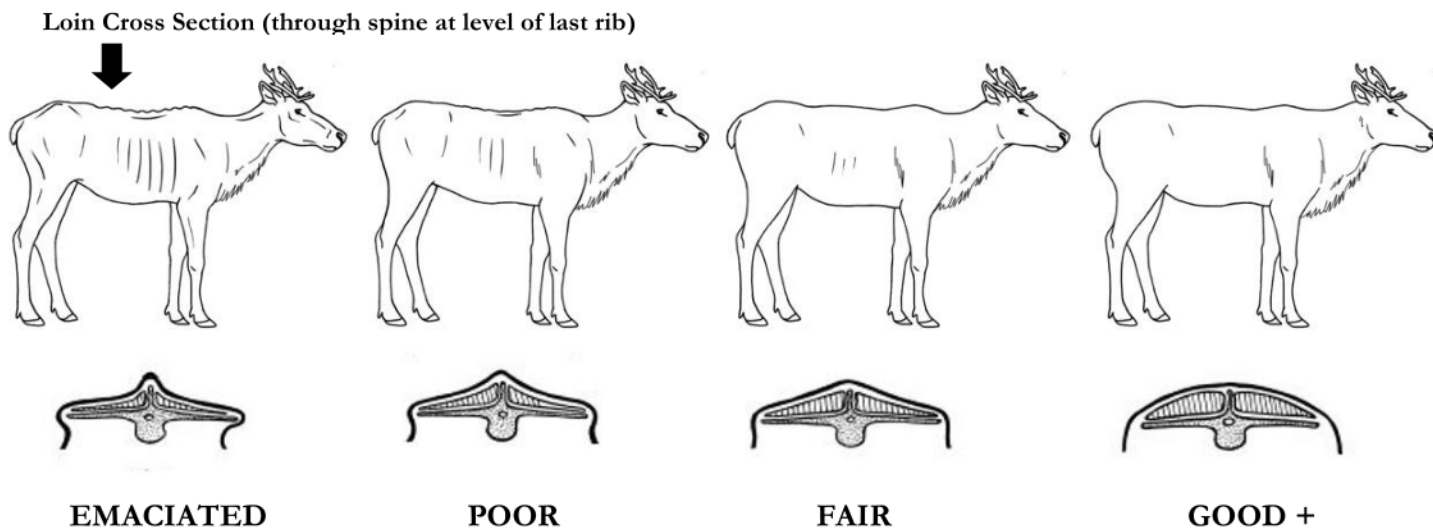
CARMA Body Condition Score

- A standardized palpation technique developed by the CircumArctic *Rangifer* Monitoring and Assessment (CARMA) Network is used as a standard method to estimate body condition of caribou.
- It assigns scores that have not been calibrated to back fat and are subjective (but still useful) indicators of overall fatness. It is a more precise method of assessing condition vs. a general visual approach.
- Using the chart below, assign palpation scores to the shoulder, ribs, and hips-spine.
- Scores may be broken down to halves (e.g. 2.5, 3.5) and area scores won't necessarily be the same.

SHOULDER	DESCRIPTION	SCORE
1	V-shaped scapula (shoulder blade), very bony, hollows behind scapula and immediately behind the scapular spine	
2	Somewhat V shaped, less bony, hollows still present	
3	U-shaped withers, hollows filled	
4	U-shaped, very broad, difficult to feel edges of bone	
RIBS	CARMA DESCRIPTION	SCORE
1	Deep groves between ribs including behind the shoulder	
2	Ribs fairly well covered immediately behind shoulder	
3	Can still feel ribs, groves are not too deep	
4	Ribs nearly flush with tissue between them	
HIPS/SPINE	CARMA DESCRIPTION	SCORE
1	Hip bones very distinct, no fat on back or tail head, spine very distinct	
2	Some padding on hips, spine remains very distinct	
3	Hips fairly well padded, spine partly covered along each side	
4	Hips well padded, spine is flush with or nearly covered with fat	
Total Score (sum of shoulder, ribs, hips/spine assessments)		

Gunn, A. et al. Eds. (2008). CircumArctic *Rangifer* Monitoring and Assessment (CARMA) Network Monitoring Protocols Level 2. 57 pp.

General Body Condition Scoring (overall appearance and loin profile)



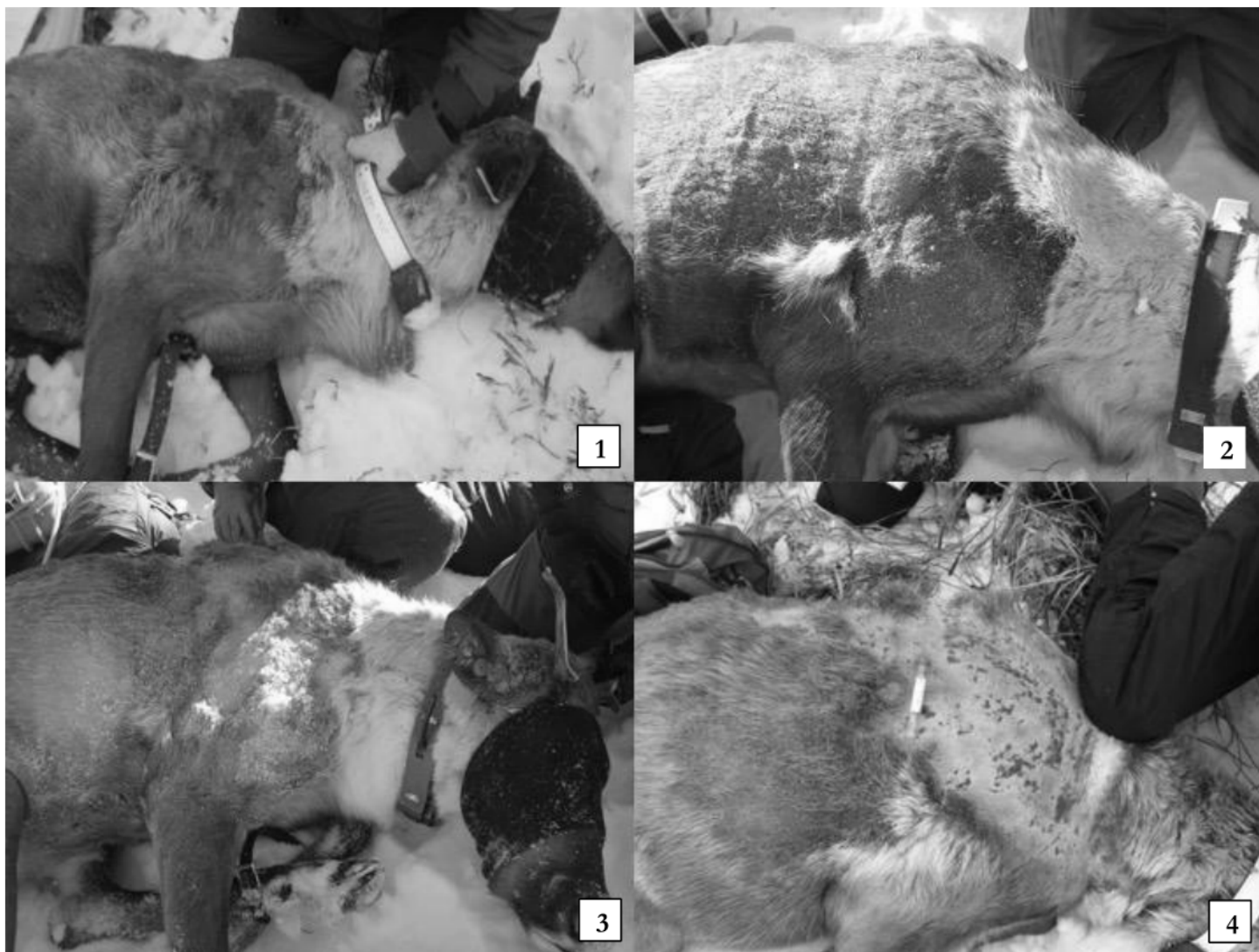
Caribou Drawings: M. Winchester, Government BC.

Winter Tick Assessments

Tick Associated Hair Loss Scoring in Caribou:

HAIR LOSS CATEGORY	PATTERN
None (No Picture)	No hair loss or breakage
Mild (Picture 1)	Few small to medium sized patches of broken hair or hair loss
Moderate (Picture 2)	Several or large patches broken hair or hair loss - NO EXPOSED SKIN
Severe (Picture 3)	Several or large patches broken hair or hair loss <u>with</u> 1-2 SMALL AREAS EXPOSED SKIN
Extreme (Picture 4)	Several or large patches broken hair or hair loss <u>with</u> large or > 2 AREAS OF EXPOSED SKIN

**** Degree of tick associated hair loss in caribou is not always correlated with number of observed ticks.**

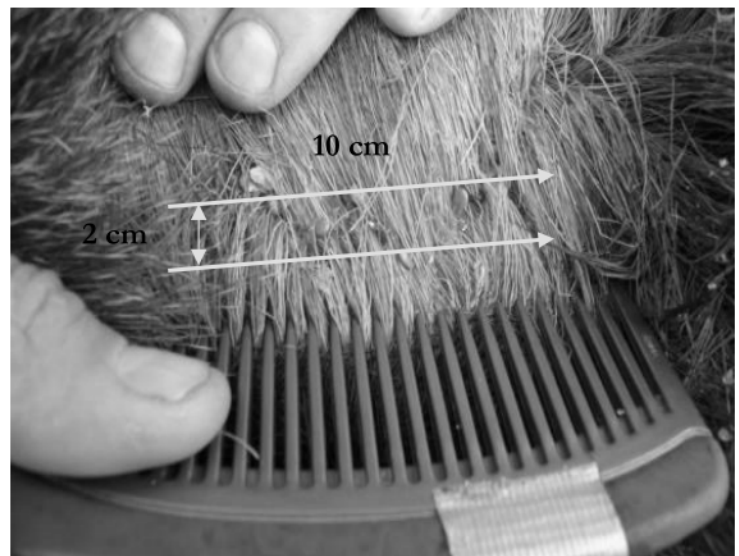
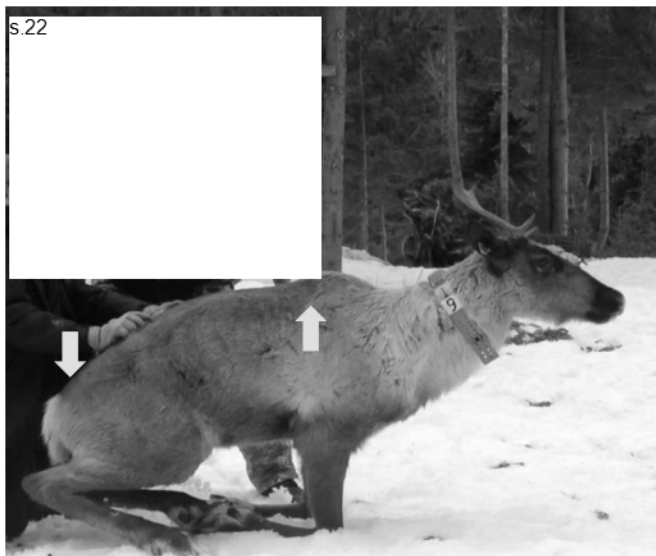


* Photos and Hair Loss Classification Score: s.15

Fort St. John, BC.

Tick Burden Assessment - Rapid Method:

- **PERFORM THIS ASSESSMENT ONLY IF TIME AND ANIMAL WELFARE PERMIT**
- Using a dedicated comb, part the hair along the upper edge of the shoulder blade.
- **ESTIMATE or COUNT (best)** the number of ticks along a single 10 cm x 2 cm transect.
- If there is significant hair loss on the shoulder, perform the assessment on the rump.
- **SCORE for BURDEN: None (0 count), Mild (0-15 ticks total), Moderate (15-30 ticks total), Severe (>30 ticks total).**
- **COLLECT** a representative sample (e.g. various life stages, engorged, not engorged) of ticks.
- Store **half of the ticks** in 70% ETOH (minimum 10:1 ratio; ethanol:ticks) at room temperature, protected from heat and light.
- Store **the other half of the ticks** frozen (-20C), **without ethanol** in a cryovial or similar.
- Ensure ticks are in well-sealed containers (e.g. cryovials or similar) to prevent evaporation.
- Record date of collection, management unit, and host (i.e. caribou) on both sets of tick samples (ETOH and frozen).



Sample Collection Protocols for Live-Captured Caribou

Each caribou sampling kit contains:

- 4 x 5.0 ml Gold top (SST) collection tubes - for serum
- 1 x 6.0 ml Royal Blue top collection tube - for serum for trace nutrients
- 1 x 6.0 ml Purple top collection tube - for whole blood (buffy coat and plasma)
- 1 x 3.0 ml Green top collection tube - for DNA/RNA
- 2 x 18 G 1.5 inch, plastic hub needles
- 1 x 35 ml syringe
- 1 x small coin envelope (white) - for biopsy
- 1 x large coin envelope (white) – for hair
- 1 x disposable 6 mm biopsy punch - can use for both ears in same animal
- 1 x ear tag with unique ID number [Note: Tag ID is not the same as Wildlife Health ID (WLH ID) Number]
- 1 x Whirl-pak bag with nitrile glove – for feces

Sample Collection

To increase handling and sampling efficiency, the role of each team member should be clearly defined prior to capture.

Blood Collection

- **Blood is the most important sample to collect from each caribou.**
- **Training and experience are required to collect blood. The most experienced team member should oversee blood collection by new staff and should take blood when handling times are limited.**
- The quality of data obtained from blood samples will be compromised by improper collection, handling, processing, and storage. Please ensure blood protocols are followed.
- Ensure caribou are well restrained before blood collection. Head control and proper positioning (head and neck not bent or twisted) are especially important if taking blood samples from the jugular vein.
- Each kit has all supplies and blood tubes for completing the collection.
- Ensure the blood collection tubes are at 18-25 °C prior to use. **NOTE:** all blood tubes should be kept at this temperature to avoid temperature shock to the blood cells. If the tubes are removed from the sample bag and placed in your pocket prior to sampling temperature shock can be avoided.

- Blood is collected with needle and syringe from **EITHER** the jugular vein or the cephalic vein (front leg)



Location for blood sampling from the jugular vein (yellow arrow). Picture from: University of Calgary, Faculty of Veterinary Medicine, *Rangifer* Anatomy Project.

- The vein must be held off by a hand on the neck or tourniquet on the leg to build up pressure and locate the vein.
- Hold the needle with the bevel up and insert carefully beside or above the vein and puncture the vein. Once the vein is punctured blood is seen in the needle hub and the blood can then be pulled into the syringe. Slowly pull past the 35 ml mark to ensure that enough blood is collected to fill all tubes.
- There is an extra needle in each kit if needed. Please secure used needles in a crush proof, puncture proof sharps container and syringes without needles can be disposed of in a sealed garbage bag.

Blood Transfer to Sample Collection Tubes

- The blood collection tubes are in the kit in a BUNDLE with an elastic band. They contain a variety of fluids or compounds and are all under negative pressure.
- To prevent hemolysis (the rupture of red blood cells turning serum pink or red), do not squirt/force blood into collection tubes. Instead, once the syringe is full, carefully insert the needle through the end and negative pressure will passively draw the blood from the needle/syringe into the collection tube.
- If the vacuum has been compromised, blood can be gently and slowly injected along the sides of the tube.



- **FILL TUBES IN THIS ORDER: START WITH YELLOW TOP TUBES, FOLLOWED BY BLUE, PURPLE AND GREEN TOP TUBE LAST.**
- **GENTLY ROLL OR TURN ALL THE TUBES IN THEIR BUNDLE IMMEDIATELY AFTER COLLECTION TO ENSURE THE BLOOD AND CONTENTS ARE WELL MIXED (30 seconds to 1 minute). THIS IS ESPECIALLY FOR PURPLE AND GREEN TOPS TO MIX THEIR CONTENTS TO STOP BLOOD FROM CLOTTING.**
- Each blood tube type is designed to collect the specific samples required for pregnancy determination, health and disease surveillance.
- **ONCE FILLED, HANDLE BLOOD TUBES WITH CARE: PLACE UPRIGHT IN A COOLER IN THE HELICOPTER, PROTECT FROM SHAKING, ROUGH HANDLING, DIRECT SUNLIGHT, FREEZING, AND HEAT.**

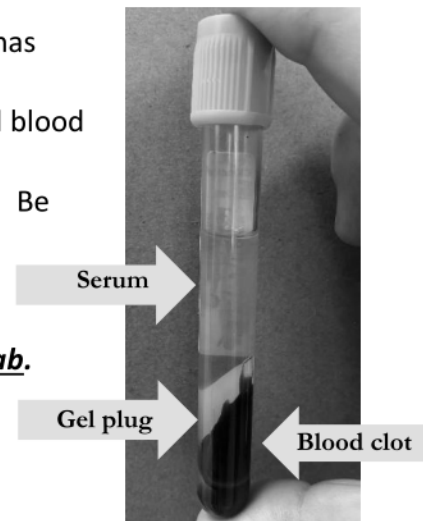
Blood - Post Field Processing and Storage

Supplies needed: From the Wildlife Health Program

- Cryovials - 2 ml volume
- Preprinted labels with: Species, WLH ID, Blood Sample Type (i.e. plasma, buffy, trace)
- Transfer pipettes - disposable plastic
- Small Ziploc bag to keep all blood samples grouped together by individual WLH ID#.

Gold Top (SST) Serum Tubes

- Once back from the field, centrifuge gold top tubes for 15 minutes after blood has clotted and within 12 hours of collection.
- After centrifuging, serum (clear, yellowish liquid) will be separated from clotted blood by the gel plug.
- If the gel does not separate the serum from the blood clot, you need to re-spin. Be sure to balance the blood tubes, (i.e. the same volume of blood in paired tubes in the centrifuge).
- *****Freeze the SPUN gold tops (minimum -20 °C) and ship to Nanaimo for sub-sampling. Do not decant the serum into cryovials, we will do that at the lab.**
- Freeze/thaw can degrade serum samples but is required for sub sampling if larger cryovials are used. To minimize freeze/thaw cycles, the WLH staff will sub-sample the serum from the gold tops once received in Nanaimo.
- Ensure the gold tops are still labelled with the correct WLH ID and species.



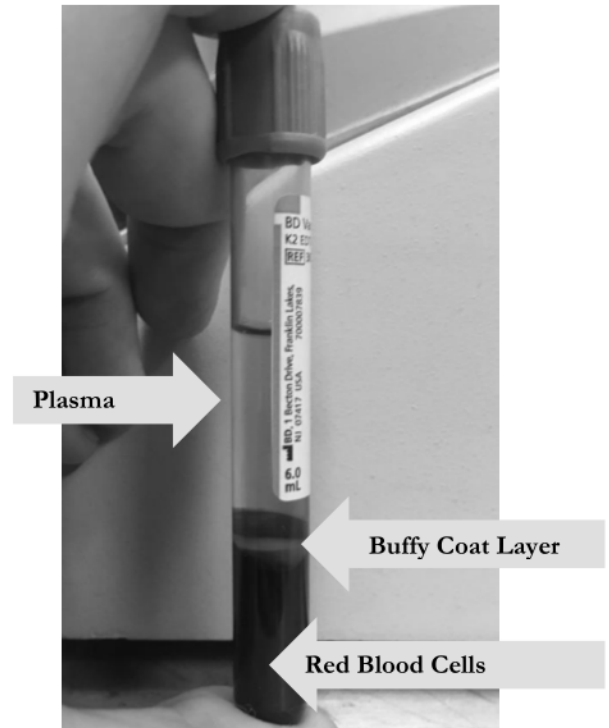
Royal Blue Top (Trace Nutrient) Serum Tube

- Centrifuge for 15 minutes once blood has clotted and within 12 hours of collection.
- Royal blue top tubes do not have separating gel, so try not to disturb the clot after centrifuging and while processing.
- Royal blue top tubes are also more easily affected by hemolysis (red blood cell rupture). Please note (in data sheet comments section) if the serum sample from a royal blue top tube appears red as hemolysis may influence interpretation of results.

- Decant serum into one labelled cryovial with a minimum of 1.8 ml. Extra serum can be decanted into a second cryovial. Label the extra cryovial with WLH ID, herd, species, **TRACE NUTRIENTS**, and date.
- Store serum from the royal blue top tube frozen (minimum -20 °C).
- **Recap royal blue top tube and retain the clot (frozen, minimum -20 °C).**

Purple Top (EDTA) Whole Blood Tube

- **Remember this tube MUST be mixed immediately after collection.**
- Centrifuge the purple top tube for 15 minutes as with other tubes.
- **CAUTION AFTER SPINNING.** The blood cell and plasma layers in the purple top tube are in a liquid state (not clotted). Do not bump or disturb the red blood cell layer and buffy coat (the opaque white blood cell layer between plasma and red cells) before sampling.
- **RE-CENTRIFUGE IF LAYERS ARE ACCIDENTALLY DISTURBED.**
- Collect plasma (clear/yellow layer) into cryovials using a new pipette.
- Divide the plasma into the two labelled cryovials.
- Store plasma from the purple top tube frozen (minimum -20 °C).
- Collect the buffy coat (opaque middle layer) into a **SEPARATE** labelled cryovial.
- The buffy coat sample will appear red as some red blood cells will be sucked up with the white blood cell layer. **Try to minimize this as much as possible. It is a very tiny sample.**
- Store buffy from the purple top tube coat frozen (minimum -20 °C).
- **Recap purple top tube and retain the clot (frozen, minimum -20 °C).**



Green Top DNA/RNA Blood Tube

- The DNA/RNA blood tube should be the last tube that blood is placed into.
- **Remember this tube MUST be mixed immediately after collection.**
- **Do not spin the green top tube or draw off serum.**
- The blood is stabilized in this tube and can be sent to Wildlife Health in the original collection tube.
- Store the Green top tubes frozen (minimum -20 °C).

Skin Biopsy

- Use the 6 mm biopsy punch to place holes for each ear tag. Use the same punch for both ears if two tags are used.
- Avoid large blood vessels in the ear.
- Punch blade is very sharp. Use an old piece of radio collar belt or folded paper placed on the back of the ear to protect your fingers.
- Transfer each ear biopsy into the **SMALLER PAPER ENVELOPE** provided in the kit.
- Record the number of biopsies collected.
- Air dry (in envelope) at room temperature.
- Ensure biopsy sample envelope is labelled with: WLH ID, herd, species, body site of collection, and date.
- Store skin biopsies at room temperature, protected from heat, light, and moisture.
- **DO NOT FREEZE SKIN BIOPSIES.**
- Dispose of used punches in a crush proof, puncture proof sharps container.

Hair

- **PLUCK** hair from the **TOP OF THE SHOULDER** (yellow arrow) where skin is as dry and as free of contaminants (blood, dirt etc.) as possible.
- Use needle nose pliers, hemostats or a Leatherman to obtain undamaged, intact hairs with roots.
- Place hair (more is better) in the **LARGE PAPER ENVELOPE** provided. **ENSURE ENVELOPE IS WELL FILLED**
- Ensure hair samples are dry before long-term storage.
- Wet or damp hair samples should be gently blotted (not wiped) with paper towel immediately on return from the field then air dried before transferring to a new envelope for long-term storage.
- Air dry wet or damp hair samples out of direct sunlight and protected from heat (i.e. NOT near a wood stove, hot windowsill, on a truck dashboard etc.).
- Ensure hair samples are labelled with: WLH ID, herd, species, body site of collection, and date. Also note on labels if samples were collected from wet or dirty animals.
- For long-term storage caribou hair samples are kept at room temperature in a dry, white, paper envelope protected from heat, light, and moisture.
- Silica desiccant can be kept in the same general storage container (i.e. if storing many envelopes containing hair in a larger Rubbermaid etc.).
- **DO NOT FREEZE HAIR SAMPLES.**

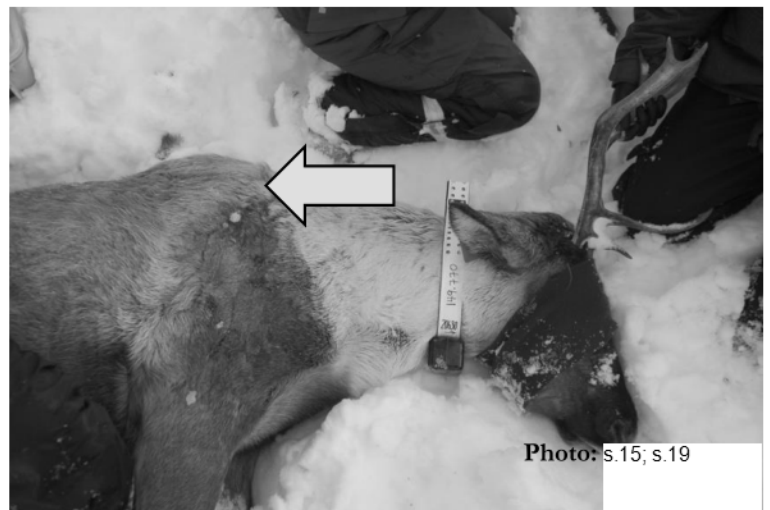


Photo: s.15; s.19

Feces

- Using the glove provided, collect a “palm full” of fecal pellets per rectum (or from the ground/snow).
- If collecting from the rectum, be careful to prevent tissue damage.
- Place pellets in the Whirl-pak (**NO ZIPLOCS**) provided, remove as much air as possible and avoid crushing pellets.
- Fold the tabs, sealing the bag and store the fecal sample frozen (minimum -20 °C).
- **AVOID FREEZING/THAWING.**

External Parasites

- Collect a sample of any external parasites (e.g. different life stages if present) if noted.
- **10+ winter ticks should be collected from any infested caribou.**
- In the field, ectoparasites can be temporarily placed in any small container if well sealed.
- Back at the lab, transfer half of the specimens into cryovial(s) or screw-top specimen containers with 70% ETOH (Ratio of 10 parts ethanol:1-part parasite). Freeze the other half of the specimens without ETOH.
- Label containers with WLH ID, herd, species, parasite type, body location recovered, and date.
- Store 70% ETOH at room temperature, protected from heat and light.
- Freeze at -20C, without ETOH.

Pictures

- Take a clear picture of the incisors of all caribou (see section 3.0). **This is a high priority sample.**
- If time permits, take a profile picture (head to rump) of each. This is a lower priority unless the animal is in poor condition, has hair loss, or is otherwise abnormal.
- If time permits, take a picture of the head of each caribou to assess antler development. Lower priority unless antler development is abnormal.

Basic Health Assessment

- A basic health assessment should always be performed during sampling and handling (collaring, tagging, sampling etc.).
- The health assessment includes checking teeth, ears, hair coat, skin, eyes, nostrils, hooves, evidence of diarrhea/fecal staining, nasal or ocular discharge, swollen joints, traumatic injuries or other abnormalities and recording them on each live captured caribou.
- **Take pictures of any caribou in poor condition, with hair loss, or of any other abnormalities.**
- **When taking pictures of abnormalities include a wide frame picture showing the entire animal and close-up views (multiple angles) with scale (e.g. a Leatherman, needle cap, etc. placed in frame).**

Capture Related Mortalities

- **If a caribou is euthanized, accidentally killed or dies during capture operations the carcass should be slung out for a full necropsy and health assessment by a project veterinarian (HIGH PRIORITY).**
- If this is logistically impossible, a complete necropsy must be performed, and samples collected in the field following guidelines outlined in the BC Caribou Necropsy Protocol.

FOR HEALTH-RELATED QUESTIONS DURING CAPTURE OPERATIONS

CONTACT

s.15; s.19

OR

FOR ANY QUESTIONS RELATED TO SAMPLE COLLECTION, HANDLING, PROCESSING, AND STORAGE

Wildlife Health Lab at 250-751-7246

Sample Shipping Instructions

ALL SAMPLES MUST BE RETURNED TO:

Wildlife Health Program

Attention: s.15; s.19

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

s.15; s.19

This includes sample kits that are not used this season. Please do not keep unused kits for “extra” sampling supplies. Return unused kits so that we can keep track of WLH IDs.

- Frozen samples MUST remain frozen during transport or their use is compromised.
- Appropriate insulated shipping containers and icepacks and can be purchased at low cost from ULINE.ca or contact the Wildlife Health Program.
- **Please notify** the Wildlife Health Lab in Nanaimo **BEFORE** samples are shipped
s.15; s.19
- Try to ship samples on Monday or Tuesday, never past Wednesday.

Shipping Checklist

- Copy of 1 x completed caribou capture form
- Serum in 4 x gold top tubes – spun with gel plug separating the serum and blood clot. **FROZEN**
- Plasma in 2 cryovials from 1 x purple top tube. **FROZEN**
- Buffy coat in 1 SEPARATE cryovial from 1 x purple top tube. **FROZEN**
- 1 x empty/spun purple top tube (re-capped) with clot. **FROZEN**
- Serum in 1 or 2 cryovials from 1 x royal blue top tube. **FROZEN**
- 1 x empty/spun royal blue top tube (re-capped) with clot. **FROZEN**
- DNA/RNA blood collection tube. **FROZEN**
- 1 x whirl-pack with fecal pellets. **FROZEN**
- 1 x small envelope with skin biopsy or biopsies (if multiple ear tags applied). **ROOM TEMPERATURE, DO NOT FREEZE**
- 1 x large envelope with plucked hair from shoulder. **ROOM TEMPERATURE, DO NOT FREEZE**
- Parasites in cryovial(s) or similar if collected. **Half in 70% ETOH, ROOM TEMPERATURE, DO NOT FREEZE and half FROZEN WITHOUT ETOH.**



**FISH, WILDLIFE AND HABITAT MANAGEMENT BRANCH
ANIMAL CARE APPLICATION FORM**

PLEASE TYPE

For office use: Date Received:

Project Number:

Project Title: Itcha-Ilgachuz, Quesnel Highland & Tweedsmuir-Entiako Caribou Capture and Wolf Reduction in Itcha-Ilgachuz & Tweedsmuir-Entiako to Support Caribou Recovery

2. Starting Date: January 15, 2021

Completion Date: April 20, 2022

3. Principal Investigator:

Name: s.15; s.19

Mailing Address: s.15; s.19

Position:

Department/Organization: s.15; s.19

Region/Institution: n/a

Phone: s.15; s.19

Fax: n/a

E-mail: s.15; s.19

Experience related to the described proposal:

s.15; s.19

4. Additional Investigators:

a) *Secondary Pilots*

Name: s.15; s.19

Position:

Department/Organization: s.15; s.19

Region/Institution: n/a

Experience related to the described proposal:

s.15; s.19

s.15; s.19

c) Net Gunners

Name: s.15; s.19
Position: Primary Net-gunners and Shooters
Department/Organization: s.15; s.19
Region/Institution: n/a

Experience related to the described proposal

s.15; s.19; s.22

5. Project Proposal

The Itcha-Ilgachuz caribou population is currently designated as Threatened in schedule 1 of the federal Species at Risk Act. The Itcha-Ilgachuz caribou have been regularly monitored since 1985 with population surveys generally occurring in June, shortly after the calving period when the majority of adult female caribou utilize alpine habitat in the Itcha and Ilgachuz mountain ranges. The Itcha-Ilgachuz caribou population has declined steeply since the herd's population peak in 2003. In June 2019, population inventory for this herd reported a sightability corrected population estimate of 385 caribou. The finite population growth rate (λ , or λ) describes the proportional change in population size over a discrete time period. From 2018-2019, λ for the Itcha-Ilgachuz herd was 0.604, which indicates a 40% decline in the herd from 2018 (N=637) to 2019 (N=385). The 2018-19 adult female survival rate was 80%. This is below the threshold of adult female survival of 88% associated with stable caribou populations. The average annual rate of decline over the past 10 years (2009-2019) is 23.2%, while the average rate of decline over the past three years (2017-2019) is 33.4%, suggesting that the rate of

decline may be accelerating. Given the three-year average rate of decline, it is possible the herd will be functionally extirpated (<20 animals) from the Chilcotin in eight years, although this may be sooner if the decline continues to accelerate. Since wolf reduction efforts began, this herd has increased by 165 animals, and the population growth rate (λ) has changed from steeply declining (2018-2019 $\lambda = 0.60$) to increasing ($\lambda = 1.08$). One of the largest early indications of success appears to be in calf recruitment, which indicates how many calves are surviving to adulthood to reproduce, measured via surveys in late winter (March). Calf recruitment changed from 8% in 2013, the last time it was measured before wolf removal, to 24% in 2021, which is above the recommended replacement level of 15%. Neonate percentages were at 25% in June 2020, while late winter recruitment the following late winter was 24%, indicating high calf survival to reproductive age. The preliminary results of predator reduction show encouraging signs for Itcha-Ilgachuz caribou recovery; however, further monitoring is required to confirm the response of this herd to wolf reduction actions.

The Tweedsmuir-Entiako caribou (TEC) are a subpopulation of the Northern group of Southern Mountain caribou and are federally designated as “threatened” meaning they are at risk of extirpation if limiting factors are not reversed. The TEC herd has been declining over the past few decades and is currently estimated at 150-200 individuals, down from an estimated 600 individuals in 1963. Annual population surveys, adult female mortality rates, late winter calf recruitment rates, and population growth rates suggest a rapidly declining TEC population with a high proportion of female mortality caused by wolf predation. Between 2014-2018, the population growth rate for the TEC subpopulation was 0.89, which is indicative of a rapidly declining population. Additionally, the cumulative population growth rate since data has been available suggests that the current population has declined by approximately 32% since the 1980s. The estimated annual female mortality rate from collared TEC females between 2014-2018 was 21.4, which is considered high. Almost half of the 2015-2018 mortalities of radio-collared female caribou occurred during the winter and wolf predation accounted for 70% of mortalities during the same period. In contrast, confirmed predation mortalities between 1983-2009 were more equally attributed to bears and wolves and confirmed wolf mortalities were evenly spread throughout seasons. Following the first year of wolf reductions for this herd in February - March 2020, the TEC calf survey in June 2020 observed an increase in calf numbers from 30 calves: 100 cows in 2019, to 45 calves: 100 cows in 2020. Following predator reduction in 2020 and 2021, there was an increase in the proportion of calves counted during the neonate surveys (30% calves in 2020, and 36% calves in 2021) compared to the previous estimate of 20% counted in 2019. The 2021 recruitment survey also yielded a high percent calf ratio at 23% calves. Additionally, in the fall of 2021, the largest minimum count since 2006 was recorded at 166 caribou, and population growth rate (λ) has changed from $\lambda = 0.86$ (2014-2019) pre wolf reduction to increasing $\lambda = 1.03$ (2020-2021). The preliminary results of predator reduction show encouraging signs for caribou recovery; however, further monitoring is required to confirm the response of the TEC herd to this management action.

Consistent with other research examining woodland caribou mortality predation is considered to be the proximate cause in the observed decline of the Itcha-Ilgachuz and Tweedsmuir caribou, with wolves considered to be the primary predator responsible for herd decline. The reduction of wolves has been shown to be effective for reversing the trends of declining woodland caribou populations in BC. Reduction efforts must be intensive and applied with the highest standards of scientific rigor and humaneness. The wolf reduction efforts in the Itcha-Ilgachuz and Tweedsmuir caribou herd are expected to support recovery while the ultimate causes of population declines (i.e. habitat-related impacts) are addressed. Radio-collaring individual wolves from wolf packs greatly increases the efficacy of removing entire wolf packs over the course of the winter; complete pack removal is an objective of intensive wolf reduction programs. Concurrent with aerial wolf reduction and collaring efforts, caribou will also be captured and radio-collared for ongoing population monitoring purposes.

*Operational plan for the Itcha-Ilgachuz and Tweedsmuir-Entiako wolf reduction program is attached.

A. Background – Goals and Objectives:

Wolf reduction has been identified as an effective short-term management action for supporting the recovery of woodland caribou in BC.

The goals and objectives of this project are to:

- 1) conduct net-gun aerial capture of individual wolves from all packs located within the Itcha-Ilgachuz and TEC treatment area to deploy radio collars and health sample 1-2 wolves per pack for the purpose of increasing the efficiency of aerial removal (humane removal);

- 2) using radio collar locations to identify pack locations, humane removal (via aerial shooting) the majority of wolves (>80%) found within the treatment area and reduce the wolf density to below 3 wolves per 1000 km²;
- 3) conduct net-gun aerial capture of individual caribou to deploy radio collars and health sample to monitor response of the Itcha-Ilgachuz, Barkerville and TEC population and inform adaptive management
- 4) implement scientific rigor and the highest possible standards for humaneness, and report out on all facets of the program

B. Key Expected Results and Management Implications:

- 1) Radio-collar deployment on individual wolves from the majority of wolf packs within the treatment areas with biological sampling for health profiles.
- 2) Reduction of the majority (>80%) of wolves via aerial shooting
- 3) Simultaneous monitoring of caribou populations via radio-collaring to report population growth, health parameters, adult female survival, and calf survival in response to wolf reduction
- 4) Ultimately, expecting positive caribou population growth on an annual basis (target 15% annually)

6. CCAC Invasiveness Category: (see Appendix A)

A ____ B ____ C ____ D x ____

7. Species and Number of Animals Required: (include justification of numbers predicted to be used)

Species: Wolf (*Canis lupus*)

Number expected for 2022: approximately 23 radio collar deployments (16 in Itcha-Ilgachuz, 7 in Tweedsmuir-Entiako), up to 200 to be humanely removed.

The number of radio collars to be deployed is contingent on the number of wolf packs within the treatment area. It is estimated that there will be between 10-15 packs within the Itcha-Ilgachuz and 5-10 wolf packs within the TEC treatment area. Radio-collar deployment is generally non-selective but will be applied to adult wolves preferentially and of both sexes.

The number of wolves to be humanely removed is also dependent on the number of wolves present within the treatment area. It is estimated that at least 75-150 wolves will be humanely removed across both treatment areas.

Justification for numbers: The number of wolves to be radio-collared is based on the estimated number of wolf packs in the treatment area. Having at least one wolf radio-collared within each pack greatly increases the efficacy of humanely removing subsequent wolves from the pack. It is estimated that at least 75-150 wolves will be humanely removed from both treatment areas in order to achieve greater than 80% reduction rate required to support caribou recovery.

Species: Caribou (*Rangifer tarandus*)

Number expected for 2022: approximately 30 radio collar deployments (10 in Itcha-Ilgachuz, 5 in Quesnel Highlands and 15 in Tweedsmuir-Entiako).

The number of radio collars to be deployed is based on maintaining an approximate sample size in both study areas of a desired number. We will be capturing primarily female caribou.

8. Details of Capture, Handling and Surgical Procedures and Final Disposition: (be detailed and SPECIFIC, attach additional pages, if necessary)

Please refer to Appendix B – CCAC guidelines on: the care and use of wildlife (2003) for techniques considered appropriate and other guidelines for handling and care.

Capture Technique:

Wolves will be captured for radio collar deployment via aerial net-gunning, and humane removal will occur via aerial shooting. Caribou will be captured for collar deployment via aerial net-gunning.

Helicopter captures and removal will take place between January and the end of March using aerial net gunning and physical restraint and aerial shooting. An MD500D helicopter will be used to track and target wolves in snow-covered, sparsely treed habitats and frozen watercourses suitable for safe capture or removal. Deep, soft snow is preferred as it will slow animals, make their movements more predictable, and reduce the risk of injury during capture, and increases the likelihood of accurate, humane shooting.

Net-gunning – Wolves and Caribou: The identified personnel ^{s.15; s.19} will use a hand-held net gun to capture wolves and caribou for radio collar deployment and health sampling. When a candidate animal has been selected in close proximity to a suitable capture location, the capture helicopter will approach the animal, haze it into a suitable nearby opening and on close approach (within 5–10 m), fire a 12' x 12' net over the front of the animal. Hazing time for wolves is difficult to limit but for caribou, will not exceed the standards required by the Province and recommended by Wildlife Health, generally less than 5 minutes with close approach for capture under 2 minutes for wolves or caribou. Capture location will be selected in order to minimize risks to the crew and animal (i.e. avoiding open water, avalanche terrain, thin ice, wooded areas, steep terrain, etc.). A second net may be deployed in order to further entangle the wolf or caribou. Only one wolf or caribou will be captured at a time. Two net-guns with 4 or 5 detachable net canisters will be available to the net-gunner for each capture. This provides a backup net-gun and nets that can be used to reduce chase duration if the first net fails to adequately restrain the animal, or to further entangle the animal if the single net is not sufficient. Once the net is deployed the animal usually quickly trips and is wrapped up in the net, becoming immobile. The helicopter will immediately land to drop off the capture crew, and the net-gunner will restrain the wolf with a Y-pole around the neck before it can chew out of the net. If a caribou, the handlers and net-gunner will immediately restrain the caribou carefully using body weight without direct pressure on the thorax and careful handling of the neck and head. For wolves, the handler will apply a catch-pole snare around the mouth of the wolf and tighten it until it is securely closed. The crew will then apply a muzzle or multiple wraps of strong duct tape to the mouth in order to eliminate the risk of a wolf biting the crew. A blindfold will then be applied to reduce stress to wolves and caribou. Hobbles will then be applied to the front and back legs of the animal as restraint to eliminate the possibility of the wolf or caribou escaping.

Shooting - Wolves: The identified personnel ^{s.15; s.19} will conduct the aerial removal (humane removal) of wolves by use of high-powered rifle. The rifle will be a .308 semi-automatic rifle equipped with extended 30- round magazines using a red-dot scope for quick and accurate target acquisition. Polymer or lead-tipped, rapid expansion lead-core bullets will be used to maximize shot impact and ensure quick or immediate kill. Non lead bullets of this caliber will be used if available to reduce the use of lead and habitat contamination. The rifle includes detachable magazines for quick reloading of the firearm, and a semi-automatic action allowing for a quick succession of shots if necessary. Wolves chosen to be shot will be hazed into open locations where the shot distance is no greater than 50 m, ensuring a high likelihood of accurate shot placement. Shot placement will preferentially be the cranium (targeting the brain first and upper spinal cord) or the chest area (lungs and heart). If immediate death is not observed following the first shot, follow-up shots will occur as soon as possible and preferentially in the head, then neck, or chest area to ensure death. Wolves will be visually observed from as close a distance as possible from the hovering helicopter for visual signs of movement (eg. respiratory effort and movement) to confirm death before moving on. Any animal that is shot and is not recumbent will be followed until the gunner is able to humanely remove as quickly as possible. Humaneness will be documented by recording time, number of and shot placement and time of death. Once a pack is eliminated, at least half of the wolves humanely removed will be inspected on the ground, clearly documenting shot locations and providing standardized photographs to the project lead and provincial wildlife veterinarian. These documentation (time, number of shots, shot placement and photographs will be provided to the lead and veterinarian at the completion of the project.

Method of Handling:

Each wolf or caribou will be handled by an experienced handling crew. As described above, the net-gunner will be the first to engage with the animal after it has been entangled in the net.

For wolves: The net-gunner will use a Y-pole to pin the wolf to the ground by applying the Y-pole directly behind the animal's head. The handler will approach the wolf with the catch-pole, and secure the mouth closed using the catch pole snare. Once the catch-pole snare is confirmed to be secured, the crew will apply a commercial dog muzzle and/or multiple wraps of duct tape around the wolf's muzzle to ensure it is unable to bite and blindfold the animal. The wolf will then be hobbled as described above.

For caribou: The net-gunner and handler will immediately approach the animal, with the handler going to the back of the animal and applying weight carefully on the rump to secure the animal and help the net-gunner to untangle the net. A blindfold will then be applied to reduce visual stress and the neck and head carefully restrained. Hobbles will then be applied by securing the right front leg to the right back leg, and the left front leg to the left back leg. Rectal body temperature will be taken immediately following restraint. Animals showing evidence of extreme stress (body temperatures above 41°C, open mouth breathing and tremors, in poor body condition) will be released immediately after basic sampling if possible or none at all. Animals with previous injuries not considered survivable will be humanely removed by gunshot to the head. Rangifer have been listed as one of the potentially susceptible species for SARS-CoV-2. All personnel handling caribou will be symptom-free, and fully-vaccinated or received a negative test for SARS-CoV-2 within 48 hours of starting the capture session.

For wolves and caribou: The net(s) will be removed from the wolf or caribou which will then be positioned to minimize discomfort (i.e. sternal or lateral recumbency, head slightly uphill, head free from deep snow). Once fully immobilized, the crew will assess the wolf or caribou for any injuries that may have occurred during capture and confirm the animal's general health and sex. The restraining process generally takes less than 2–3 minutes, at which point the radio-collaring and sampling procedures will begin. Small crews of two personnel will be used to minimize stress, and sudden movements or auditory stimuli will be kept to a minimum. To release the wolf or caribou, it is first pointed in a safe direction of travel away from the crew, helicopter, or any hazards.

For wolves: Once sampling and collaring is completed, the catch-pole snare is securely attached around the mouth, at which point the muzzle or tape around the wolf's muzzle is carefully removed and the Y-pole is re-applied. The blindfold is removed, the hobbles are removed, and the catch-pole is released, and finally the Y-pole is lifted.

For caribou: Once sampling and collaring is completed, the animal is positioned to rise in a direction away from the team, the blindfold is removed, followed by removal of the hobbles.

Other Procedures: (Marking method, Sampling)

Each wolf and caribou will be fitted with a satellite GPS radio-collar (Caribou = Vectronics Vertex Lite 2D =1700 g, Wolves = Vectronics Vertex Lite 2D =1500 g). The radio collar will be applied by the most experienced crew member to ensure the correct fit. Radio-collars will be fitted to ensure comfort for the animal, while ensuring that they are not too loose as to slip off or cause irritation (generally two fingers fitted vertically). Radio-collars fitted on younger animals, if necessary, will be slightly looser to allow for growth. For wolves, satellite collars will be programmed to obtain positional fixes every 3–4 hours over the course of the winter to acquire up-to-date location information to support reduction efforts. For caribou, satellite collars will be programmed to obtain position fixes twice a day during most seasons and up to 6 times a day during calving. Radio-collared wolves will either be left alive following the winter's removal efforts in order to collect further data and to support removal efforts the following winter, or they will be humanly removed once all other pack members have been removed.

Biological samples will be taken by the crew as per standardized Wildlife Health Program protocols while the wolf or caribou is immobilized. The total time associated with radio-collar attachment and sample collection takes less than 10 minutes for wolves and less than 15 minutes for caribou.

The radio-collars contain an internal tip switch to detect animal movement rates and are programmed to send a mortality alert via email and text message if no movement is detected for a sustained period of time (12 hours). Immediate investigation of mortalities is not anticipated for wolves, although radio collars will be picked up as soon as logistically feasible and an investigation on cause of death will occur if possible. Caribou mortalities will

be investigated as per the standardized Wildlife Health Program protocol by Ministry staff. Collars include label plates instructing hunters/trappers to contact FLNRO if they harvest a collared wolf, or a collar is found.

Additional data will be recorded, and samples will be taken by the handling crew while animals are physically restrained according to the standardized BC wolf and caribou sampling protocols (Appendix C):

For wolves:

- Age class using tooth eruption/wear/staining as an index (if visible under the tape)
- Sex
- Colour
- Pack size
- Location
- Body condition
- Photos
- Presence of old injuries or new capture-related injuries
- External parasite presence and prevalence
- From each wolf, 10 to 15 ml of blood will be withdrawn from the saphenous or cephalic vein for serological screening (parvovirus, Neospora, distemper), ensuring bleeding has stopped before releasing the animal
- Each wolf may be ear-tagged with a unique identifier number, and a 6 mm punch biopsy of the ear will be air-dried and archived for genetics
- Approximately 100 hairs with roots from the top of the shoulders from each wolf for genetic or other studies (e.g., stress assessment through cortisol levels, diet analysis with stable isotopes).

For caribou:

- Similarly, data will be recorded on the standard BC caribou capture form and samples will be taken by the crew while the caribou is physically restrained. This will include all samples and data required by the *BC Caribou Research Capture Sampling Protocols*. Samples will be processed each evening and stored before shipping to the BC Wildlife Health Program.

Contingency Plan: (what training, preparations and equipment are available in event of animal injury during capture or handling)

The following measures will be in place to reduce the risk of injury to wolves:

- 1) Capture crews are personnel with extensive experience in capturing, handling and shooting wild canids.
- 2) At least two out of three personnel are trained in first aid and CPR and avalanche safety?
- 3) Aerial net-gun captures will be conducted in deep, soft snow in ambient temperatures of between 0 to -25 C, on terrain consisting of flat or rolling terrain and not exposed ground or open water and animals will be assessed and monitored during physical restraint.
- 4) The capture crew will have a satellite phone to contact other experienced professionals and veterinarians for advice and guidance for any unusual circumstances that arise in the field
- 5) A firearm will be available for humane killing of any wolves or caribou badly injured during net-gun captures
- 6) While mortalities can occur with capture operations any mortality must be investigated and if the mortality rate exceeds 2% the operation must cease and the wildlife veterinarian and project lead contacted immediately.

Method of Humane Removal and Disposal Technique: (if necessary)

In the event of an animal being injured without a chance of survival after release, it will be euthanized humanely by high caliber gunshot to the brain and samples taken to confirm cause of death. Wolf carcasses may be sampled and left in the field unless brought back to the lab for examination or necropsy and disposal at the dump,

s.18.1

, Caribou deaths will be documented and followed by full necropsy and

sampling if possible.

9. Details of Potentially Controversial Procedures and Justification: (Include any expected morbidity and methods used to avoid)

Animal welfare is of high priority for this project. All net-gun captures will occur following the procedures described above (and in the regional SOPs for aerial net-gun capture). Few complications have been observed using this

protocol. Aerial shooting of wolves is considered the most effective and humane method of removing wolves in remote, expansive areas, with the ability to target without bycatch occurring (AVMA, 2013). All possible measures will be taken to ensure the ethical and humane removal of wolves.

10. Budget:

Funding sources applied for: Provincial Caribou Recovery Program

Are these peer reviewed? Yes (the region's wolf reduction programs have undergone internal and external reviews to measure effectiveness)

Status: Approved

11. Region:

The wolf reduction and caribou capture will occur within the TEC treatment area. The treatment boundary covers an area of approximately 15,786 km² in the mountain caribou range of west-central British Columbia. The treatment area was identified due to the recovery urgency for this particular caribou herd.

12. Permit:

Is a permit required? Yes **Status:** Pending Decision

Please attach any permit documents to application.

Please send the completed BC Animal Care Form Application Form to the Permit & Authorization Service Bureau (PASB) along with a General Permit Application, detailed project proposal and permit fees (if applicable). For further information on how to apply, please visit the PASB website at <http://www.env.gov.bc.ca/pasb/> or call PASB at 1-866-433-7272 (to bypass phone tree push 231).

Approval of an Animal Care Application does not constitute approval of any application to handle wildlife. Applicants must also have a valid permit, issued under the Wildlife Act, before engaging in any such activity.

Principal Investigator's Signature

Date of Application

Appendix A:

Canadian Council on Animal Care: Categories of Invasiveness for Wildlife Studies

A. Methods used on most invertebrates or on live isolates

Possible examples: the use of tissue culture and tissues obtained at necropsy; the use of eggs, protozoa or other single-celled organisms; experiments involving containment, incision or other invasive procedures on metazoa.

B. Methods used which cause little or no discomfort or stress

Possible examples: observational studies in which the same individuals are not repeatedly observed so as to habituate or otherwise modify their behavior; census or other surveys which do not involve capture or marking individuals; non-invasive studies on animals that have been habituated to captivity; short periods of food and/or water deprivation equivalent to periods of abstinence in nature.

C. Methods which cause minor stress or pain of short duration

Possible examples: capture, using methods with little or no potential to cause injury and marking of animals for immediate release; long-term observational studies on free-ranging animals where the behaviour of individuals may be altered by repeated contact; brief restraint for blood or tissue sampling; short periods of restraint beyond that for simple observation or examination, but consistent with minimal distress; short periods of food and/or water deprivation which exceed periods of abstinence in nature; exposure to non-lethal levels of drugs or chemicals; low velocity darting and slow-injection darts with immobilization chemicals. Such procedures should not cause significant changes in the animal's appearance, in physiological parameters such as respiratory or cardiac rate, or fecal or urinary output, in social responses or *in ability to survive*.

Note: During or after Category C studies, animals must not show self-mutilation, anorexia, dehydration, hyperactivity, increased recumbency or dormancy, increased vocalization, aggressive-defensive behavior or demonstrate social withdrawal and self-isolation.

D. Methods which cause moderate to severe distress or discomfort

Possible examples: capture, using methods that have the potential to cause injury (e.g. Leg snares, leghold traps, high velocity darting and rapid-injection darts with immobilization chemicals, net gunning, etc.); maintenance of wild caught animals in captivity; translocation of wildlife to new habitats; major surgical procedures conducted under general anesthesia, with subsequent recovery; prolonged (several hours or more) periods of physical restraint; induction of behavioral stresses such as maternal deprivation, aggression, predator-prey interactions; procedures which cause severe, persistent or irreversible disruption of sensorimotor organization.

Other examples *in captive animals* include induction of anatomical and physiological abnormalities that will result in pain or distress; the exposure of an animal to noxious stimuli from which escape is impossible; the production of radiation sickness; exposure to drugs or chemicals at levels that impair physiological systems. (NB. Experiments described in this paragraph would be Category E if performed on wildlife immediately prior to release.)

Note: Procedures used in Category D studies should not cause prolonged or severe clinical distress as may be exhibited by a wide range of clinical signs, such as marked abnormalities in behavioral patterns or attitudes, the absence of grooming, dehydration, abnormal vocalization, prolonged anorexia, circulatory collapse, extreme lethargy or disinclination to move, and clinical signs of severe or advanced local or systemic infection, etc.

E. Procedures which cause severe pain near, at, or above the pain tolerance threshold of unanesthetized conscious animals

This Category of Invasiveness is not necessarily confined to surgical procedures, but may include exposure to noxious stimuli or agents whose effects are unknown; exposure to drugs or chemicals at levels that (may) markedly impair physiological systems and which cause death, severe pain, or extreme distress; behavioral studies about which the effects of the degree of distress are not known; *environmental deprivation that has the potential to seriously jeopardize an animal's wellbeing*; use of muscle relaxants or paralytic drugs without anesthetics; burn or trauma infliction on unanesthetized animals; a euthanasia method not approved by the CCAC; any procedures (e.g., the injection of noxious agents or the induction of severe stress or shock) that will result in pain which approaches the pain tolerance threshold and cannot be relieved by analgesia (e.g., removal of teeth without analgesia, or when toxicity testing and experimentally-induced infectious disease studies have death as the endpoint), *capture methods with a high potential of causing severe injury that could result in severe chronic pain and/or death*.

Appendix B:

Canadian Council on Animal Care guidelines on: the care and use of wildlife (2003)

http://www.ccac.ca/english/gui_pol/GUFRAME.HTM
<http://www.ccac.ca/english/gdlines/wildlife/Wildlife.pdf>

Appendix C:

BC Caribou and Wolf Sampling Protocols



BC Caribou Research
Capture Sampling Proc



BC Wolf Capture
Sampling Protocols_C

British Columbia Caribou Health Assessment and Sampling Protocols Net Gun Captures

This is a companion document to the current BC Caribou Research Capture Data Form and MUST be reviewed prior to any caribou captures as it is modified on a regular basis.

General Considerations

The net-gun capture of free-ranging caribou creates risk so animal welfare is critical at all stages of animal capture and sampling. Minimizing hazing time (of groups and individuals), limiting the duration of intense pursuit (< 2 minutes), restricting operations to cooler weather (< -10 °C), and quick and efficient handling (< 15 minutes) are key to reducing the risk of injury or complications such as capture myopathy.

These sampling protocols are modified from those used for net-gun capture of > 250 boreal caribou in NE BC from 2013-2016. Complete sample sets were obtained from most animals and no serious injuries or mortalities occurred.

Recommendations for Time/Temperature Cut-offs and Sampling Priority

The collection of a complete set of biological samples from each live-captured caribou is an obligation, a high priority research need, and protocols have been designed to balance this need with animal welfare. An experienced capture/handling team can collar, tag, collect all samples, and perform a basic health assessment on a properly restrained, net-gunned caribou in ≤ 15 minutes. However, capture teams must be able to recognize signs of distress in captured animals. If distress occurs, partial sampling or immediate release may be required. Body temperature, animal behaviour, and handling time should be used to guide decision making (See Table 1).

Table 1. Decision Matrix for Sampling Free-Ranging Caribou Captured by Net-Gun

Rectal Temperature	Recommended Sampling Strategy	Recommended Handling Time
≤ 41°C/ 105.8 °F	Full collar/ear tag and sample collection protocol	Aim ≤ 15 minutes
41-41.5°C/105.8-106.7°F	Collar/ear tag and collect blood and hair only	Do not exceed 10 minutes
> 41.5 °C/106.7°F	Collar/ear tag and collect hair only	Release immediately

- Rectal temperature is taken with a digital thermometer immediately after a caribou is hobbled and blindfolded. Most net-gunned caribou captured in cooler weather, after an acceptable chase time will have rectal temperatures ≤ 41°C/105.8°F.
- Excessive struggling may increase body temperature and lead to modifying sampling.
- If an animal must be released, fecal samples may be collected off snow.
- To increase handling efficiency, the role of each team member should be clearly defined prior to capture and the most experienced team member should take blood when handling times are limited.

Estimating Age

AGE CLASS	PATTERN OF INCISOR WEAR	FIELD AGE
Subadult	Very white teeth with rounded caps (little or no wear)	2-3 Years (Picture 1)
Adult	First incisors are flattening, and second incisors are beginning to wear.	4-5 Years (Picture 2)
Adult	All teeth in the incisor bar are flattening and appear to be a straight line across the top of the teeth.	6-7 Years (Picture 3)
Old Adult	All teeth in the incisor bar are flattened significantly (all teeth appear significantly shorter than 6-7 year old)	8-9 Years (No Picture)
Old Adult	All teeth in the incisor bar are stubs (shorter still)	10-11 Years (Picture 4)
Old Adult	All teeth in the incisor bar are worn to the gum line	12+ Years (Picture 5)



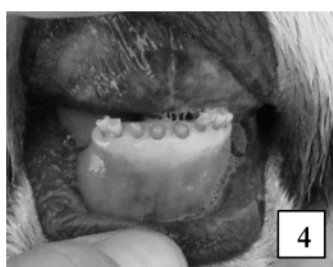
1



2



3



4



5

Modified After: Cattet, M.R.L. (2011) Government of Northwest Territories, Wildlife Care Committee Standard Operating Procedure (SOP) for Capture, Handling and Release of Caribou. Version 2-2011. Picture 5. ^{s.15, s.19} Government of BC.

Assessment of Body Condition

Evaluate the body condition of each live-captured caribou **USING BOTH** the standardized CARMA condition score and a general assessment technique.

CARMA Body Condition Score

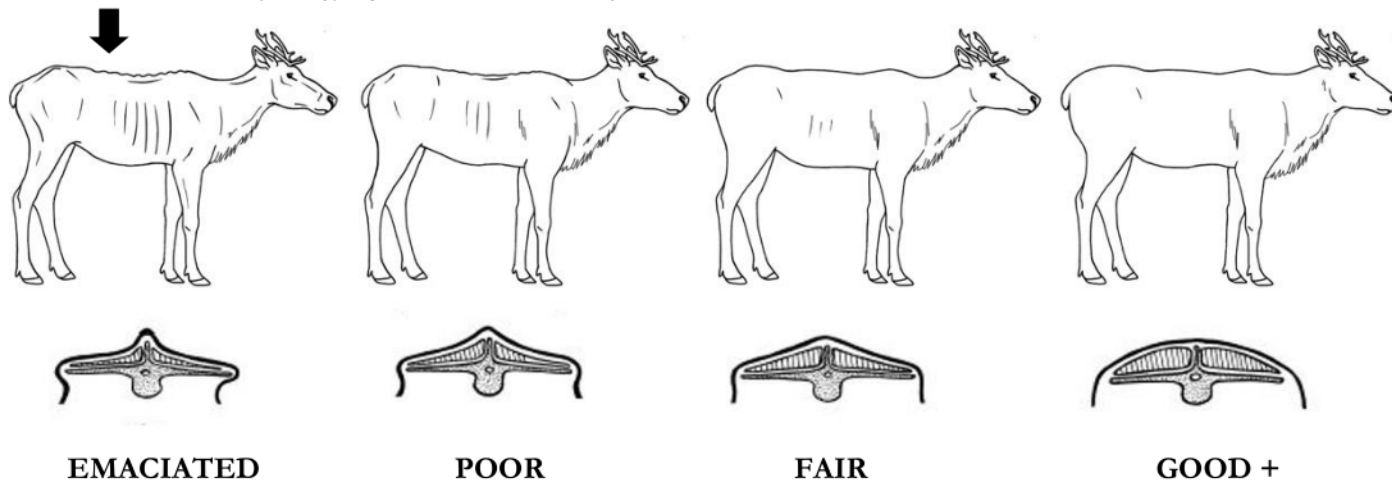
- A standardized palpation technique developed by the Circum Arctic *Rangifer* Monitoring and Assessment (CARMA) Network is used as a standard method to estimate body condition of caribou.
- It assigns scores that have not been calibrated to back fat and are subjective (but still useful) indicators of overall fatness. It is a more precise method of assessing condition vs. the general approach.
- Using the chart below, assign palpation scores to the shoulder, ribs, and hips-spine.
- Scores may be broken down to halves (e.g. 2.5, 3.5) and area scores won't necessarily be the same.

SHOULDER	DESCRIPTION	SCORE
1	V-shaped scapula (shoulder blade), very bony, hollows behind scapula and immediately behind the scapular spine	
2	Somewhat V shaped, less bony, hollows still present	
3	U-shaped withers, hollows filled	
4	U-shaped, very broad, difficult to feel edges of bone	
RIBS	CARMA DESCRIPTION	SCORE
1	Deep groves between ribs including behind the shoulder	
2	Ribs fairly well covered immediately behind shoulder	
3	Can still feel ribs, groves are not too deep	
4	Ribs nearly flush with tissue between them	
HIPS/SPINE	CARMA DESCRIPTION	SCORE
1	Hip bones very distinct, no fat on back or tail head, spine very distinct	
2	Some padding on hips, spine remains very distinct	
3	Hips fairly well padded, spine partly covered along each side	
4	Hips well padded, spine is flush with or nearly covered with fat	
Total Score (sum of shoulder, ribs, hips/spine assessments)		

Gunn, A. et al. Eds. (2008). CircumArctic *Rangifer* Monitoring and Assessment (CARMA) Network Monitoring Protocols Level 2. 57 pp.

General Body Condition Scoring (overall appearance and loin profile)

Loin Cross Section (through spine at level of last rib)



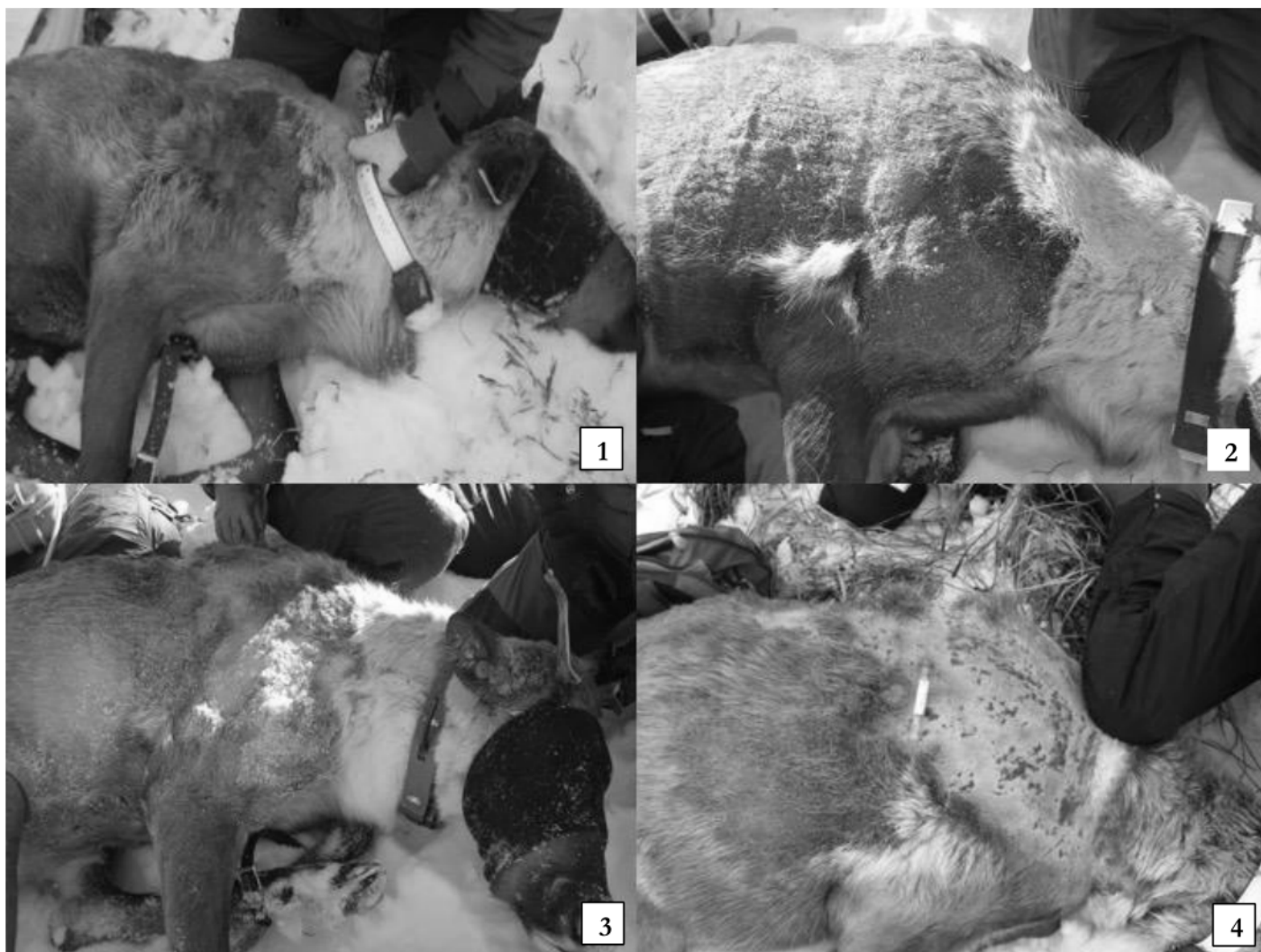
Caribou Drawings: M. Winchester, Government BC.

Winter Ticks

Tick Associated Hair Loss Scoring in Caribou

HAIR LOSS CATEGORY	PATTERN
None (No Picture)	No hair loss or breakage
Mild (Picture 1)	Few small to medium sized patches of broken hair or hair loss
Moderate (Picture 2)	Several or large patches broken hair or hair loss - NO EXPOSED SKIN
Severe (Picture 3)	Several or large patches broken hair or hair loss <u>with</u> 1-2 SMALL AREAS EXPOSED SKIN
Extreme (Picture 4)	Several or large patches broken hair or hair loss <u>with</u> large or > 2 AREAS OF EXPOSED SKIN

**** Degree of tick associated hair loss in caribou is not always correlated with number of ticks.**



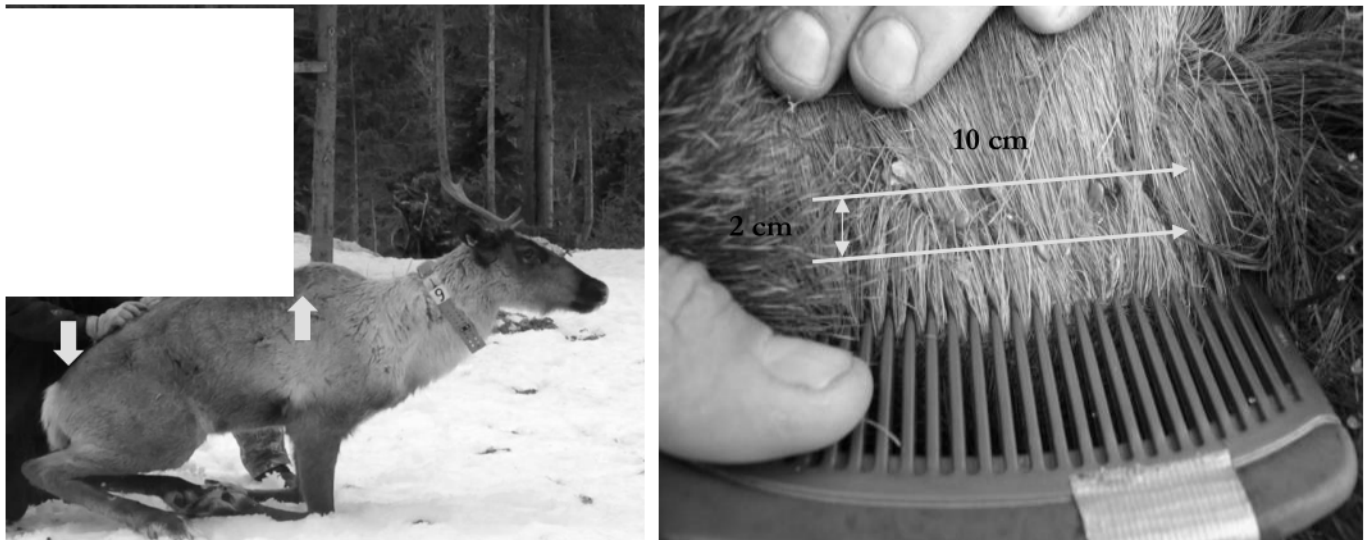
* Photos and Hair Loss Classification Score:s.15; s.19

, Fort St. John, BC.

Tick Burden Assessment - Rapid Method

- **PERFORM THIS ASSESSMENT ONLY IF TIME AND ANIMAL WELFARE PERMIT**
- Permanently mark a comb with 10 cm transect length to assist.
- Part the hair along the upper edge of the shoulder blade with the comb.
- **ESTIMATE or COUNT (best)** the number of ticks along a single 10 cm x 2 cm transect.
- If there is significant hair loss on the shoulder, perform the assessment on the rump.
- **SCORE for BURDEN: None (0 count), Mild (0-15 ticks total), Moderate (15-30 ticks total), Severe (>30 ticks total).**
- **COLLECT** a representative sample (e.g. various life stages, engorged, not engorged) of ticks in 70% ETOH (minimum 10:1 ratio; ethanol:ticks).
- **STORE** ticks in ETOH at room temperature, protected from heat and light.
- Ensure tick specimens are in well-sealed containers (e.g. cryovials or similar) to prevent evaporation.

s.22



Sample Collection Protocols for Live-Captured Caribou

Each caribou sampling kit contains:

- 4 x 5.0 ml Gold top (SST) collection tubes - for serum
- 1 x 6.0 ml Royal Blue top collection tube - for serum for trace nutrients
- 1 x 6.0 ml Purple top collection tube - for whole blood
- 1 x 3.0 ml Green top collection tube - for DNA/RNA
- 2 x 18 G 1.5 inch, plastic hub needles
- 1 x 35 ml syringe
- 1 x small coin envelope (white)
- 1 x large coin envelope (white)
- 1 x disposable 6 mm biopsy punch - can use for both ears in same animal
- 1 x ear tag with unique ID number [Note: Tag ID is not the same as Wildlife Health ID (WLH ID) Number]
- 1 x Whirl-pak bag
- 1 x nitrile glove

Sample Collection

To increase handling and sampling efficiency, the role of each team member should be clearly defined prior to capture.

Blood Collection

- **Blood is the most important sample to collect from each caribou.**
- **Training and experience are required to collect blood. The most experienced team member should oversee blood collection by new staff and should take blood when handling times are limited.**
- Ensure caribou are well restrained before blood collection. Head control and proper positioning (head and neck not bent or twisted) are especially important if taking blood samples from the jugular vein.
- Each kit has all supplies and blood tubes for completing the collection.
- Ensure the blood collection tubes are at 18-25 °C prior to use. **NOTE:** all blood tubes are best at this temperature as it avoids temperature shock to the blood cells.
- Blood is collected with needle and syringe from **EITHER** the jugular vein, the cephalic vein (front leg), or the saphenous vein (hind leg).



Location for blood sampling from the jugular vein (yellow arrow). Picture from: University of Calgary, Faculty of Veterinary Medicine, *Rangifer* Anatomy Project.

- The vein must be held off by a hand or tourniquet to build up pressure and locate the vein.
- Hold the needle with the bevel up and insert carefully beside or above the vein and puncture the vein. Once the vein is punctured blood is seen in the needle hub and the blood can then be pulled into the syringe. Slowly pull past the 35 ml mark to ensure that enough blood is collected to fill all tubes.
- There is an extra needle in each kit. Please secure used needles in a crush proof, puncture proof sharps container and syringes without needles can be disposed of in a sealed garbage bag.

Blood Transfer to Sample Collection Tubes

- The blood collection tubes are in the kit in a BUNDLE with an elastic band. They contain a variety of fluids or compounds and are all under negative pressure.
- To prevent hemolysis (the rupture of red blood cells turning serum pink or red), do not squirt/force blood into collection tubes. Instead, once the syringe is full, carefully insert the needle through the end and negative pressure will passively draw the blood from the needle/syringe into the collection tube.
- If the vacuum has been compromised, blood can be gently and slowly injected along the sides of the tube.
- **START FILLING THE YELLOW TOP TUBES, FOLLOWED BY THE BLUE, PURPLE AND THE GREEN TOP TUBE LAST.**
- **GENTLY ROLL OR TURN ALL THE TUBES IN THEIR BUNDLE IMMEDIATELY AFTER COLLECTION TO ENSURE THE BLOOD AND CONTENTS ARE WELL MIXED (30 seconds to 1 minute). THIS IS ESPECIALLY FOR PURPLE AND GREEN TOPS TO MIX THEIR CONTENTS TO PRESERVE BLOOD CELLS.**
- Each blood tube type is designed to collect the specific samples required for pregnancy determination, health and disease surveillance, trace nutrient testing, etc.
- The quality of data obtained from blood samples will be compromised by improper collection, handling, processing, and storage. Please ensure blood protocols are followed.
- **ONCE FILLED, HANDLE BLOOD TUBES WITH CARE: PLACE UPRIGHT IN A COOLER IN THE HELICOPTER, PROTECT FROM SHAKING, ROUGH HANDLING, DIRECT SUNLIGHT, FREEZING, AND HEAT.**



Blood Post Field Processing and Storage

Supplies needed: From the Wildlife Health Program

- Cryovials - 2 ml volume
- Preprinted labels with: Species, WLH ID, Blood Sample Type (i.e. serum, plasma, buffy, trace, RNA)
- Transfer pipettes - disposable plastic
- Small Ziploc bag to keep all blood samples grouped together by individual WLH ID#.

Gold Top (SST) Serum Tubes

- Once back from the field, centrifuge gold top tubes for 15 minutes after blood has clotted and within 12 hours of collection.
- After centrifuging, serum (clear, yellowish liquid) will be separated from clotted blood by the gel plug. If the gel does not separate the serum you may need to re-spin.
- Decant serum into labelled cryovials using a disposable transfer pipette.
- **Use a new transfer pipette for each type of tube and use transfer pipettes to process samples from each caribou.**

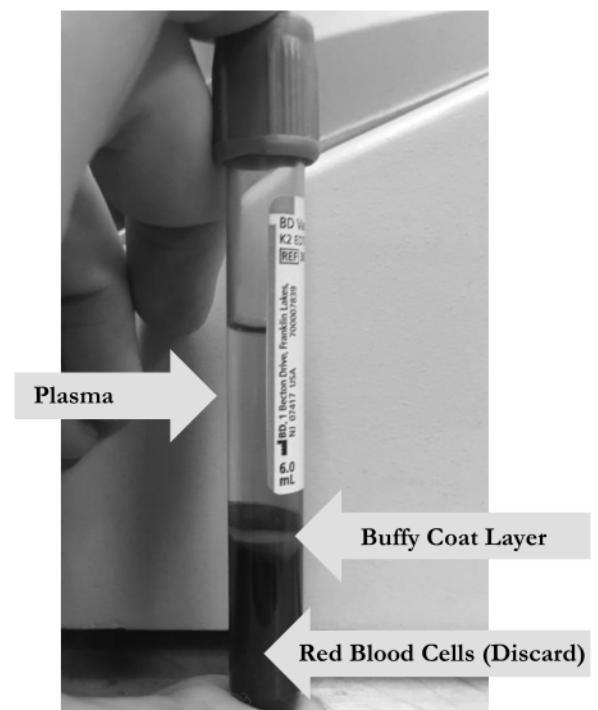
- If a transfer pipette becomes contaminated with gel, blood from the clot, other debris, etc. discard and use a new pipette.
- Fill each cryovial with 1 ml, with a maximum of 2 ml serum.
- Please do not use cryovials > 2 ml. Freeze/thaw can degrade serum samples and is required for sub sampling if larger cryovials are used.
- Ensure each cryovial is labelled with: WLH ID (**NOT COLLAR FREQUENCIES**), herd, species, **SERUM**, and date. **USE PREPRINTED LABELS**
- Store serum from gold top tubes frozen (minimum -20 °C).
- **Recap gold top tube and retain one with clot (frozen, minimum -20 °C).**

Royal Blue Top (Trace Nutrient) Serum Tube

- Centrifuge for 15 minutes once blood has clotted and within 12 hours of collection.
- **Royal blue top tubes do not have separating gel, so try not to disturb the clot after centrifuging and while processing.**
- **Royal blue top tubes are also more easily affected by hemolysis (red blood cell rupture). Please note (in data sheet comments section) if the serum sample from a royal blue top tube appears red as hemolysis may influence interpretation of results.**
- Decant serum into two labelled cryovials. Label cryovials with WLH ID, herd, species, **TRACE NUTRIENTS**, and date. **USE PREPRINTED LABELS**
- Store serum from the royal blue top tube frozen (minimum -20 °C).
- Discard the clot and the royal blue top tube.

Purple Top (EDTA) Whole Blood Tube

- **Remember this tube MUST be mixed immediately after collection.**
- Centrifuge the purple top tube for 15 minutes as with other tubes.
- **CAUTION AFTER SPINNING.** The blood cell and plasma layers in the purple top tube are in a liquid state (not clotted). Do not bump or disturb the red blood cell layer and buffy coat (the opaque white blood cell layer between plasma and red cells) before sampling.
- **RE-CENTRIFUGE IF LAYERS ARE ACCIDENTALLY DISTURBED.**
- Collect plasma (clear/yellow layer) into cryovials using a new pipette.
- Fill each cryovial with a maximum of 2 ml plasma.
- Label each cryovial with WLHID, herd, species, **PLASMA**, and date. **USE PREPRINTED LABELS**



- Store plasma from the purple top tube frozen (minimum -20 °C).
- Collect the buffy coat (opaque middle layer) into a **SEPARATE** cryovial.
- Label this vial with WLH ID, herd, species, **BUFFY**, and date. **USE PREPRINTED LABELS**
- The buffy coat sample will appear red as some red blood cells will be sucked up with the white blood cell layer. **Try to minimize this as much as possible.**
- Store buffy from the purple top tube coat frozen (minimum -20 °C).
- Discard the remaining red blood cell layer and the purple top tube.

Green Top DNA/RNA Blood Tube NEW****

- The DNA/RNA blood tube should be the last tube that blood is placed into.
- **Remember this tube MUST be mixed immediately after collection.**
- Do not spin the green top tube or draw off serum.
- The blood is stabilized in this tube and can be sent to Wildlife Health in the original collection tube.
- Green top tubes do not need to be frozen, they can be kept at room temperature.

Skin Biopsy

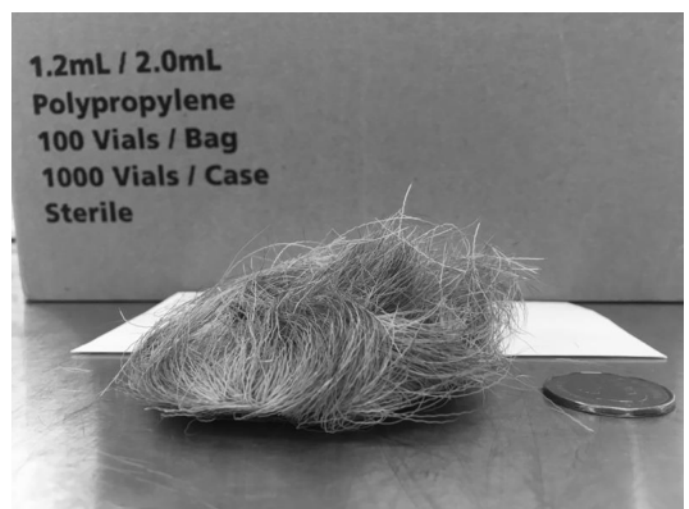
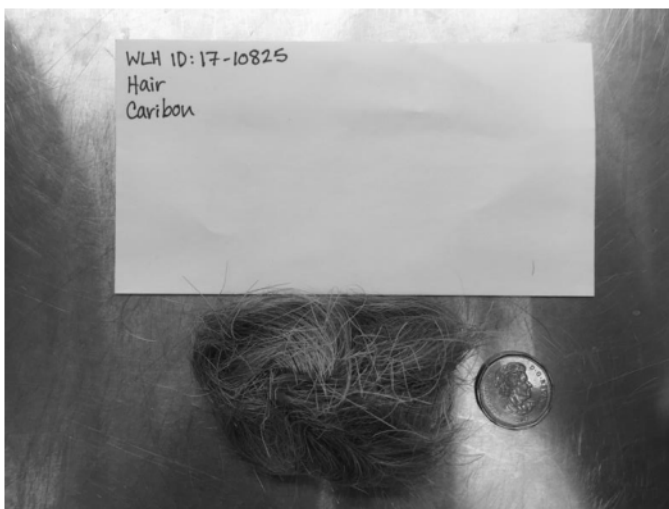
- Use the 6 mm biopsy punch to place holes for each ear tag. Use the same punch for both ears if two tags are used.
- Avoid large blood vessels in the ear.
- Punch blade is very sharp. Use an old piece of radio collar belt or folded paper placed on the back of the ear to protect your fingers.
- Transfer each ear biopsy into the **SMALLER PAPER ENVELOPE** provided in the kit.
- Record the number of biopsies collected.
- Air dry (in envelope) at room temperature.
- Ensure biopsy sample envelope is labelled with: WLH ID, herd, species, body site of collection, and date.
- Store skin biopsies at room temperature, protected from heat, light, and moisture.
- **DO NOT FREEZE SKIN BIOPSIES.**
- Dispose of used punches in a crush proof, puncture proof sharps container.

Hair

- **PLUCK** hair from the **TOP OF THE SHOULDER** (yellow arrow) where skin is as dry and as free of contaminants (blood, dirt etc.) as possible.
- Use needle nose pliers, hemostats or a Leatherman to obtain undamaged, intact hairs with roots.
- Place hair (more is better) in the **LARGE PAPER ENVELOPE** provided. **ENSURE ENVELOPE IS WELL FILLED**



- Ensure hair samples are dry before long-term storage.
- Wet or damp hair samples should be gently blotted (not wiped) with paper towel immediately on return from the field then air dried before transferring to a new envelope for long-term storage.
- Air dry wet or damp hair samples out of direct sunlight and protected from heat (i.e. NOT near a wood stove, hot windowsill, on a truck dashboard etc.).
- Ensure hair samples are labelled with: WLH ID, herd, species, body site of collection, and date. Also note on labels if samples were collected from wet or dirty animals.
- For long-term storage keep caribou hair samples at room temperature in a dry, white, paper envelope protected from heat, light, and moisture.
- Silica desiccant can be kept in the same general storage container (i.e. if storing many envelopes containing hair in a larger Rubbermaid etc.).
- **DO NOT FREEZE HAIR SAMPLES.**



Feces

- Using the glove provided, collect a “palm full” of fecal pellets per rectum (or from the ground/snow).
- If collecting from the rectum, be careful to prevent tissue damage.
- Place pellets in the Whirl-pak (**NO ZIPLOCS**) provided, remove as much air as possible and avoid crushing pellets.
- Fold the tabs, sealing the bag and store the fecal sample frozen (minimum -20 °C).
- **AVOID FREEZING/THAWING.**

External Parasites

- Collect a sample of any external parasites (e.g. different life stages if present) if noted.
- **10+ winter ticks should be collected from any infested caribou.**
- In the field, ectoparasites can be temporarily placed in any small container if well sealed.
- Back at the lab, transfer specimens into cryovial(s) or screw-top specimen containers with 70% ETOH (Ratio of 10 parts ethanol:1-part parasite).
- Label containers with WLH ID, herd, species, parasite type, body location recovered, and date.
- Store 70% ETOH at room temperature, protected from heat and light.

Pictures

- Take a clear picture of the incisors of all caribou (see section 3.0). **This is a high priority sample.**
- If time permits, take a profile picture (head to rump) of each. This is a lower priority unless the animal is in poor condition, has hair loss, or is otherwise abnormal.
- If time permits, take a picture of the head of each caribou to assess antler development. Lower priority unless antler development is abnormal.

Basic Health Assessment

- A basic health assessment should be performed during sampling and handling (collaring, tagging, sampling etc.).
- The health assessment includes checking teeth, ears, hair coat, skin, eyes, nostrils, hooves, evidence of diarrhea/fecal staining, nasal or ocular discharge, swollen joints, traumatic injuries or other abnormalities and recording them on each live captured caribou.
- **Take pictures of any caribou in poor condition, with hair loss, or of any other abnormalities.**
- **When taking pictures of abnormalities include a wide frame picture showing the entire animal and close-up views (multiple angles) with scale (e.g. a Leatherman, needle cap, etc. placed in frame).**

Capture Related Mortalities

- **If a caribou is accidentally killed or dies during capture operations the carcass should be slung out for a full necropsy and health assessment by a project veterinarian (HIGH PRIORITY).**
- If this is logistically impossible, a complete necropsy must be performed, and samples collected in the field following guidelines outlined in the BC Caribou Necropsy Protocol.

**FOR HEALTH-RELATED QUESTIONS DURING CARIBOU CAPTURE OPERATIONS
OR
FOR ANY QUESTIONS RELATED TO CARIBOU SAMPLE COLLECTION, HANDLING, PROCESSING, AND STORAGE
CONTACT**

s.15; s.19

Sample Shipping Instructions

ALL SAMPLES MUST BE RETURNED TO:

Wildlife Health Program

Attention: ^{s.15; s.19}

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

^{s.15; s.19}

This includes sample kits that are not used this season. Please do not keep unused kits for “extra” sampling supplies. Return unused kits so that we can keep track of WLH IDs.

- Frozen samples MUST remain frozen during transport or their use is compromised.
- Appropriate insulated shipping containers and icepacks and can be purchased at low cost from ULINE.ca or contact the Wildlife Health Program.
- **Please notify** the Wildlife Health Lab in Nanaimo **BEFORE** samples are shipped
^{s.15; s.19}
- **Try to ship samples on Monday or Tuesday, never past Wednesday.**

Shipping Checklist

- Copy of 1 x completed caribou capture form
- Serum in multiple cryovials from 4 x gold top tubes. **FROZEN**
- 1 x empty/spun gold top tube (re-capped) with clot. **FROZEN**
- Plasma in multiple cryovials from 1 x purple top tube. **FROZEN**
- Buffy coat in 1 SEPARATE cryovial from 1 x purple top tube. **FROZEN**
- Serum in two cryovials from 1 x royal blue top tube. **FROZEN**
- DNA/RNA blood collection tube. **ROOM TEMPERATURE**
- 1 x whirl-pack with fecal pellets. **FROZEN**
- 1 x small envelope with skin biopsy or biopsies (if multiple ear tags applied). **ROOM TEMPERATURE, DO NOT FREEZE**
- 1 x large envelope with plucked hair from shoulder. **ROOM TEMPERATURE, DO NOT FREEZE**
- Parasites in cryovial(s) or similar if collected. **70% ETOH, ROOM TEMPERATURE, DO NOT FREEZE**

British Columbia Wolf Health Assessment and Sampling Protocols

General Considerations

Any animal capture creates risk so animal welfare is critical at all stages of animal capture and sampling. Minimizing hazing time (of groups and individuals), limiting the duration of intense pursuit (< 2 minutes), restricting capture to cooler weather (e.g. $\leq -10^{\circ}\text{C}$), and quick and efficient handling (< 15 minutes) are key to reducing the risk of injury or complications such as capture myopathy, even in wolves.

Recommendations for Time/Temperature Cut-offs and Sampling Priority

The collection of a complete set of biological samples from each live-captured animal is an obligation, a high priority research need, and protocols have been designed to balance this need with animal welfare.

An experienced capture/handling team can collar, tag, collect all samples, and perform a basic health assessment on a properly restrained animal in ≤ 15 minutes. However, capture teams must be able to recognize signs of distress in captured animals and immobilized animals. If distress occurs, partial sampling or immediate release may be required. Body temperature, animal behaviour, and handling time should be used to guide decision making (See Table 1).

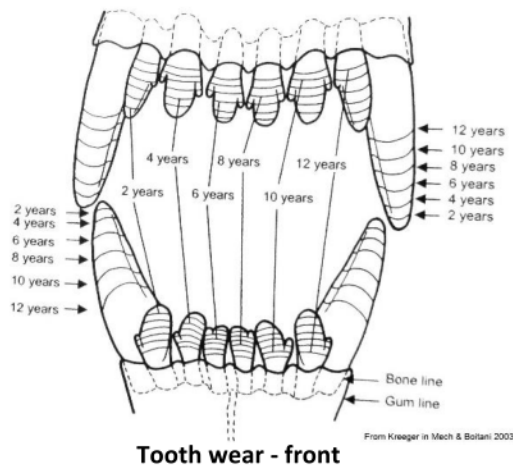
Table 1. Decision Matrix for Sampling Wolves

Rectal Temperature	Recommended Sampling Strategy	Recommended Handling Time
$\leq 41^{\circ}\text{C}/105.8^{\circ}\text{F}$	Full collar/ear tag and sample collection protocol	Aim ≤ 15 minutes
$41-41.5^{\circ}\text{C}/105.8-106.7^{\circ}\text{F}$	Collar/ear tag and collect blood and hair only	Do not exceed 10 minutes
$> 41.5^{\circ}\text{C}/106.7^{\circ}\text{F}$	Collar/ear tag and collect hair only	Release immediately

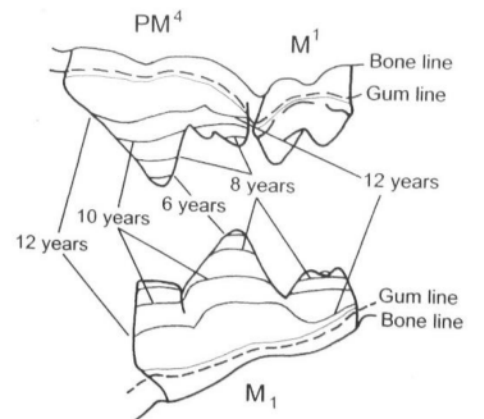
- **Ensure you wear disposable gloves when handling wolves.** *Echinococcus granulosus* is a zoonotic tapeworm that can cause severe disease. The eggs are transmitted through wolf feces so be aware.
- Depending on restraint method the animal may require muzzling. A dog muzzle is far more humane than duct tape to prevent biting and is easier to remove and apply.
- Using a blindfold will protect the eyes and reduce stress.
- Take the rectal temperature immediately after the wolf is either physically restrained or chemically immobilized.
- If not immobilized, excessive struggling may increase body temperature and lead to modifying sampling.
- To increase handling efficiency, the role of each team member should be clearly defined prior to capture and the most experienced team member should take blood when handling times are limited.

Estimating Age

AGE CLASS	PATTERN OF TOOTH WEAR	FIELD AGE
Pup	All deciduous teeth; delicate, white teeth have little wear.	< 1Year
Yearling	Most adult teeth erupted; after 6 - 8 months permanent canine teeth are present, white with little or no wear.	1 Year
Adult	All teeth are showing wear and staining. There may be some damage so examine all teeth in mouth.	2-6 Years
Aged	All teeth are worn, possibly to the gumline and may be heavily stained, damaged or missing. Wolves very rarely live this long.	7+ Years

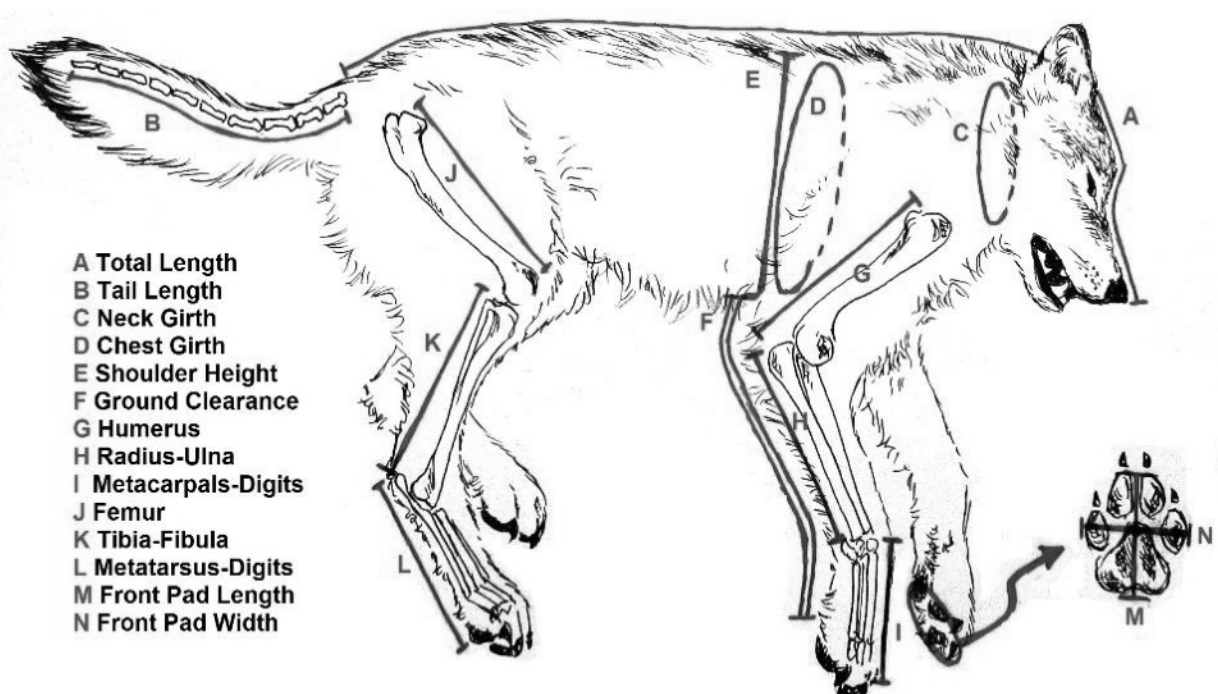


Tooth wear - front



Tooth wear - rear

Morphometrics measurements



Assessment of Body Condition

Evaluate the body condition of each animal using overall appearance and loin profile.



EMACIATED



POOR



FAIR



GOOD +

Sample Collection Protocols

Each sampling kit contains:

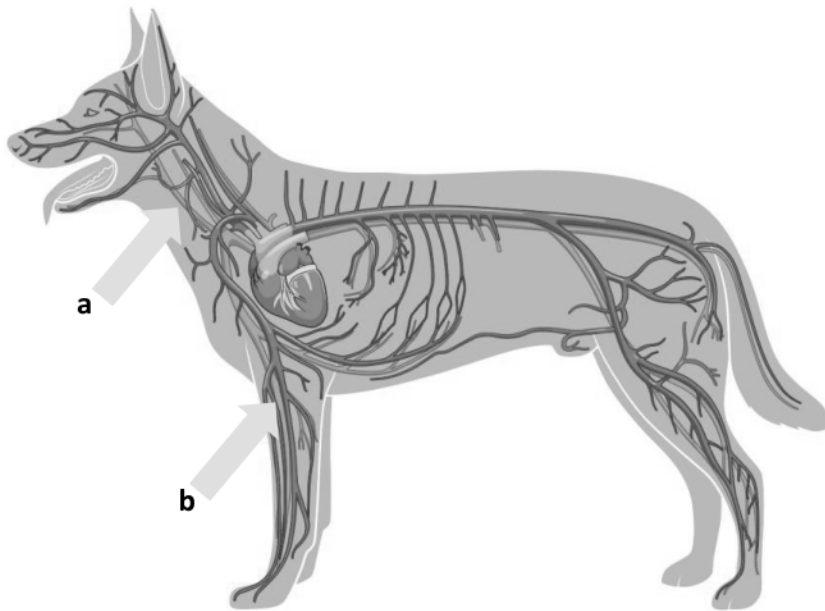
- 2 x 5.0 ml Gold top (SST) collection tubes - for serum
- 2 x 20 G 0.75 inch, plastic hub needles
- 1 x 10 ml syringe
- 1 x small coin envelope for biopsy punch
- 1 x small coin envelope for hair
- 1 x disposable 6 mm biopsy punch - can use for both ears in same animal

Sample Collection

To increase handling and sampling efficiency, the role of each team member should be clearly defined prior to capture.

Blood Collection

- **Blood is the most important sample to collect from each animal.**
- **Training and experience are required to collect blood. The most experienced team member should oversee blood collection by new staff and should take blood when handling times are limited.**
- The quality of data obtained from blood samples will be compromised by improper collection, handling, processing, and storage. Please ensure blood protocols are followed.
- Head control and proper positioning (head and neck not bent or twisted) are especially important if taking blood samples from the jugular vein. Other veins may also be used for blood collection (see below).
- Each kit has all supplies and blood tubes for completing the collection.
- Ensure the blood collection tubes are at 18-25 °C prior to use. **NOTE:** all blood tubes should be kept at this temperature to avoid temperature shock to the blood cells. If the tubes are removed from the sample bag and placed in your pocket prior to sampling temperature shock can be avoided.
- Blood is collected using a needle and syringe at **EITHER:** a) jugular vein or b) the cephalic vein (front leg).

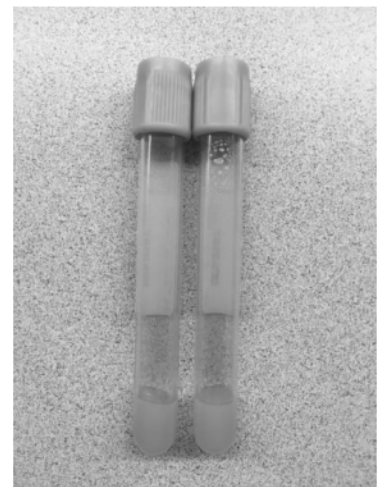


Location for blood sampling from the a) jugular vein or b) cephalic vein (blue lines).

- The vein must be held off by a hand on the neck or tourniquet on the leg to build up pressure and locate the vein.
- Hold the needle with the bevel up and insert carefully beside or above the vein and puncture the vein. Once the vein is punctured blood is seen in the needle hub and the blood can then be pulled into the syringe. Slowly pull past the 10 ml mark to ensure that enough blood is collected to fill all tubes.
- There is an extra needle in each kit if needed. Please secure used needles in a crush proof, puncture proof sharps container and syringes without needles can be disposed of in a sealed garbage bag.

Blood Transfer to Sample Collection Tubes

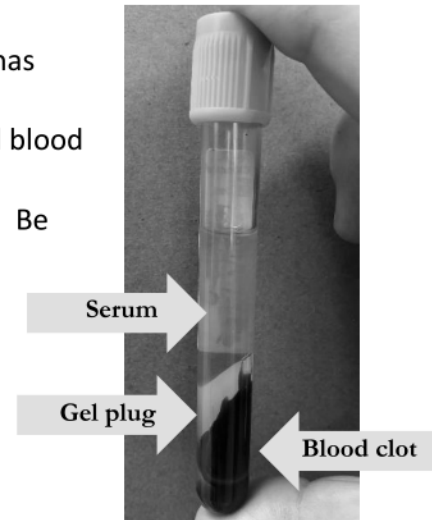
- The blood collection tubes are in the kit in a BUNDLE with an elastic band. They are under negative pressure.
- To prevent hemolysis (the rupture of red blood cells turning serum pink or red), do not squirt/force blood into collection tubes. Instead, once the syringe is full, carefully insert the needle through the end and negative pressure will passively draw the blood from the needle/syringe into the collection tube.
- If the vacuum has been compromised, blood can be gently and slowly injected along the sides of the tube.
- **ONCE FILLED, HANDLE BLOOD TUBES WITH CARE: PLACE UPRIGHT IN A COOLER IN THE HELICOPTER, PROTECT FROM SHAKING, ROUGH HANDLING, DIRECT SUNLIGHT, FREEZING, AND HEAT.**



Post Field Processing and Storage

Gold Top (SST) Serum Tubes

- Once back from the field, centrifuge gold top tubes for 15 minutes after blood has clotted and within 12 hours of collection.
- After centrifuging, serum (clear, yellowish liquid) will be separated from clotted blood by the gel plug.
- If the gel does not separate the serum from the blood clot, you need to re-spin. Be sure to balance the blood tubes, (i.e. the same volume of blood in paired tubes in the centrifuge).
- *****Freeze the *SPUN* gold tops (minimum -20 °C) and ship to Nanaimo for sub-sampling. Do not decant the serum into cryovials, we will do that at the lab.**
- Freeze/thaw can degrade serum samples and is required for sub sampling if larger cryovials are used. To minimize freeze/thaw cycles, the WLH staff will sub-sample the serum from the gold tops once received in Nanaimo.
- Ensure the gold tops are still labelled with the correct WLH ID and species.



Skin Biopsy

- Use the 6 mm biopsy punch to collect skin sample for DNA archive.
- Avoid large blood vessels in the ear, use a site near the centre of the ear flap and close to the head.
- The punch blade is very sharp. Use an old piece of radio collar belt or folded paper placed on the back of the ear to protect your fingers.
- Transfer each ear biopsy into the **PAPER ENVELOPE** provided in the kit.
- Record the number of biopsies collected.
- Air dry (in envelope) **at room temperature**, do not store in plastic bags. If very wet, use a new envelope
- Biopsy sample envelope is labelled with: WLH ID, study area, species, body site of collection, and date.
- Store skin biopsies at room temperature, protected from heat, light, and moisture.
- **DO NOT FREEZE SKIN BIOPSIES.**
- Dispose of used punches in a crush proof, puncture proof sharps container.

Hair

- **PLUCK** hair from the **TOP OF THE SHOULDER** where skin is as dry and as free of contaminants (blood, dirt etc.) as possible.
- Use needle nose pliers, hemostats or a Leatherman to obtain undamaged, intact hairs with roots.
- Place hair (more is better) in the small paper envelope provided.
- Ensure hair samples are dry before long-term storage.
- Wet or damp hair samples should be gently blotted (not wiped) with paper towel immediately on return from the field then air dried before transferring to a new envelope for long-term storage.

- Air dry wet or damp hair samples out of direct sunlight and protected from heat (i.e. NOT near a wood stove, hot windowsill, on a truck dashboard etc.).
- Hair samples are labelled with: WLH ID, study area, species, and date. Also note on labels if samples were collected from wet or dirty animals.
- For long-term storage keep hair samples at room temperature in a dry, white, paper envelope protected from heat, light, and moisture.
- Silica desiccant can be kept in the same general storage container (i.e. if storing many envelopes containing hair in a larger Rubbermaid etc.).
- **DO NOT FREEZE HAIR SAMPLES.**

External Parasites OR Other Abnormalities

- Take photos.
- Collect a sample of any external parasites (e.g. different life stages if present) if noted and collect other samples according to what you see – take notes.
- In the field, ectoparasites can be temporarily placed in any small container if well sealed.
- Back at the lab, transfer unusual or unidentified specimens into cryovial(s) or screw-top specimen containers with 70% ETOH (Ratio of 10 parts ethanol:1-part parasite).
- Engorged ticks should NOT be stored in ethanol.
- Label containers with WLH ID, study area, species, parasite type, body location recovered, and date.
- Store all vials at room temperature, protected from heat and light.

**FOR HEALTH-RELATED QUESTIONS DURING CAPTURE OPERATIONS
OR
FOR ANY QUESTIONS RELATED TO SAMPLE COLLECTION, HANDLING, PROCESSING, AND STORAGE
CONTACT**

s.15; s.19

Sample Shipping Instructions

ALL SAMPLES MUST BE RETURNED TO:

Wildlife Health Program

Attention: s.15; s.19

Ministry of Forests, Lands, Natural Resource Operations and Rural Development

s.15; s.19

This includes sample kits that are not used this season. Please do not keep unused kits for “extra” sampling supplies. Return unused kits so that we can keep track of WLH IDs.

- Frozen samples **MUST** remain frozen during transport or their use is compromised.
- Appropriate insulated shipping containers and icepacks and can be purchased at low cost from ULINE.ca or contact the Wildlife Health Program.
- **Please notify** the Wildlife Health Lab in Nanaimo **BEFORE** samples are shipped
s.15; s.19

- **Try to ship samples on Monday or Tuesday, never past Wednesday.**

Shipping Checklist

- Copy of completed capture form
- 2 x spun gold top tubes with serum separated by the gel plug. **FROZEN**
- 1 x small envelope with skin biopsy. **ROOM TEMPERATURE, DO NOT FREEZE**
- 1 x small envelope with plucked hair from shoulder. **ROOM TEMPERATURE, DO NOT FREEZE**
- Parasites in cryovial(s) or similar if collected. **EMPTY vial or 70% ETOH, ROOM TEMPERATURE, DO NOT FREEZE**

RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>, s.15; s.19
FLNR:EX s.15; s.19 ;@gov.bc.ca>, s.15; s.19 FLNR:EX
s.15; s.19 ;@gov.bc.ca>

Sent: January 12, 2022 10:20:22 AM PST

Received: January 12, 2022 10:20:23 AM PST

Hello,

This ACA has been reviewed and is approved.

Thank you,

s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: January 12, 2022 10:00 AM
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>;
s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Hi s.15; s.19, when you have a chance would you be able to approve the attached ACA. Front counter needs the approval to proceed with s.15; s.19 Permit.

Thanks!

s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: January 10, 2022 9:32 AM
To: s.15; s.19 FLNR:EX s.15; s.19 ;@gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Thank you s.15; s.19 for taking the lead on the animal care form and s.15; s.19 thank you for your review and additions! Good to know about Rangifer being one of the possibly susceptible species to COVID-19.

Cheers,

s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: January 10, 2022 9:20 AM
To: s.15; s.19 FLNR:EX s.15; s.19 ;@gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Thanks s.15; s.19 I have added your suggested text to the Method of Handling Section *For caribou*.

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: January 7, 2022 4:01 PM
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Hi s.15; s.19

One thing to add, sorry. Rangifer have been listed as one of the potentially susceptible species for SARS-CoV-2 as they have the receptor genes. Can you please add a section on measures to reduce the transmission of Covid-19 from humans to wildlife. E.g All personnel handling caribou will be symptom-free, and fully-vaccinated or receive a negative test for SARS-CoV-2 within 48 hours of starting the capture session. I've already spoken to s.15; s.19 about this, so it won't be a surprise.

Thanks!

s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: January 7, 2022 3:49 PM
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Hi s.15; s.19

s.15; s.19 were successful again this year for predator reduction and caribou collaring in the Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands study areas.

At your earliest convenience, please review and approve the ACA attached. Note, since the last version I have just entered in the pilot(s) and capture crew names and information.

Thanks for your time,
s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: December 8, 2021 9:30 AM
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Ilghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Hi s.15; s.19

The ACA looks good, no other changes to the methods required. I can't approve it without the personnel listed, so as soon as you know who it will be please insert the names and previous experience.

Thanks,
s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: December 6, 2021 3:30 PM
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>

Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX <s.15; s.19 @gov.bc.ca>
Subject: RE: FOR REVIEW: Tweedsmuir-Entiako, Itcha Illghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Thanks for the quick reply and suggestions s.15; s.19. I have replaced "euthanize" with humanely removed. Please see the updated version attached.

Kind regards,

s.15; s.19

From: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Sent: December 6, 2021 1:55 PM
To: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Cc: s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>; s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca>
Subject: Re: FOR REVIEW: Tweedsmuir-Entiako, Itcha Illghuz and Quesnel Highlands wolf reduction and caribou/wolf collaring ACA

Hi s.15; s.19

Sure thing. Send it my way. FYI, I've reviewed several already this year and one comment has to been to replace the word 'euthanasia' with 'humane removal', 'dispatch', etc..

Thanks,

s.15; s.19

Sent from my iPhone

On Dec 6, 2021, at 1:47 PM, s.15; s.19 FLNR:EX s.15; s.19 @gov.bc.ca> wrote:

Hi s.15; s.19

s.15; s.19 and I are getting our contracts ready for Predator Reduction and caribou and wolf captures in Tweedsmuir, Itcha-Illghuz and Quesnel Highlands (Barkerville herd). The contractor will be in place early January (RFP will be sent out to s.15; s.19 December 8th). In preparation for capture/ reduction work to start in mid-late January would you be able to review our ACA? It is pretty much the same as last year except for updating collar numbers per species/region.

Thank you for your time!

s.15; s.19

Forests, Lands, Natural Resource Operations and Rural Development
s.15; s.19

DATE	PERSONNEL	WOLVES REMOVED	Year total	WOLVES COLLARED	PACK	REMAINING PACK SIZE ESTIMATE	UPDATED PACK REMAINING	LATS. (decimal degrees)	LONGS (decimal degrees)	COLLAR SERIAL #	COLLAR FREQUENCY	SEX	COLOUR	AGE ESTIMATE	SIZE	SAMPLES TAKEN?	WILDLIFE HEALTH ID#
Feb 6,20	S.15, S.19			1	Chief Louis	>3		S.15		42196	S.15	M	Black	2	60 lbs	Yes	19-1482
Feb 6,20		1	1		Chief Louis	>3							Gray	adult	90	no	
Feb 6,20				1	Marilla	>3				42178		F	Gray	1 year	60 lbs	yes	19-1481
Feb 7,20		1	2		Oosta'	0						M	Gray	02-Jan	90		
Feb 8,20		2	4		Marilla	2						n/a	Gray	unknown	unknown	no	n/a
Feb 8,20		2	6		Chief Louis	04-Jan						n/a	Gray	unknown	unknown	no	n/a
Feb 9,20				1	Sigutlat	6				42186		F	Black	Adult	small	yes	19-1483
Feb 9,20		3	9		Sigutlat	3						n/a	Gray Black Black	unknown		no	n/a
11-Feb-20				1	E . Francois	7	4			42190		unknown	gray	1year	medium	yes	19-1484
11-Feb-20		3	12		E . Francois	4	4					unknown	Gray Gray Black	unknown	adult	no	n/a
11-Feb-20		1	13		Marilla	1						unknown	gray	unknown	adult	no	n/a
12-Feb-20		1	14		Sigutlat	2						unknown	Gray	unknown	adult	no	n/a
12-Feb-20				1	Nadina	3				42191		Male	Gray	2 years	adult	yes	19-1480
12-Feb-20		2	16		Nadina	3						unknown	Gray Black	Old young		no	n/a
12-Feb-20				1	Entiako	unknown				42195		Female	Gray	young	75lbs	yes	19-1485
13-Feb-20		3	19		Nadina	1						unknown	gray gray gray	unknown		no	n/a
16-Feb-20		9	28		Cheslaslie	0						unknown	all gray	unknown		no	n/a
19-Feb-20		1	29		Sigutlat	1						unknown	black	unknown		no	n/a
29-Feb-20		1	30		Tsetzi	1						unknown	gray	unknown	adult	no	n/a
01-Mar-20		2	32		Marilla							unknown	Gray Black	unknown	adult	no	n/a
01-Mar-20		1	33		Chief Louis							unknown	Black/Brn	unknown	adult	no	n/a
04-Mar-20		1	34		Cpt Harry	1						unknown	Gray	unknown	adult	n	n/a
04-Mar-20				1	Cpt Harry	1				42187		Female	BLUE GRAY BLACK		5 adult	YES	19-1479
06-Mar020		4	38		Tahasta	1							Gray Gray Black Black	unknown	adults	no	n/a
06-Mar020				1	Tahasta	1				81199		Male	Black	2 years	adult	yes	19-1478
06-Mar020		1	39		Cheslaslie	0						Female	Gray	unknown	adult	no	n/a
07-Mar-20		2	41		West Tetachuck	0						male	gray	5 years			
08-Mar		2	43		Cheslaslie	0						femal	gray	4 years	adult	yes	
09-Mar-20				1	Tat elkuz	5				81194		unknown	gray	unknown	adult	no	n/a
09-Mar-20		2	45		Chedakuz	0						female	gray	yearling	small	yes	19-1477
12-Mar-20		2	47		Tat elkuz	3						unknown	gray black	unknown	adult	no	n/a
12-Mar-20		3	50		W Nadina	1						unknown	gray Black Black	unknown	adult	no	n/a
14-Mar-20		1	51		Blackwater	0						unknown	Black Black Black	unknown	adult	no	n/a
15-Mar-20		3	54		W. Cheslatta	0						unknown	Gray	unknown	adult	no	n/a

DATE	PERSONNEL	WOLVES REMOVED	ID	Year total	WOLVES COLLARED	PACK	REMAINING PACK SIZE ESTIMATE	UPDATED PACK REMAINING	LATS. (decimal degrees)	LONGS (decimal degrees)	COLLAR SERIAL #	COLLAR FREQUENCY	SEX	COLOUR	AGE ESTIMATE	SIZE	SAMPLES TAKEN?	WILDLIFE HEALTH ID#
Feb 22/21	s.15; s.19			0	1	Chelaslie	0		s.15; s.19		45398	s.15	Male	gray	2	avg	y	s.15;
Feb 22/21		1		1	0	Tsacha Lk	0											s.15
Feb 22/21		1	TWR-2021-01	2	0	Tsacha Lk	0											
Feb 22/21		1		3	0	Tsacha Lk	0											
Feb 22/21		1		4	0	Tsacha Lk	0											
Feb 22/21		1	TWR-2021-02	5	0	Tsacha Lk	0											
Feb 22/21		1		6	0	Intata	0?											s.15
Feb 22/21		1		7	0	Intata	0?											
Feb 22/21		1		8	0	Intata	0?											
Feb 22/21					1	Chelaslie	0				45399		Female	gray	6	avg recollar	y	s.15;
Feb 22/21		1				Chelaslie	0											-10
Feb 23/21		0		9	1	Dean River	6?				45401		Male	gray	3	huge	y	s.15
Feb 23/21		1		10	0	Johnny Lk	0	2										
Feb 23/21		1		11		Johnny Lk	0	2										
Feb 23/21		1		12		Johnny Lk	0	2										
Feb 24/21		0		12	0	NA	.											
Feb 25/21		1		13	0	West Ootsa	1											
Feb 25/21		1		14		West Ootsa												
Feb 26/21		0		14	0													
Feb 27/21		0		14	0													
Feb 28/21		1		15	0	Dean River	5							gray	2	yearling		
Mar 01/21		0		15	0													
Mar 02/21		0		15	0													
Mar 03/21		0		15	1	Ootsa / Andrews Bay	0	0			45400		Male	grey	3	avg	y	20-1377
Mar 03/21		1	TWR-2021-03	16		Ootsa / Andrews Bay								black				
Mar 03/21		1	TWR-2021-04	17		Ootsa / Andrews Bay								black				
Mar 03/21		1	TWR-2021-05	18		Ootsa / Andrews Bay								black				
Mar 03/21		1	TWW1019	19		Ootsa / Andrews Bay								black			y	
Mar 03/21		1		20		Ootsa / Andrews Bay								black				Had Lotek collar 81202
Mar 03/21		1		21		Ootsa / Andrews Bay								gray				
Mar 03/21		1		22		Ootsa / Andrews Bay								gray				
Mar 03/21		1		23	0	South Francois	0							gray				
Mar 03/21		1		24		South Francois								black				
Mar 03/21		1		25		South Francois								black				
Mar 03/21		1		26		South Francois								black				
Mar 03/21		1		27		South Francois								black				
Mar 03/21		1		28		South Francois								black				
Mar 04/21					1	Tesla Lake	0				45403		Female	gray	one to two	small	y	20-1375
Mar 04/21		1		29		Tesla Lake								gray				
Mar 04/21		1	TWR-2021-06	30		Tesla Lake								gray				
Mar 04/21		1		31		Tesla Lake								gray				
Mar 05/21		0		31	0													
Mar 6/21		1		32		Dean River	2	incl collar						gray	pup		n	
Mar 6/21		1		33		Dean River	2	incl collar						gray	yearling		n	
Mar 6/21		1		34		Dean River	2	incl collar						gray	yearling		n	
06-Mar-21		1	TWR0-2021-07	35		Nahlouza Lake								male	black	very old	average	y, ear
06-Mar-21		1		36		Nahlouza Lake					42187		female	black	very old	average		
Mar 06/21		1		37	-1	Tesla pack	0	collar retrieved			45403		female	gray female	collared 04 Mar 2021	small	when collar	20-1375
Mar 07/21		1		38	-1	Tsacha Lk	0	retrieved collar			42196		female	black female		avg	when collared, yes	
Mar 08/21		1	TWR-2021-08	39	-1	Francois Lake	0	collar retrieved			42191		female	dark gray		avg	when collared, yes	

Mar 08/21	s.15; s.19	1	TWR-2021-09	40		Francois Lake			s.15; s.19		s.15						
Mar 08/21		1	TWR-2021-10	41		Francois Lake											
Mar 09/21		0		41	0												
Mar 28/21		1	42	1	Lucas Lake	4?	4 + 1 collar			15403		male	bluish	3	avg	yes	20-1370
Mar 28/22		1	42	1	Lucas Lake	4?											
										31191							
Mar 29/21		6	48	-1	Lucas Lake	0	1 collar			reissue		female	gray	4	avg	no	
Mar 29/21		6	48	-1	Lucas Lake	0				ethanize							
Mar 29/21		6	48	-1	Lucas Lake	0				and collar							
Mar 29/21		6	48	-1	Lucas Lake	0				retrieved							
Mar 29/21		6	48	-1	Lucas Lake	0											
Mar 29/21		6	48	-1	Lucas Lake	0											
Mar 29/21		6	48	-1	Lucas Lake	0											
Mar 30/21		0	48	0													
Mar 31/21		0	48	0													

DATE	PERSON NEL	WOLVES REMOVED	YEAR TOTAL	WOLVES COLLARED	PACK	REMAININ G PACK SIZE ESTIMATE	UPDATED PACK REMAININ G	LATS. (decimal degrees)	LONGS (decimal degrees)	COLLAR SERIAL #	COLLAR FREQUENC Y	SEX	COLOUR	AGE ESTIMATE	SIZE	SAMPLES TAKEN?	WILDLIFE HEALTH ID#
26-Jan-22	S.15;	0	0	0				S.15; S.19		S.15							
27-Jan-22	S.19	0	0	0													
28-Jan-22		0	0	0													
29-Jan-22		7	7	1	Whitesail	0	1 black female collared			81234		f	black	small	avg	yes	21-2066
30-Jan-22		0	7	0													
31-Jan-22		0	7	0													
01-Feb-22		1	8	1	Bird Lake	0				81232		m	gray	3	avg	yes	21-2068
02-Feb-22		2	10	0	Cheslasie	0	Gray collared female #45399 ethaniz ed as per KM						both gray	?	avg	from #45399, yes	
03-Feb-22		0	10	0													
04-Feb-22		4	14	0	Cow Lake	0	One of the grays ethaniz ed had old black collar. We retrieved it. No serial # info on it						3 gray 1 black	adults	avg		
05-Feb-22		0	14	0													
06-Feb-22		2	16	1	Sigutlat River	3	1 black male colored			81233		m	2 gray 1 black	yearling collared	avg	yes	21-2065
07-Feb-22		0	16	0													
08-Feb-22		0	16	0													
09-Feb-22		0	16	0													
10-Feb-22		1	17	0	Cheslatta	2						m	gray	yearling	avg	ear/hair	
11-Feb-22		0	17	0													
12-Feb-22		1	18	0	Intata	0						f	gray	2 avg	ear/hair		
13-Feb-22		0	18	0													
14-Feb-22		0	18	0													
15-Feb-22		0	18	0													
14-Mar-22		0	18	0													

s.15, s.19

15-Mar-22	s.15, s.19 10	28	0	Francois Colley	0		s.15	mix	all gray		no
15-Mar-22	2	30	0	Qualcho DD	0			1 unk and 1 male	both gray	avg xlarge	no
16-Mar-22	2	32	0	Whitesail	0	collar, plus 1	81234 removed	1 unk and 1 female	both black	small small	no
17-Mar-22	3	35	0	Nakina	3?			unk	all gray		no
18-Mar-22	1	36	0	Bird Lake	0	he had picked up one new one		unk	black		no



MINISTRY OF WATER, LAND AND RESOURCE STEWARDSHIP
&
MINISTRY OF FORESTS

STANDARD OPERATING PROCEDURES

Subject:
**Aerial-Based Live Capture and Lethal
Removal of Wolves**

AERIAL-BASED LIVE CAPTURE AND LETHAL REMOVAL OF WOLVES

INTRODUCTION

Certain work activities associated with the delivery of wildlife management initiatives (e.g., woodland caribou population recovery) may benefit from, or require, government employees (hereafter referred to as ‘Staff’) or external contractors (hereafter referred to as “Contractors”) to conduct the lethal removal of wolves (*Canis lupus*) using an aerial-based (i.e., helicopter) approach. Such activities may include the live capture of wolves for the purpose of radio-collaring, and/or shooting of wolves for lethal removal.

Aerial-based wolf reduction is deemed by the Province to be the most effective and humane method of removing wolves from remote, expansive landscapes for the purpose of eliciting positive population responses for at-risk ungulate species, such as woodland caribou. Aerial-based wolf reduction facilitates the removal of entire wolf packs with no risk of bycatch (i.e., incidental death of non-target species). A high level of removal intensity is required over large geographical areas to reduce wolf densities below the necessary thresholds to support population recovery for caribou – this can be achieved through aerial-based shooting. At this time, ground-based methods (i.e., trapping or shooting) of removing wolves have not been effective at eliciting positive population responses in at-risk species like caribou, and there is uncertainty surrounding the humaneness and inherent risks of bycatch that can occur through ground-based methods.

Standard Operating Procedures (SOPs) are necessary to ensure that the activities are conducted by standardized and acceptable methods, and that all measures are taken to achieve high standards for animal handling and humane killing. The focus of this document is towards the use of appropriate equipment, animal care and handling techniques, and shooting techniques to maximize humane killing.

PREPARED BY		AUTHORIZATION	
NAME	Name	NAME	SIGNATURE
Michael Bridger	Dr. Caeley Thacker	Michael Burwash	
POSITION	Position	POSITION	
Wildlife Specialist	Provincial Wildlife Veterinarian	Associate Director – Wildlife	
			DATE EFFECTIVE
			December 16, 2022

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For examples of practices and procedures specific to human safety considerations, please refer to the Northeast Region Safe Work Practices (SWPs) and SOPs for aerial net-gunning capture of wildlife and aerial firearm use for wildlife management (<https://intranet.gov.bc.ca/flnrord/tools/safety/branch-local-office-safety/north-east>).

DEFINITIONS

- **Contractor** – Non-government personnel or a company hired by the Province of British Columbia (BC) to carry out wolf reduction activities under contract and permit
- **Crew** – All personnel onboard a helicopter (including pilot) partaking in the work outlined in the Standard Operating Procedures
- **Dart gun** – Uses gas or a gunpowder charge to propel a dart containing a chemical immobilizer for the purpose of live wildlife capture
- **Firearm** – Rifles or shotguns of appropriate make, model, and calibre identified for the work outlined in the Standard Operating Procedures
- **Humane Killing**: Killing performed in a manner that minimizes animal distress but may not meet the requirements of euthanasia due to situational constraints (AVMA 2020)
- **Net gun** – A projector used to fire a net over top of wildlife from a helicopter for the purpose of physical restraint for live capture
- **Observer or Handler** – Those Staff or Contractors that have been approved by a Regional Manager to participate as passengers during live capture and shooting of wolves, but not actively engaged in the shooting of net guns, dart guns, or firearms
- **Project Lead** – A BC government employee who oversees a wolf reduction project
- **Shooter** – Those Staff or Contractors that have been approved by a Regional Manager, situated in the rear of the helicopter behind the pilot who are responsible for the operation of the firearm(s), net gun(s), and/or dart gun(s)
- **Staff** – BC government employees
- **Wolf Reduction** – The lethal removal (via aerial shooting) of wolves in pre-determined treatment areas to reduce overall wolf densities as deemed necessary for certain wildlife management activities (e.g., caribou population recovery)

SCOPE AND PURPOSE

The SOPs apply to the Staff or Contractors involved in helicopter flights where the live capture and/or humane killing of wolves occurs to support certain wildlife management activities. The procedures within this SOP apply to all parties involved in aerial wolf reduction activities. Contractors are expected to follow the procedures outlined in this document; however, the Contractors are expected to follow their company SOPs or SWPs regarding crew safety considerations. Crew safety is out of scope of this SOP – Staff should refer to provincial or regional SOPs and SWPs specific to the human-safety aspects of aerial-based wildlife capture and aerial-based shooting for the purpose of lethal wildlife removal.

The purpose of this SOP is to provide specific step-by-step direction regarding equipment selection, live animal handling techniques, and lethal shooting techniques and considerations. The SOP aims to maximize animal care during live capture and handling and minimize distress for animals that are humanely killed.

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These standard operating procedures have been reviewed and endorsed by the BC Provincial Wildlife Veterinarian and will continue to be adapted and amended, as necessary.

PROCEDURES

A. EQUIPMENT: FIREARMS, NET-GUNNING, CHEMICAL IMMOBILIZATION, AND SAMPLING

- Firearms – for the lethal removal of wolves
 - Properly functioning firearm(s) of adequate make, model, and calibre must be on board each helicopter
 - Centrefire Rifles:
 - Minimum caliber of .223 or greater
 - Factory-loaded ammunition, high-velocity, with rapid expansion lead-core bullets, or rapid expansion solid copper bullets
 - Expanding copper bullets are currently limited in availability for many rifle calibers, but should be sought out as a preferred option if available
 - Rifles must be equipped semi-automatic actions and detachable magazines for quick follow-up shots and rapid reloading
 - A scope with low magnification or no magnification must be used – scopes with crosshairs or scopes with illuminated red dots are acceptable
 - Shotguns:
 - Should be considered a secondary option relative to a rifle, primarily due to their lower range of effectiveness
 - 10 or 12 gauge
 - Ammunition must be double-aught (00) or triple-aught (000) buckshot
 - Used only at close range (<30 m)
 - Preference for shotguns with semi-automatic actions and detachable magazines for quick follow-up shots and rapid reloading
 - A scope with low magnification or no magnification must be used – scopes with crosshairs or scopes with illuminated red dots are preferable
- Net-Gunning Capture Equipment (for live capture of wolves to facilitate radio-collaring)
 - Two netguns per helicopter (to enable quick follow-up shots)
 - Recommend at least four nets and canisters per helicopter
 - 12' x 12' nets are the recommended size for wolves
 - Blank ammunition of appropriate caliber for netgun
 - Hobbles, blindfold, Y-pole (or equivalent), and catchpole (aka. snare pole) for restraining wolves
- Chemical Immobilization (for live capture of wolves to facilitate radio-collaring)
 - Dart gun – CO₂ or gunpowder propelled
 - Appropriate darts (e.g., Pseudart, Daninject) suitable for delivering 2–3 mL of solution
 - Appropriate sedative/anesthetic – typically^{s.15} approx. 6–10 mg/kg
dosage

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- Consideration for other drugs or new drugs must be discussed with the Provincial Wildlife Veterinarian prior to use
 - Reversal drugs, if available for the anesthetic that was used
 - Syringes and needles
 - Pole syringe (if combining net-gunning and chemical immobilization)
 - Blindfold
 - Eye lubricant
 - Body blanket or mat
 - Scalpel blade for dart excision
 - Sterile saline solution
 - Antibiotic ointment for wound management
 - Thermometer
 - Ear tag pliers
 - Portable pulse oximeter
 - Oxygen and oxygen delivery equipment
- Biological Sampling and Radio-Collaring of Live Wolves
 - 6 mm biopsy punch
 - Envelope for biopsy sample collection
 - Envelope for hair sample collection
 - Ear tag and ear tag applicator (optional for net-gun captures; required for chemical immobilization)
 - Blood collection tubes, needles, and syringe
 - Flexible measuring tape
 - Radio collar – <4% of animal's body weight
 - Associated radio collar hardware (i.e., extra nuts and plates, nut driver, knife, etc.)

B. REQUIREMENTS AND APPROVALS FOR PERSONNEL (SHOOTERS/HANDLERS, ETC.)

- Candidate Staff identified to participate in animal handling, net-gunning, darting, and/or shooting must meet the minimum requirements outlined in applicable regional or provincial Safe Work Practices, or similar documents
- All Contractors involved in animal handling, net-gunning, darting, and/or shooting must meet the minimum requirements outlined in Government contract procurement processes, and must meet their company's minimum requirements, as applicable
- All personnel involved in wolf reduction activities must be identified on Animal Care Applications and be approved by the Provincial Wildlife Veterinarian prior to being added to a Wildlife Act permit for decision by a Regional Manager
- All personnel identified on the Wildlife Act permits to conduct wolf reduction activities must be deemed to have sufficient skillset, training, and experience by a Regional Manager responsible for issuing Wildlife Act permits
 - 4-7-04.13.07 Evaluating Sufficient Skill Under the Permit Regulation (2021)

C. PILOT REQUIREMENTS AND HELICOPTER CONSIDERATIONS

- Helicopter pilots must meet or exceed the following requirements:
 - o Minimum company requirements for wildlife capture and culling flights
 - o Minimum requirements outlined in Government contract procurement processes and/or minimum requirements outlined in regional or provincial Safe Work Practices, or similar documents
 - o Identified on the Animal Care Application and approved by the Provincial Wildlife Veterinarian
 - o Deemed to have sufficient skill, training, and experience by a Regional Manager responsible for issuing Wildlife Act permits
- Suitable Light/Intermediate helicopter models appropriate for low-level flight, where the Project Lead must consider the terrain, weather conditions, elevation, etc.
 - o Appropriate models may include variations of Bell 206 (i.e., Jet Ranger, or Long Ranger), Eurocopter AS350, and Hughes-MD 500 (or variations thereof)
- Helicopter must be equipped with either a sliding or removable rear door for the Shooter's seat (which must be in the rear of the helicopter and on the same side as the pilot's seat)
- Helicopter must be equipped with voice-activated communication
- Helicopter must be equipped with standard safety equipment, including real-time flight tracking, radios, radio-telemetry equipment, emergency locator transmitter, satellite phone, first aid kit, winter survival kit, axe, fire extinguisher, and remote fueling gear (as needed)

D. LIVE CAPTURE OF WOLVES FOR THE PURPOSE OF RADIO-COLLARING

The deployment of radio-collars can be critical to the success of aerial wolf reduction programs by enabling the Crew to quickly relocate wolf packs and ensure entire pack removal occurs (if that is an objective of the program). Radio-collared wolves may be removed by the Crew prior to the end of the winter field season, at the discretion of the Project Lead. Live capture of wolves follows the general guidance outlined in the "Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians & Reptiles" (RIC 1998). The procedures outlined here also align with protocols outlined in Animal Care Applications for live capture of wolves.

Net-Gunning

The method of aerial net-gunning wolves to facilitate live capture is a commonly used technique in BC. This method poses the lowest risk of injury or mortality to wolves, however, can pose greater challenges to the Crew during the handling process. Net-gunning generally allows for quick handling and processing times and few complications for the captured wolves (relative to chemical immobilization).

The following procedures should be followed upon locating and identifying wolves for the purpose of live net-gunning capture and radio-collaring:

- Captures will take place during the winter (December–March) when cold temperatures reduce the risk of heat stress and deep snow slows wolf movement and reduces the risk of injury
- Once wolves are located, the selection of a particular individual wolf for capture is usually indiscriminate, but that may vary depending on the objectives of the study

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- When a candidate wolf has been selected near a suitable capture location, the helicopter will approach the animal and haze it into a suitable nearby opening – maintaining an appropriate flight altitude to encourage the animal to move at a relatively slow pace (e.g., walk, trot, slow run)
- A net projected from a net gun should only be used to capture a single wolf at a time
- Haze times may be extensive (15–20 minutes) as wolves tend to be difficult to push into large openings suitable for capture – wolves are generally in a standstill, walking, trotting, or on a slow run during the hazing period
- The chase time (when wolves are running at a high rate, immediately preceding an opportunity to deploy a net) should be minimized to reduce stress, overheating, and exhaustion (<2 minutes)
- Capture location will be selected to minimize risks to the crew and animal (i.e., avoiding open water, avalanche terrain, thin ice, wooded areas, steep terrain, etc.)
 - o Suitable locations may include frozen lakes and rivers, meadows, clearcuts, linear features, preferably with deep snow to slow wolf mobility and cushion any impacts from net entanglement
- Once the wolf is hazed/chased into a suitable opening for capture, upon close approach (within 5–10 m) with the helicopter, the Shooter will fire a net (preferably 12' x 12') over top of the wolf
 - o A second, follow-up net may be deployed to further entangle the wolf, or if the wolf escapes the first net
 - o Two net-guns with four or five loaded detachable net canisters will be available to the Shooter for each capture – this provides a backup netgun and nets that can be used to reduce chase duration if the first net fails to adequately restrain the animal, or to further entangle the animal if a single net is inadequate
- Once the net is deployed the animal usually quickly trips and is wrapped up in the net, becoming entangled
- The pilot should immediately land the helicopter nearby the wolf to drop off the Shooter first (or whomever has access to the Y-pole), followed by the Handler
- The Shooter is generally the first to engage the wolf, and will use a Y-pole (or variation of a pitchfork-like tool) to pin the entangled wolf to the ground by placing the Y-pole around the neck immediately behind the head
 - o Care should be taken to avoid allowing the wolf to bite the Y-pole to reduce risk of damage to the mouth/teeth of the wolf
 - o The Shooter must apply substantial pressure to the Y-pole to keep the wolf pinned, but should be aware of potential airway and breathing issues and allow the wolf to breath freely
 - o Capture in deeper snow can provide cushioning during this process, while also limiting the mobility of the wolf
- Once the wolf is restrained with the Y-pole, the Handler will apply a catchpole snare around the mouth of the wolf and tighten it until it is securely closed
 - o Again, care should be taken to avoid allowing the wolf to bite the catchpole excessively to reduce risk of damage to the mouth/teeth of the wolf
 - o Care must also be taken when applying the snare pole to ensure the airway of the wolf is not restricted – the snare should be secured as far up the snout towards the forehead as possible to avoid sinching the snare near the nose and hence restricting airflow
- Once the catchpole snare is secured, the Crew will then apply a commercial muzzle or multiple wraps of strong tape (i.e., duct tape) to the mouth to eliminate the risk of a wolf biting any crew members
 - o Care must also be taken to ensure the muzzle or duct tape does not restrict the wolf's airway
 - o Airways should be maintained by outstretching the neck and keeping the nose dependent, and monitoring for proper breathing throughout the restraint, radio-collaring, and sampling process
- A blindfold will then be applied to reduce visual stress to the animal

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- Auditory stimuli should be minimized at this time as well, including turning off the helicopter engine, and talking quietly
- Hobbles will then be applied by securing the right front leg to the right rear leg, and the left front leg to the left rear leg
- At this point, the wolf is considered fully immobilized and safe, and can then be untangled and separated from the net(s)
- The wolf will then be positioned to minimize discomfort and complications (i.e., lateral recumbency, head slightly uphill, head and airways free from deep snow)
- The restraining process should generally take less than 2–3 minutes, at which point the radio-collaring and sampling procedures will occur (see Biological Sampling and Tagging of Live Wolves section)
- Upon completion of biological sampling and radio-collaring, the wolf can be released by following these steps:
 - Point the wolf in a safe direction away from the Crew, helicopter, or any hazards
 - The blindfold is removed, and the catchpole snare is reapplied securely high on the wolf's snout
 - The muzzle can be undone, or the tape can be gently unwrapped or carefully cut away while ensuring the catchpole snare remains securely in place
 - The Y-pole is reapplied securely behind the head of the wolf, at which point the hobbles can be removed
 - Finally, the catchpole snare is released, the Y-pole is removed, and the wolf is free to flee
- In the event of any injuries to a wolf, the crew will assess the extent of the injury and likelihood of survival without unnecessary suffering
 - The crew may consider contacting the Project Lead or the Provincial Wildlife Veterinarian for advice prior to taking action
 - If an injury is deemed to cause significant suffering or results in a significantly reduced likelihood of survival, the wolf will be euthanized by high caliber gunshot to the brain
- While mortalities of wolves during net-gunning capture are extremely rare, any mortality will be investigated and if the mortality rate exceeds 2% of captured wolves, the operation will cease, and the Provincial Wildlife Veterinarian and Project Lead will be contacted immediately

Chemical Immobilization

An alternative method to net-gunning capture is the use of chemical immobilization techniques. Chemical immobilization must be conducted by experienced personnel to reduce the risk of harm to captured wolves. This method poses additional risks to captured wolves (i.e., dart velocity and placement, drug complications, body temperature regulation, etc.), but is generally a safer method for the crew during the handling process. The same principles regarding the selection of capture locations, haze times, and chase times described in the aerial net-gunning procedures apply.

The following procedures should be followed upon locating and identifying wolves for the purpose of live capture via chemical immobilization (i.e., aerial darting):

- Upon locating a target wolf for capture and radio-collaring, considerations for capture locations, haze time, and chase time (as described above) will be followed
- The helicopter will be positioned approximately 5–10 m from the wolf, setting up the Shooter for a shot opportunity with the dart gun
 - The helicopter positioning should allow for a shot perpendicular to a large muscle mass of the wolf (i.e., hind quarter)

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- Multiple darts will be prepared ahead of time to allow for quick follow-up shots if necessary (i.e., first shot misses, or is in an ineffective location to administer the drugs)
 - o Each dart will contain the appropriate drug, as advised by the Provincial Wildlife Veterinarian – Most commonly used in BC is a mixture of ^{s.15} reconstituted with sterile water
 - o For example, 1.8 mL of sterile water per vial of ^{s.15} to yield a 227 mg/mL concentration and a dosage of 6–10 mg/kg
 - o The Crew may consider pre-mixing different dosages in different sized darts for small (< 40 kg) and large wolves (> 45 kg)
- Once a shot is taken, the crew will confirm the dart location, and the helicopter will climb in elevation and distance to observe the wolf without unnecessarily hazing or stressing the animal
 - o If the initial shot misses, the helicopter will be repositioned for a follow-up shot
 - o If the initial shot is in a poor location to effectively administer the drug, the Crew will retreat and discuss options while observing the wolf's response, and consider repositioning for a follow-up shot if the wolf does not show signs of succumbing to the drugs
- Induction time is generally under ten minutes
 - o During that time, the crew will attempt to passively haze the wolf into a good location for the wolf to safely succumb to sedation/anesthesia (i.e., away from hazards, like open water) and where the helicopter can safely land nearby
- Once the wolf has become immobilized, the helicopter will land nearby, and the Crew will assess the depth of anesthesia before approaching the wolf (i.e., observing response to sound)
 - o An additional, lesser dose may be administered by hand injection or pole syringe if the initial anesthesia is deemed to be too light
- Upon confirming satisfactory sedation/anesthesia, the Crew will commence with radio-collaring and biological sampling
- A blindfold will be applied to reduce visual stress to the animal
 - o Auditory stimuli should be minimized at this time as well, including turning off the helicopter engine, and talking quietly
- The wolf will be positioned to minimize discomfort and complications (i.e., lateral recumbency, head slightly uphill, nose dependent, head and airways free from deep snow, the use of a mat or blanket to control heat loss could be considered)
- Vital rates will be monitored during the radio-collaring and sampling process
 - o Having oxygen and oxygen delivery equipment available in case of emergency is recommended
 - o There is no reversal available for ^{s.15}
- Once radio-collaring and sampling is complete, the Crew will monitor the recovery of the wolf (from a distance) by observing movements of head and legs, and will remain present until the wolf is fully mobile
 - o Typical recovery time is approximately 30–120 minutes following administration
- Considerations for injuries or mortalities will be addressed, as described in the net-gunning and sampling procedures

Combination of Net-Gunning and Chemical Immobilization

Another option for the live capture of wolves is to use a combination of net-gunning and chemical immobilization. This approach combines the use of a net to entangle a wolf, and a chemical immobilizer to sedate/anesthetize the wolf for

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the purpose of radio-collaring and sampling. This method may reduce the risk of harm to the crew during the handling process.

The following procedures should be followed upon locating and identifying wolves for the purpose of live capture via net-gunning combined with chemical immobilization:

- The aerial net-gunning procedures, as outlined above, are followed
- Once the wolf is entangled in the net, the Shooter may administer a dart to the muscle mass of the wolf via dart gun (following the procedures outlined above for chemical immobilization)
- Alternatively, once the wolf is entangled in the net, the helicopter may land, and the Crew will engage the wolf as described in the procedures for net-gunning
- Once the wolf has been pinned with the Y-pole, a Crew member may hand inject drugs (as outlined in the chemical immobilization procedures) directly into a large muscle mass (i.e., hind quarter) of the wolf
- The Crew will continue to physically restrain the wolf via the Y-pole while entangled in the net until the wolf is anesthetized
 - o The wolf will be assessed for depth of anesthesia, as described above, and the Crew can commence with radio-collaring and sampling when sufficient anesthesia is confirmed
- Considerations for body positioning, airways, and auditory and visual stimuli will be addressed, as described above
- Upon completion of radio-collaring and sampling, the Crew will follow the same procedures described above for assessing the recovery of the wolf from anesthesia
- Considerations for injuries or mortalities will be addressed, as described in the net-gunning and sampling procedures

Biological Sampling and Radio-Collaring of Live Wolves

The live capture and radio-collaring of wolves to facilitate lethal removal presents an opportunity to collect biological samples that can contribute to the broader understanding of wolf health, genetics, diet, and a variety of other research considerations. For sample processing details, refer to BC Wolf Health Sampling Data Form instructions.

The following procedures for sampling and radio-collaring live wolves should be followed:

- Once physically restrained, or chemically immobilized, the crew will assess the wolf for any injuries that may have occurred during capture
 - o In case of injury during a capture event, the Crew will assess the severity
 - o If an injury is deemed to significantly affect the likelihood of survival, the wolf will be euthanized via a high velocity gunshot directly to the brain
 - o In the event of a capture-related mortality or euthanasia, the Crew must notify the Project Lead and/or the Provincial Wildlife Veterinarian before proceeding with additional captures
- Small crews of two personnel will be used for radio-collaring and sampling, and sudden movements or auditory stimuli will be kept to a minimum to reduce stress
- Wolves will be fitted with a satellite GPS radio-collar, weighing approximately 700 g (equal to about 1.5% of the body mass of an average-sized wolf)
 - o Any model or variation of radio-collar to be used must be less than 4% of the animal's body weight
 - o Radio-collars will contain an internal tip switch to detect animal movement, and should be programmed to send a mortality alert if no movement is detected for a sustained period (i.e., 12-hours)
- The radio-collar will be applied by the most experienced crew member

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- Radio-collars will be fitted in a manner to maximize comfort for each wolf, while ensuring that they are not fitted too loosely as to slip off the individual or cause neck irritation
 - Radio-collars should be fitted snugly, with one or two fingers width between the skin and the collar belt
 - If young wolves (< 1 year-old) are captured, radio-collars should be slightly looser to allow for growth over the course of the winter
- Radio-collars should include labelled plates instructing hunters or trappers to contact Staff if they harvest a collared wolf
- Radio-collars should be programmed with relatively high fix rates (8–12 fixes per day) to provide the Crew with up-to-date location data to facilitate effective lethal removal
- A sample of over > 100 hairs will be pulled from between the shoulders (roots included) and placed into a paper envelope
 - Pliers may be required to pull hairs, as wolf hair is often difficult to pluck
- A 6 mm punch biopsy may be taken from the ear of the wolf near the base (close to the head), making sure to avoid blood vessels or cartilaginous ridges in the ear
 - The biopsied tissue will be placed into a paper envelope
 - The hole left by the punch may be used for applying an ear tag
- Ear tags are a requirement only if chemical immobilization was used or other drugs administered, and may be useful as a visual queue when attempting to differentiate the radio-collared wolf from uncollared individuals in the pack while conducting lethal removals
- Blood should be drawn (10–15 mL) from either a jugular, cephalic, or saphenous vein for serological screening (i.e., parvovirus, neospora, distemper, etc.), pressure will be applied to the venipuncture site until bleeding has stopped before releasing the wolf
 - Blood should be prevented from freezing in the field prior to processing
- Biological samples should be processed and prepared, as necessary, soon after collection, and sent to the BC Wildlife Health Program once ready (see BC Wolf Health Sample Data Form for instructions)
- Other information to be collected includes:
 - General body condition and previous injuries
 - Morphometric measurements
 - Age estimate using tooth eruption/wear/staining as an index
 - Sex
 - Breeding status for females (i.e., lactating, swollen labia with discharge, etc.)
 - Colour
 - External parasite presence and severity
 - Pack size estimate
 - Location
 - Photos
- The total handling time associated with radio-collar attachment and sample collection should be less than 15 minutes

E. AERIAL SHOOTING FOR THE PURPOSE OF LETHAL REMOVAL (I.E., CULLING)

The procedures outlined below align with the AVMA Guidelines for the Euthanasia of Animals: 2020 Edition (Subsection 7.6: Free-Ranging Wildlife) and the AVMA Guidelines for the Depopulation of Animals: 2019 Edition

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(Section 9: Free-Ranging Wildlife, Subsection 9.4: Carnivores). Gunshot is an acceptable and effective method for humanely killing carnivores, and is the preferred method for removing large, free-ranging carnivores from the landscape. Furthermore, aerial shooting is commonly used to remove carnivores, such as wolves, from vast landscapes. Nontarget bycatch is avoided entirely through this method. Appropriate shot placement results in minimal animal suffering, where bullet placement is to the head, heart/lungs (chest), or neck (vertebrae, with intent of severing the spinal cord). Wolves should only be shot when a humane kill is judged as highly probable – this requires skilled shooters, appropriate firearms, ammunition, shooting distances, and ultimately a high likelihood of hitting a target area that results in instantaneous or near-instantaneous incapacitation.

Prior to entering the field, the accuracy and precision of the firearms should be tested at a firearms range, and Shooters should sight the firearm for the typical distances anticipated while shooting in the field. Shooting should be carried out by skilled and experienced Shooters who have been deemed suitable for the task and hold the necessary licenses and training (see 4-7-04.13.07 Evaluating Sufficient Skill Under the Permit Regulation - 2021).

The following sequence of events should be adhered to upon locating and identifying wolves for the purpose of lethal removal via aerial shooting:

- Upon locating wolves, the pilot and Shooter should discuss the external conditions, such as wind direction and terrain, and determine the safest direction of approach to haze the wolves into a suitable location for shooting
- A suitable location for shooting should be open enough to allow the pilot to position the helicopter within an ethical shot distance that would result in a high likelihood of the Shooter hitting the target zone
 - o An ethical distance is considered the longest shot that can be taken that will result in a humane kill (instantaneous or near-instantaneous incapacitation) with a low chance of missing the target area
 - o For a rifle, under most circumstances, shot distances should be less than 50 m
 - o For a shotgun, under most circumstances, shot distances should be less than 30 m
- A clear line of sight is required to ensure projectiles do not deflect on route to the target
- Wolves should be slowed down, when possible, to maximize shot accuracy
 - o This can be achieved by hazing wolves uphill or into deep snow
- Shooters should be aiming for the 1) head – brain, 2) neck – upper cervical spine, 3) chest – heart/lungs to achieve the most humane kill possible
 - o Desired target location may depend on shot distance, speed, terrain, etc.
 - o A shot to the brain or upper cervical spine is optimal for instantaneous loss of consciousness and rapid death, but is also a smaller, challenging target area
 - o A shot to the chest (heart/lungs) may be preferable, as it is the largest vital area and has a higher likelihood of an accurate shot under field conditions
- Shots must only be taken when a wolf's kill zone can clearly be seen and is within the effective range of the firearm being used
- If shot opportunities do not meet the aforementioned conditions, no shots should be taken
- Once a shot occurs, the Shooter and pilot will communicate about the shot location and effectiveness
- If the wolf becomes incapacitated after the initial shot and impact, the crew will hover over the wolf and confirm death by observing the following:
 - o No head or tail movement or shaking
 - o The carcass is limp and muscles are relaxed

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- Stiff, tense, or kicking limbs may occur post-mortem, but should return to a relaxed state shortly thereafter
 - No rhythmic breathing (if able to observe closely from helicopter)
 - No eye blinking – eyes are fixed and glazed (if able to observe closely from helicopter)
- If there is any doubt about death, another lethal follow-up shot should be taken
- If a wolf is not immediately incapacitated, a lethal follow-up shot(s) should occur until the wolf is immobile/incapacitated and death is confirmed
 - Additional ammunition, or detachable magazines, must be immediately available for rapid reloading and follow-up shots, as necessary
 - Semi-automatic rifle and shotgun actions are preferred for lethal wolf removal when attempting to remove multiple wolves from a pack during a lethal removal event
- Once death is confirmed, the shooting can be terminated, a GPS location of the carcass or carcasses should be recorded, and the Crew can move on to locate and remove other wolves
 - Coat colour and age estimates of dispatched should be recorded

By following the procedures outlined in this document, the standards for live capture and humane killing can be achieved. Professional oversight from Ministry Staff frequently onboard wolf reduction flights helps support the assessment of humaneness. Ministry Staff, in their role as Wildlife Biologists and designated as Officers under the B.C. Wildlife Act can provide real-time assessment of crew proficiency and ultimately make determinations as to whether the standards for live capture and humane killing are being met. Processes are in place for contract procurement and issuance of Wildlife Act permits ensure that the experience and skillset of those Contractors are sufficient and that they can achieve humane standards when not under the direct oversight of Ministry Staff. Regular check-ins between Staff, Contractors, and the Provincial Wildlife Veterinarian prior to, during, and following wolf reduction efforts are an important part of the ongoing assessments.

If any aspects of the program implementation consistently fail to meet the expectations for live capture and/or humane killing, measures will be taken to address those.

- Such aspects may include the performance of individual personnel (e.g., net-gunner/shooter, handler, or pilot) or Crews as a whole, firearm models, calibers, ammunition, or other equipment
- Corrective measures may include changes to equipment, or removal of individuals or Crews from aerial wolf reduction programs
- Such measures should be at the discretion of the Staff and Project Leads overseeing the operational aspects of the programs, the Provincial Wildlife Veterinarian, and/or the Regional Manager responsible for the issuance of permits

POLICIES, PROCEDURES, AND OTHER CROSS-REFERENCES

B.C. Legislation and Regulations:

- *Wildlife Act* (RSBC 1996 c.448)
- Permit Regulation (BC Reg 19/2021)
- Hunting Regulation (BC Reg 220/2020)

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- Wildlife Act General Regulation (BC Reg 340/82)

B.C. Policy, Procedures, Management Plans, and other guidance:

- 4-7-04.01.3 Control of Species Policy (2006)
- 4-7-04.01.3 Protecting Species at Risk from Other Species (2006)
- 4-7-04.13.07 Evaluating Sufficient Skill Under the Permit Regulation (2021)
- 4-7-04.06 Caribou Recovery Program Interim Aerial Wolf Reduction Procedure (2021)
- Resources Information Standards Committee
 - o Live Animal Capture and Handling Guidelines for Wild Mammals, Birds, Amphibians, and Reptiles (1998)
- B.C. Parks Policy
 - o Native Wildlife Species Control Policy: Control of Native Wildlife Species for the Recovery of Species or Ecological Communities at Risk (2020)
- Management Plan for the Grey Wolf (*Canis lupus*) in British Columbia, 2014
- BC Animal Care Applications
- NE Standard Operating Procedures and Safe Work Practices for net-gunning live capture of wildlife
- NE/LWRS Standard Operating Procedures and Safe Work Practices for using firearms from a helicopter

Federal Legislation and Regulations:

- Firearms Act (SC 1995, c.39)
- Aeronautics Act (RSC 1985, c.A-2)
 - o Canadian Aviation Security Regulations (SOR/2011-318)
- Transportation of Dangerous Goods Act, 1992
 - o Transportation of Dangerous Goods Regulations (SOR/2001-286)

Other Guidelines:

- American Veterinary Medical Association Guidelines for the Depopulation of Animals (2019)
- American Veterinary Medical Association Guidelines for the Euthanasia of Animals (2020)