U.S. Rocky Mountain Fisher Survey Protocol

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I. INTRODUCTION

Fishers (*Martes pennanti*) are 2.5–7 kg mustelids endemic to North America, whose populations were extirpated in many locations throughout the United States. Historically, the recovery of fisher populations was a priority because fisher pelts were valuable and fisher predation on tree-damaging porcupines (*Erethizon dorsatum*) was considered beneficial by foresters. More recently, fisher recovery has been justified under the Federal Endangered Species Act or similar state legislation (Greenwald et al. 2000; U. S. Fish and Wildlife Service 2004). In 2004, the U.S. Fish and Wildlife Service responded to a petition to list the West Coast (Washington, Oregon, and California) Distinct Population Segment (DPS) of fishers under the ESA. They ruled that the West Coast DPS was "warranted, but precluded" by higher priorities.

Fisher are apparently rare in the West Coast, yet they are common in the Northeastern and Midwestern portions of the United States; over 2,000 fisher are legally trapped in Maine, New York, and Minnesota each year. In the Rocky Mountains, the only other area of the United States that contain fishers, there is little information regarding their distribution and population status. The state of Idaho confers fisher its highest level of protection by listing the species as "critically imperiled" and a Species of Greatest Conservation Need under its Comprehensive Wildlife Conservation Strategy. Furthermore, a recent "Rare and Declining Species" review was conducted by the Intermountain Forest Industry Association and the Idaho Department of Lands. The goal of the review was to prioritize Idaho's Species of Greatest Conservation Needs. The fisher ranked among the top five species in Idaho in need of a conservation plan. In Montana fisher are considered a furbearer with a quota of 7 fisher allowed to be trapped statewide (2 in 1 district and 5 in a second district). Wyoming is the only other state in the Rocky Mountains that may contain fisher, although there has been no confirmed evidence of its presence there.

Given the recent management concern regarding fishers multiple agencies, institutions, and organizations have recognized the need to obtain some basic information in the Rocky Mountains. Of primary interest is determining the geographic range of this species within the Rocky Mountains. Current available maps are either too general (e.g., brushstroke maps) and thus contain habitat that is not currently occupied by fisher, or are based on untested habitat relationships or unscreened sighting data. Relying on untested habitat relationships or unscreened sighting data can lead to severe biases in estimating the species distribution (Aubry and Lewis 2003, Cushman et al. In Review).

The primary goal of this coordinated survey effort is:

> Goal #1: To delineate the geographic range of fisher in the Rocky Mountains. Specifically we are interested in detecting all the populations, and determining these populations' boundaries.

In the Rocky Mountains the vast majority of fisher surveys in the past 5 years have used non-invasive genetic sampling techniques. Specifically, the surveys have deployed baited-snare boxes (see below) that lure a fisher into the box (which mimics a traditional trappers cubby set), and capture tufts of hair (See Zielinski et al. 2007). DNA from these hairs is extracted and species (Riddle et al. 2002) and individuals are identified (Wisely et al. 2003, Pilgrim and Schwartz Unpublished Data, Jordan et al. 2007). In addition, the DNA can be

used to infer whether the population from which the fisher came from has native genes or is solely the product of reintroduced stocks (Drew et al. 2003, Vinkey et al. 2006, Schwartz et al. In Press). Thus, secondary and tertiary goals of this survey are:

> Goal #2: To determine which Rocky Mountain fisher populations have native genes and which fisher populations are comprised of reintroduced individuals.
>
> Goal #3: To index the abundance of fisher (e.g., minimum number of individuals alive) in each population through the use of DNA.

II. METHODS

Given that centralized funding to conduct this survey is not available, and that multiple partners with varying resources will be conducting this survey, any survey designed must meet the following criteria:

- Simple to follow and deploy
- Cheap to deploy
- Presence of a fisher must be unambiguous
- The protocol must have all components scientifically assessed
- The survey area should be partitioned to allow surveys to accumulate over time, but still be standardized.

Below we describe a survey protocol. Specifically, we describe the broad study area, the partitioning of the survey area using a sample grid, and the details of the survey for each unit. The accompanying appendices provide a detailed design of the non-invasive sampling device (Appendix I), a justification for the survey effort and design (Appendix II), and a DNA handling and storage protocol (Appendix III). We also provide a shaded box with a brief overview of the survey and a glossary of terms used in the survey protocol

Survey Area

Our focus area for this protocol was all predicted fisher habitat within Idaho and Montana, identified using the U.S. Geologic Survey (USGS) GAP analysis data. We recognize that actual fisher habitat will likely be far less that that predicted by GAP, but these data provide a reasonable starting point. Fisher habitat within these two states occurs in 18 different National Forests, as well as on State, Tribal, and private land. We created a base layer in *ArcGIS* that delineated all fisher habitat in Idaho, Montana, and Wyoming using USGS GAP Analysis data (Figure 1; see attached GIS layers). Subsequently, we overlaid this habitat with all US Forest Service National Forest boundaries to identify the proportion of habitat that occurs on USFS lands and the amount of habitat within each National Forest.

Sample Grid and Survey Units

There are many ways to design a survey to estimate geographic range. In general, survey effort must be partitioned either by a grid overlain on the area or by breaking the survey area into logical landscape units based on the geology of the area. Due to the size and topographic variability of the survey area, we opted to use a uniform grid placed over the survey area.

We reviewed the fisher home range and forest carnivore survey literature to determine an optimal size of survey units (e.g., 4 mi. x 4 mi.units, 5 mi. x 5 mi. units, 6 mi. x 6 mi.units, 8 mi x 8 mi. units). We balanced natural history and prior survey efforts with the logistic reality of designing a survey which covered such an extensive area as the Northern Rocky Mountains.

Surveys in the Rocky Mountains that take advantage of the Public Lands Survey or are designed for other forest carnivores have a primary sampling unit that ranges in area from 4 miles^2 to 25 miles^2 (Zielinski et. 1995, Squires et al. 2004). Given this large latitude in survey sizes we decided to base this current protocol on the local biology of fisher. The average fisher female home range nationwide is approximately 16 km^2 (4 km x 4 km), while the average fisher female home range in the Rocky Mountains is approximately 25 km^2 (5 km x 5 km; Powell and Zielinski 1994; For males the home range sizes are substantially larger). However, the goals of our survey are not to detect all individual fishers, but rather to detect populations of fishers. Assuming a non-overlapping home range, a small fisher population that consists of 3 females would occupy 75 km^2 or 29 miles^2 (approximately 5 miles x 5 miles). Thus, given the large land area that we hope to survey we choose to implement a 5 mile x 5 mile survey grid (Figure 1). We further refined these survey grids by removing survey units that contained less than 25% and less than 50% fisher habitat to determine how grid size would be affected (Table 1).

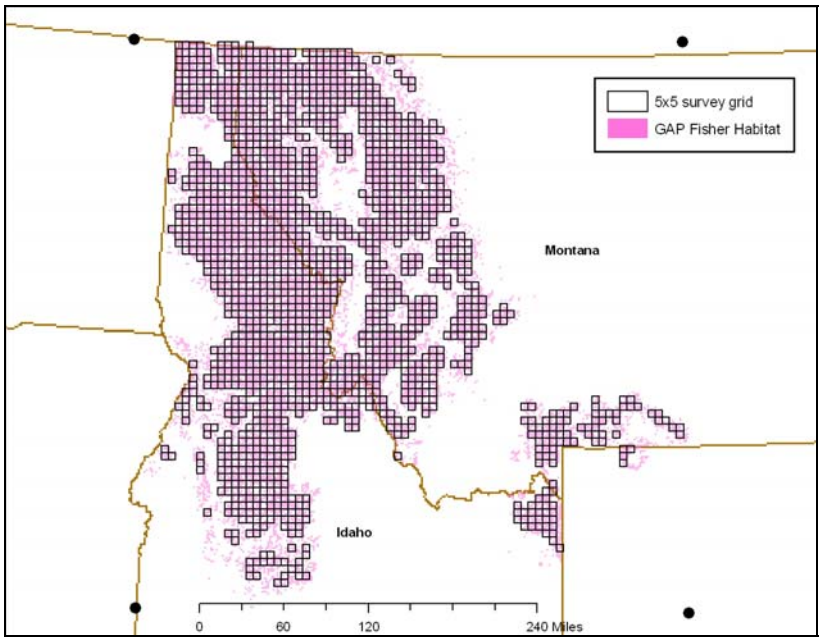


Figure 1: Map of all USGS GAP analysis fisher habitat in Idaho and Montana, overlaid with a survey grid consisting of 5x5 mile survey units with more than 50% fisher habitat.

A 5 mile x 5 mile survey grid placed over the putative fisher geographic distribution in the Rockies produces 3,155 sampling units. However, many of these sampling units had fisher habitat in a small fraction of the total area. In order to maximize efficiency and prevent searching areas that may have a lower probability of containing fishers, we

established a rule whereby we only survey units with greater than 50% fisher habitat. Using a 5 mile x 5 mile grid and surveying only units with 50% putative fisher habitat produces a total of 1,689 survey units within the Rocky Mountains (Figure 1, Table 1).

Table 1: Number of survey units in the survey area based on grids of various sizes and habitat criteria. "Any habitat" means that if any fisher habitat is in a cell (e.g., 7% of the cell is fisher habitat), then the cell would be surveyed. ">25%" and ">50%" means that at least 25% and 50% habitat, respectively, is required to be present before the cell would be considered for survey in this study.

Grid Format	Number of Survey Units
4-mile (any habitat)	4766
4-mile w/ > 25% habitat	3589
4-mile w/ > 50% habitat	2699
5-mile (any habitat)	3155
5-mile w/ > 25% habitat	2322
5-mile w/ > 50% habitat	**1689**
8-mile (any habitat)	1312
8-mile w/ > 25% habitat	937
8-mile w/ > 50% habitat	642
12-mile (any habitat)	625

Of the 1,689 total survey units identified as containing fisher habitat, more than 90% (n=1529) consisted primarily of USFS land. We overlaid this 5x5 mile grid onto a map of all USFS National Forest boundaries containing fisher habitat and determined how survey units were allocated across each of the 18 National Forests that contained fisher habitat. The number of 5x5 mile survey units per forest are shown in table 2 and figure 2.

Table 2. The number of survey units per National Forest

National Forest	# of survey units
Bitterroot	74
Beaverhead-Deerlodge	136
Boise	72
Clearwater	113
Custer	9
Flathead	162
Gallatin	53
Helena	36
Idaho Panhandle	145
Kootenai	188
Lewis & Clark	25
Lolo	159
Nez Perce	123
Payette	91
Salmon-Challis	81

Sawtooth	27
Targhee	30
Wallowa-Whitman (WA)	5
Total	**1529**

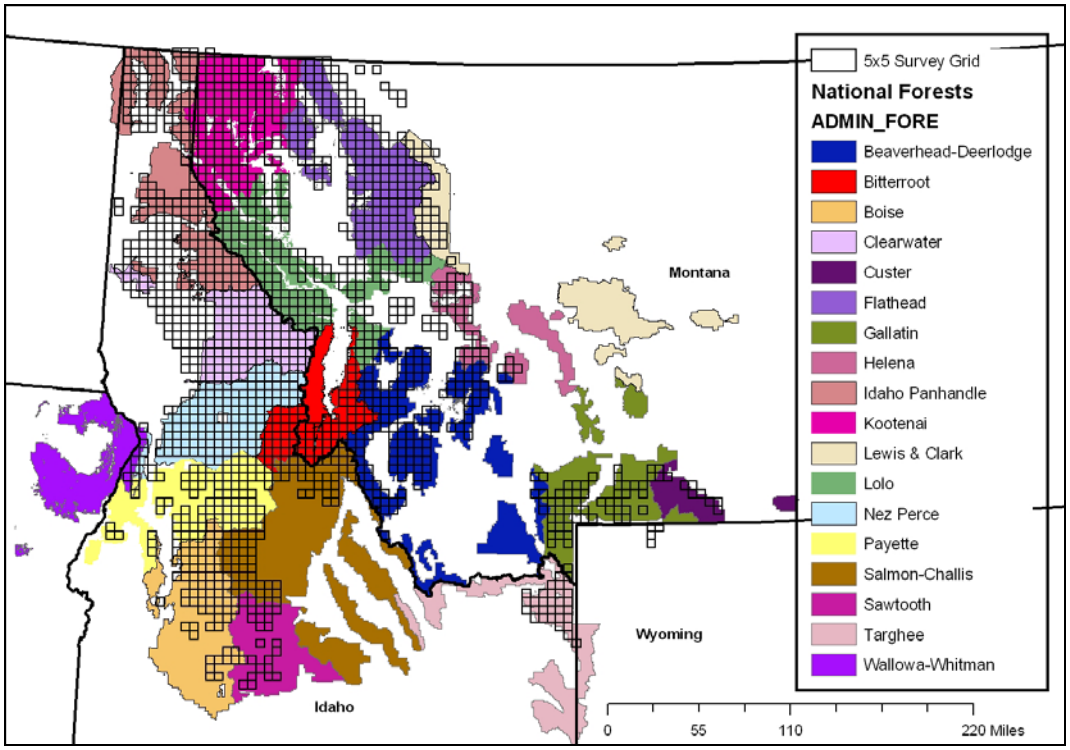


Figure 2: Allocation of 5x5 mile survey units across the 18 National Forests that contain fisher habitat

Stations with a Survey Unit and Survey Effort

Each survey unit covers a large area. Thus, multiple stations are needed per unit to adequately detect if a fisher population exists in the survey unit. Based on preliminary data, where detection devices (hair-snares) were placed in known fisher locations (in an area with a large fisher population) we estimated that the single device detectability was 0.39. That is, 39% of snares in known fisher locations detected a single fisher in a single session. In the case of the preliminary survey, a single session involved leaving one hair snare for 21 days. Thus, running 4 sessions in a survey unit or placing 4 snares in a survey unit for one session should provide a 97.7% of detecting a fisher, if fishers are present. *Therefore, we recommend a minimum of 4 snares per survey unit.* Given that the preliminary data was collected in an area with a strong fisher population, more snares per survey unit would be appropriate in areas with fewer fishers.

One problem with this detectability statistic is that there are many places within a 25 mile^2 unit where a fisher, or even a fisher population, can be present, but not detected because no survey was conducted. One solution to this problem is to choose a starting point in typical fisher habitat. In general, fishers prefer mature forest cover, late-seral coniferous forests, and riparian zones (Powell and Zielinski 1994, Jones and Garton 1994). However, in

2 studies conducted in the Rocky Mountains fisher also used young to medium-age stands of conifers at certain times of the year (Jones 1991, Roy 1991). Overall, fisher clearly avoided non-forested areas, large forest openings, recent clearcuts, and areas above timberline. Table 3 presents a few habitat features that typify fisher habitat in the Rocky Mountains.

Table 3: Some habitat features typifying fisher habitat in the Rocky Mountains.

Habitat Feature	***Reference***
Old-growth grand fir	**Jones and Garton 1994**
Old-growth subalpine fir	**Jones and Garton 1994**
Large diameter cedar	**Schwartz et al. unpublished**
Riperian areas	**Jones and Garton 1994**
Mesic cover types	**Roy 1991**
Area of high canopy closure	**Jones and Garton 1994**
Areas with complex physical structure	**Jones and Garton 1994**
Elevation <1800 m	**Schwartz et al. unpublished**

Following the logic of Squires et al. (2004) we are basing this survey on roads. Roads reduce travel times between sampling locations and can thus increase the overall number of stations and survey units sampled. Fisher display no apparent avoidance to areas surrounding roads. In fact, our preliminary survey placed snares 100 meters off a minor highway (Highway 12 – Idaho).

To spread effort within the survey block follow a road, or choosing a cardinal direction from the initial sampling station, and set the other 3 stations within the survey unit 0.5 miles from the previous station. If this location results in a forest opening or other clearly unsuitable fisher habitat proceed along the road to the next available fisher habitat. Figure 3 is a graphical representation of a survey.

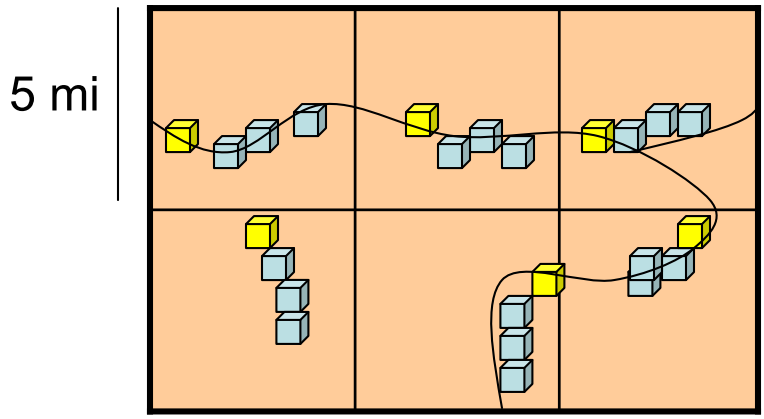


Figure 3. A graphical representation of six survey units. The lines running through 5 of the boxes symbolize roads. The squares represent the hair snare boxes. The yellow box is the first box in an array of 4. The location of the additional three boxes is conditioned on the location of the first – with each box located 0.5 miles from the previous. The bottom left survey unit would require snowshoes or skis to access as there is no road.

Summary
Overall, we are interested in primarily assessing the geographic range of fisher in the Rocky Mountains. This protocol is a preliminary protocol that will be adapted as more information on this rare Rocky Mountain carnivore becomes available. While this is not a centralized survey effort, the Rocky Mountain Research Station will be maintaining a database of where surveys have been conducted, with the goal of helping coordination between partners. For a summary of the details of the survey please see Box 1.

Box 1. Brief Outline of Survey Protocol

- A Sample Grid was placed over all fisher habitat in the Rocky Mountains (as defined by GAP analysis)
- This Grid is composed of 5 mile x 5 mile (25 mile^2) cells called survey units.
- Survey only those cells in the fisher geographic range with > 50% habitat (See GIS layers appended to this document)
- Deploy a minimum of 4 stations per grid for 21 days.
- Stations should be spaced 0.5 miles apart. Placement of the first station is flexible, but placement of the next 3 stations is conditioned on the placement of the first.
- Stations should be placed in a microhabitat appropriate for fisher (lots of structure, mature trees, riparian areas, etc.)
- Each station consists of 1 hair snare (triangle or square design with gun brushes)
- Send samples to Rocky Mountain Research Station for identification
- If questions or concerns arise please ask. Contact either the lead in your agency or Mike Schwartz (mkschwartz@fs.fed.us)
- While innovations are great, they should be done as supplements to this survey not instead of the survey.

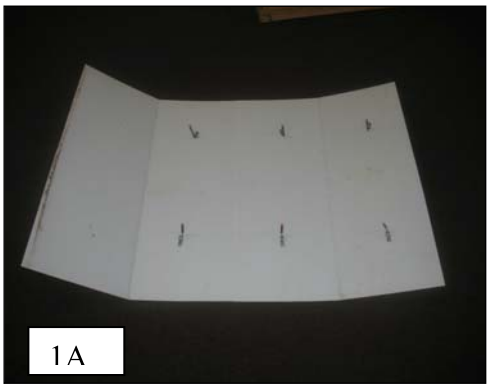
APPENDICES

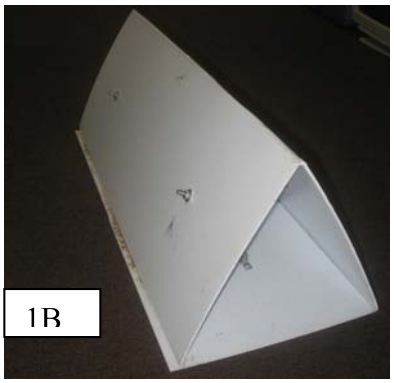
Appendix I: Hair Snare Design and Setup

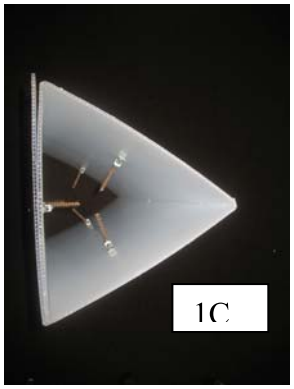
Based on our testing, we recommend using a triangular snare over the 4-sided snare (e.g., Zielinski et al. 2007) because the 3-sided device is easier to assemble, more stable and less prone to crushing. This design has been successfully used by several RMRS surveys. One deviation from other designs is that the RMRS snare has both ends open, with snare (gunbrushes) arrays at both end and the bait in the middle. This allows the snare to be accessed by the animal through both sides. The materials needed to build a snare include:

- 1 sheet of 48 x 32 inch plastic (*Coroplast*: Laird Plastic, Spokane WA)
- 6 30-caliber brass gun brushes
- 6 electrical terminal lugs w/ bolts
- 8 in. piece of tie-wire to hang bait (piece of chicken)
- 24 in. piece of tie-wire to hang sponge/lure
- 1 sponge soaked in lure
- Leatherman® or screwdriver
- 50 ml vial filled with silica desiccant (for collecting the hairs)

We recommend improving survey efficiency by preparing all snares beforehand, rather than one at a time out in the field. To build a snare, the *Coroplast* sheet is folded into 4 equal sections measuring 12 inches per side. Sides 1, 2, and 3 are folded into a triangle, and side 4 is bent so it overlaps side 1 (Photo 1A). Holes for mounting brush devices are then drilled 6 inches from each opening on all 3 sides, for a total of 6 holes. Bolts are then pushed through these holes from the outside, and screwed into the terminal lugs on the inside of the trap. Because sides 1 and 4 overlap, the bolts that pass through the holes in these sides serve to hold the trap in it's place, which is sturdier that the duct tape method used on previous 4-sided snare designs used between 2002-2004 (Photo 1B). A gun brush is inserted and tightened into each terminal lug, and subsequently bent 90 degrees at the base so that each brush protrudes towards the center of the snare opening (photo 1C). Finally, a hole should be punched in the center (17 in from the opening) of the top corner, where a piece of tie-wire with chicken attached can be inserted. The bait should hand in the center of the trap at least 6 inches away from the gun brushes on each end (if done properly it will hang 11 inches from the brush array). Once this basic preparation is completed, placement in the field is relatively easy. For transportation, we recommend opening the trap as shown in Photo 1A







In the field, there are three steps that need to be undertaken:

- The appropriate habitat must be found. Characteristics of this habitat are described in table 3 above.
- A micro-site must be located. Fisher like structure and cover. Placing this hair snare under a log, in a pile of jack-straw logs, near a boulder field or brush pile, near the base of a tree with coarse woody debris nearby, or close to trees with cavities is preferable. Covering a snare that is not under a natural object with bark and other woody debris may be helpful. Photo 2 below provide examples of snare placements.
- After assembling the snare, a scent lure (call) needs to be hung from a nearby branch. Currently, we are using a mixture of fish and blood as a scent lure. Commercial lures are also available. Joel Sauder of IDF&G recommends using "skunk quill", which can be found at (http://www.minntrapprod.com/products.php). In assembling the snare ensure that no hairs or other fibers are on the brush. Dogs and other domestic pets should be kept away from the equipment while in storage and in the field.

Photo 2: Examples of old square snares at microsites.

Appendix II: Protocol Validation

We conducted trial surveys in the Clearwater National Forest (CNF), Nez Perce National Forest in Idaho and in the Beaverhead-Deerlodge National Forest (BDNF) of Montana. These trials in the CNF focused on testing the effectiveness of the hair snare device and to determine detectability for each device when sampling a known, large fisher population. We set 23 snares in areas near creeks and riparian areas along the Lochsa River corridor in the CNF for 1 month. For the first 2 weeks, we checked snares every other day to determine the latency to first detection, and then checked snares a single time at the end of the second 2-week period. Our grid protocol had not been designed at the time of the survey, but when retroactively applied using *ArcGIS*, we found that we would have covered a total of 8 survey units, with an average of 3 snares per unit. We detected fishers in 7 of the 8 units, and calculated the probability of detection for a single device to be 0.48 for detecting fisher and 0.39 for detecting individuals. Further details on these surveys are forthcoming.

Caveats

Limitations of this survey must also be recognized. These limits are that we will likely not be able to detect individual fisher or small populations, given available resources, but will detect the major fisher populations in the Rocky Mountains.

Appendix III: DNA Samples

The use of gun brushes, and their mounting system, simplifies the collection of hair over older versions of the snare. Any wire brushes containing hair samples can be removed by simply loosening the screw on the terminal lug, pulling the brush out, and replacing it with a new brush. By straightening the bend in the brush, it can then be placed directly into a 50 ml vial filled with silica desiccant and removed from the field. Each brush containing a sample from the same snare should be placed in a separate desiccant vial. There is no need to use latex gloves while handling the snare, brush, or vial, as the genetic tools used in the laboratory are species specific. However, minimize handling the samples, as species identification work will pick up human DNA, which can swamp the sample.

After exiting the field, hairs can be removed from the brush and placed in the silica desiccant vial (the gunbrush can then be kept, cleaned [burned], and redeployed). Alternatively, if prior arrangements are made with the laboratory, the entire gunbrush can be sent with the sample attached for a small additional charge (i.e., a lab technician can remove hair from 10-14 brushes an hour).

One of the most important aspects of DNA sample collection is devising an adequate labeling scheme that identifies the date and the individual snare at which the sample was collected. Such specifics are necessary for relating genetic findings back to the survey effort and provides the basis for other types of spatial analysis. When samples are sent to the laboratory please include a sample list both electronically (via e-mail: mkschwartz@fs.fed.us) and a hard copy. All samples should be organized at one's home institution (i.e., IDF&G, St. Joe N.F.), then sent in a batch to the following location:

Michael Schwartz
USFS Rocky Mountain Research Station
800 E. Beckwith Ave
Missoula MT 59801
Lab Phone: 406-542-3255

DNA samples degrade over time, so it is best to send batches monthly. Also, please notify the laboratory via e-mail that samples are being sent. Also, please ensure that prior arrangements for analysis have been established between your institution and the laboratory.

GLOSSARY

Cell – Another term for a Survey Unit

Detectability - the probability of detecting a species during a single survey, given it is present at the site.

Hair Snare – A non-invasive genetic sampling device that has a call/lure to bring animals to the device, a bait that draws animals into the device, and a snare that captures hair for future DNA analysis.

Microhabitat – The precise location of a snare (e.g., under a tree, in a natural cubby, etc.)

Non-invasive Genetic Sampling – Collecting genetic material that ultimately provides information on species, populations, and individuals, without having to capture an animal. Usually this is accomplished by the collection of hair or feces and extraction of DNA from this material.

Population – This survey is designed to detect fisher populations. Our estimates of capture probability are based on detecting populations, not individual fishers.

Sample Grid – This refers to the large grid that was placed over the entire study area and divided into 5 mile x 5 mile survey units.

Session – A session is 21 days. Previous non-invasive surveys have left snares for 14 days. Recent results suggest that additional information is obtained in the subsequent 7 days.

Station – In this survey a station is an individual hair snare within a survey unit. The protocol is to place a minimum of 4 stations within each survey unit. A hierarchy exists in this protocol and is as follows: Station<Survey Unit (Cell)<Sample Grid.

Survey Area – The survey area is all fisher habitat predicted by GAP analyses (with the exception of those areas in National Parks.

Survey Unit – A 5 mile x 5 mile (25 mile^2) block to be surveyed.