IMPLEMENT HUMAN-BEAR MANAGEMENT PLAN -- INVENTORY AND MONITIORING: FINAL REPORT
NORTH CASCADES NATIONAL PARK SERVICE COMPLEX
OCTOBER 2002

Introduction

A very small, federally- and state-listed (threatened and endangered, respectively) population of grizzly bears (*Ursus arctos*)occupies the North Cascades National Park Service Complex ("Complex") and the surrounding ecosystem. Grizzly bears in the North Cascades have been designated as threatened under British Columbia, Canada's provincial Grizzly Bear Conservation Strategy (British Columbia Ministry of Environment, Lands and Parks 1995).

An ecosystem evaluation was conducted between 1986 and 1991 (Almack et al. 1993). Based on the quality, quantity and distribution of confirmed and highly reliable grizzly bear observations in the ecosystem, Almack estimated there were 10 – 20 grizzly bears resident in the US portion of the North Cascades (Figure 1). The most recent confirmed report of a grizzly bear in the *US portion* of the ecosystem was approximately 50 kilometers southwest of the Complex in 1996.

Early in 1998 British Columbia, using criteria similar to those used for the US evaluation, estimated a minimum of 17 grizzly bears in the Cascades north of the border (Gyug 1998).

Later that year, in an effort to better quantify the number of grizzly bears remaining in the Canadian portion of the Cascades, British Columbia provincial biologists placed 5 x 5 kilometer hair-snare grids in the border region north of the Complex. Though only one individual was identified from DNA samples collected from barbed-wire hair snares (Mowat 1999), this inventory yielded aerial observations of a female grizzly bear with a cub in a meadow spanning the international border between British Columbia and the Complex, as well as two other adults.

A similar inventory was conducted in the northern North Cascades ecosystem (US) during 1999-2000 (Wielgus 1998, Romain 2002). No grizzly bear hairs were identified in the US portion of the North Cascades. This project did estimate density and population figures for the 3,750 km^2 study area, which comprised approximately 11% of the entire North Cascades ecosystem (including British Columbia). They accomplished this by comparing relationships between catch per unit effort (CPUE) and density in this and six other projects, as well as between density and homerange size for populations throughout their North American range (McLoughlin et al. 2000 <u>in</u> Romain 2002). The most robust regression model for the relationship between CPUE and density predicted an estimate in the study area of 0.15 bears/100km^2, with a mean population estimate of six. The model was supported by the curvilinear relationship between homerange size and population density; the extremely low CPUE in the North Cascades (they included British Columbia's sample as the one "catch") would be expected given the tendency for homerange sizes to increase dramatically with decreasing density (Romain 2002).

The objectives of our project were to evaluate the use of two additional, non-invasive sampling methods, to provide definitive documentation of grizzly bears in the North Cascades Ecosystem (US). It was our hope one or both of these methods would succeed in locating a grizzly bear in the
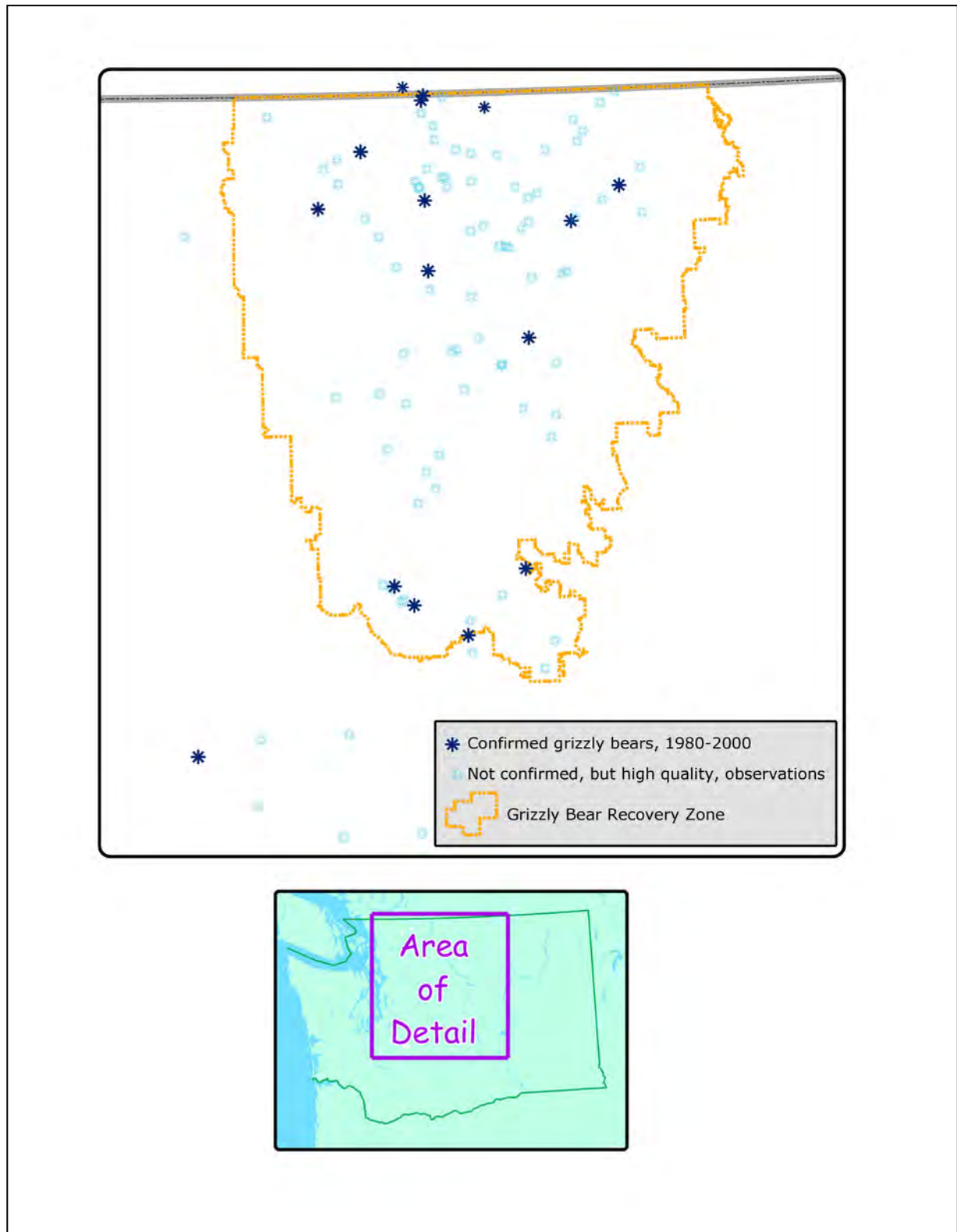
Figure 1. General locations of grizzly bear observations in the North Cascades Grizzly Bear Recovery Zone during the past 20 years.

US portion of the ecosystem. Doing so would at minimum reconfirm their presence either where they had been previously recorded, or in "new" areas. Inventory and monitoring of grizzly bear population size and distribution was one of five actions recommended in the NCE chapter of the Grizzly Bear Recovery Plan (USFWS 1993 and 1997). But perhaps even more importantly, it has been widely contended that tangible documentation of some type may be necessary to provide socio-political impetus for the commencement and implementation of an environmental impact statement addressing recovery actions for this ecosystem, another of the Recovery Plan's recommended actions. Because the remaining "population" is clearly very small, the initiation of an EIS to evaluate recovery alternatives is imperative.

We conducted this project in partnership with the US Forest Service, Washington Department of Fish and Wildlife and the University of Washington. Remotely triggered cameras were set during the first season. During the second, specially trained dogs were used to locate bear scats, from which DNA was extracted for species identification. We were most hopeful regarding the latter method. Despite the difficulty in extracting usable DNA from fecal samples, this method had the advantage of being independent of the need for an animal to both detect and investigate a scent lure, as the camera sets required. Using dogs trained to locate every bear scat in a given area would increase our chances for finding the "needle in the haystack" we were pursuing.

Year 1:

Study Area and Methods

During August – October 2000 a remote-camera survey was conducted in the eastern half of the North Cascades Recovery Zone (Figure 2).

The camera survey was conducted by two bear biologists from the Wenatchee National Forest. We used TrailMaster® passive infrared monitoring systems (Goodson & Associates, Inc., Lenexa, Kansas) and followed protocols similar to those described by Mace et al. (1994) and Almack et al. (1993). The apparatus consisted of a 35mm automatic camera and a TM 550 monitor. The camera was set to flash with every exposure and to print the date and time on each picture. Electrical tape on the monitor sensor narrowed the field of detection from the original 150° to the field of view, approximately 45°. The monitor was set for a five-minute camera delay with sensitivity set to photograph larger mammals (P=5.0, pt=5.0).

Camera stations were located based on the following criteria:
1) Follow up of historical sightings. These were Class 1 and 2 observations as classified in the North Cascades Grizzly Bear Ecosystem Evaluation (Almack et al. 1993).
2) Follow up on sightings reported this season.
3) Suggestions from experienced local bear biologists.

Once the general area was determined, specific locations providing quality grizzly bear habitat components were selected. The camera survey was begun in the late summer, when berry
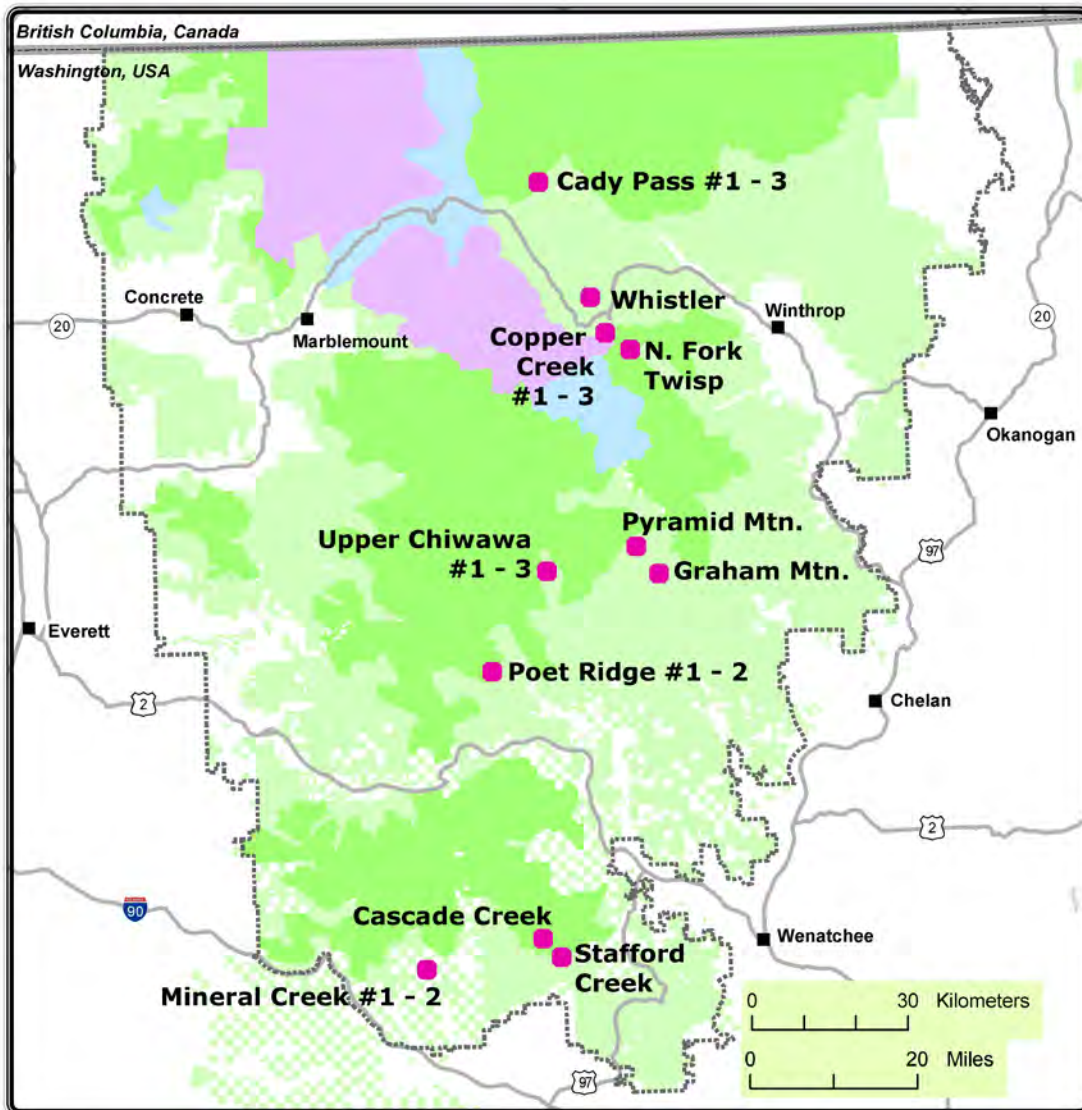
Figure 2. Camera stations installed in the North Cascades Grizzly Bear Recovery Zone, August 1 through October 26, 2000.

season was just beginning. To take advantage of this prime habitat component, we avoided heavily forested areas and opted for avalanche chutes and shrubfields.

The camera/ monitors were attached to a tree approximately one to two meters above the ground. A tree or rock approximately five to six meters away from the camera/ monitor was baited with Alaska® Fish Fertilizer and skunk scent. We attempted to check cameras every 14 days. At each visit we either removed the set-up or changed the film and the batteries in both the camera and monitor.

In our attempt to photograph a rare, elusive animal in a very large area and hoping to improve the odds of obtaining a photograph, we chose to be opportunistic with regard to access, habitat and in the amount of time we operated camera stations.

Results

Nineteen cameras were set up from August 1st through October 26th, 2000. The cameras were operational for a total of 286 camera nights, resulting in 208 photographs; 17 (8.2%) showed an identifiable animal in the frame (Table 1.). We photographed deer, rabbits, coyotes and black bears. A grizzly bear was not photographed.

Table 1. Result summary for remote camera monitoring survey for grizzly bear in the North Cascades Ecosystem Grizzly Bear Recovery Zone, WA.

Location	# Cameras	Camera nights	# photos with animals	Species Photographed
Stafford Ck.	1	19	1	deer
Cascade Ck.	1	10	0	
Mineral Ck.	2	43	4	deer, rabbit, black bear
Graham Mtn.	1	14	0	
Pyramid Pk.	1	14	0	
Upp. Chiwawa Basin	3	54	0	
N. Fk. Twisp River	1	21	2	coyote
Copper Ck.	3	60	10	deer, rabbit, black bear
Cady Pass	3	16	0	
Poet's Ridge	2	34	0	
Whistler Basin	1	1	0	
Total	19	286	17	

Discussion

Remote camera surveys can be very effective and have been used extensively with mammals, including grizzly bears (Mace et al. 1994, Aubry et al. 1997, MacHutchon et al. 1998). They have successfully detected rare lynx and wolverine in the North Cascades (WDFW unpublished data, 2002). However the grizzly bear population in North Cascades is so small and the Grizzly Bear Recovery Zone so large (25,300km²), the probability of obtaining a picture was very low. The inverse relationship between population density and homerange size (McLoughlin et al. 2000) likely contributed to the difficulty in finding a rare grizzly bear within a vast and diverse area. An individual would need to first be within scent range of a lure in order to investigate it. In so large and topographically complex an area, simply detecting a lure may be impossible within a given time frame (e.g. Green et al. 1997).

Adding to our difficulties was a phenomenal berry crop on the eastern slope of the Cascade Range in 2000, which may have reduced bears' interest in bait stations. It is also possible grizzly bears in Washington are sufficiently wary of humans to avoid bait stations entirely. Grizzly bears were so heavily exploited in the North Cascades during the past two centuries, it may be only bears that actively avoided people survived to reproduce (e.g. Clevenger and Purroy 2001). This may have developed in part as an inherited trait, and/or a behavior learned via "cultural transmission" (e.g. Braaten 1988). A heightened wariness of people, coupled with a potentially much larger homerange, may be reasons for poor results from the hair snagging effort as well. Despite efforts to minimize human scent at snag and camera sites, bears will inevitably be able to smell our presence. Any preference bears have to avoid human scent altogether may overpower their interest in the scent of the lure.

It was largely these possibilities that led us to evaluate during Year 2 a method altogether independent of scent lure and/or human avoidance.

Related Camera Project, FY2000

Also during FY2000, the Washington Department of Fish and Wildlife and Northwest Ecosystem Alliance partnered on a remote camera survey on the northwestern portion of the Okanogan National Forest, just east of the Complex. This project did not produce a photograph of a grizzly bear. It did however yield two photographs of lynx (WDFW unpublished data, 2000).

Year 2 Planning, this study

At the end of September 2000 an NPS biologist, a US Forest Service biologist and a University of Washington geneticist undertook an aerial reconnaissance of the North Cascades ecosystem. The flight path was designed to fly over most of the sites where there have been confirmed grizzly bear observations, while also observing as much as possible of the rest of the ecosystem. The results of this reconnaissance were a) a new appreciation for the suitability of this ecosystem for supporting grizzly bears and b) <u>many</u> potential Year 2 sampling sites noted for later prioritization – far more than we could hope to visit during a single field season. Observations made during this flight guided site selection for Year 2.

YEAR 2:

Scat sample collection and analysis were conducted under contract with Dr. Sam Wasser of the University of Washington. National Park Service and US Forest Service wilderness rangers accompanied the field crews in North Cascades National Park and the Pasayten Wilderness.

**Study Area and Methods:**

IN THE FIELD

Four scat detection dog teams sampled three areas (Figure 4) for grizzly bear scat between 14 May and 14 June, 2001. Areas sampled included the Chilliwack Valley (North Cascades National Park), the middle and west forks of the Pasayten River (Pasayten Wilderness, Okanogan National Forest), and the White River Valley, north of Lake Wenatchee in the Wenatchee National Forest.

We timed the fieldwork to coincide with early spring in the North Cascades, when bears' activities would be largely constricted by winter snowpack to lower elevation habitats. Samples were collected during 14 -16 May in the Chilliwack Valley, 30 May - 4 June in the Pasayten Wilderness and 11 - 14 June in the White River Valley, for a total of twelve days in the field.

Each dog team was comprised of a handler, data collector/orienteer and one dog. The four teams underwent training during April and early May in conjunction with the Washington State Department of Corrections K-9 Unit, which trains narcotic detection dogs for use throughout the Pacific Northwest (Wasser et al. 1999). After first learning the fundamentals of obedience and narcotics detection along with the police dogs, the scat detection dogs' training branched out to include black and grizzly bear scat samples. These had been collected in the wild (grizzly bear samples were from another ecosystem), to best simulate the types of odors the dogs would encounter in the North Cascades.

Sampling sites were divided into a grid made up of one square kilometer cells. Each team was assigned one or more cells, depending on how much area could be covered in an eight-hour sampling period. The distance covered by the teams was profoundly affected by the type of habitat: larger areas were covered in the relatively open areas of the high, dry Pasayten River Valley, for example, than could be sampled in the moist old-growth valley bottom in North Cascades National Park's Chilliwack Valley.

When each team arrived at its assigned grid the approximate location of the starting point was mapped and the scat-sniffing dog was put on "alert" for bear scats. The dogs were allowed to run free during their hunt for fecal samples, increasing their ability to follow in erratic and rapid paths the wind patterns and scent traces. When a dog alerted on a sample it stopped running, sat next to the sample and waited for its handler. The dog's reward for "tagging" the proper species' scat was a brief game of tug-of-war and fetch with a tennis ball. Using play-motivated, as opposed to food-motivated, dogs reduced the likelihood they would consume the samples as they located them.
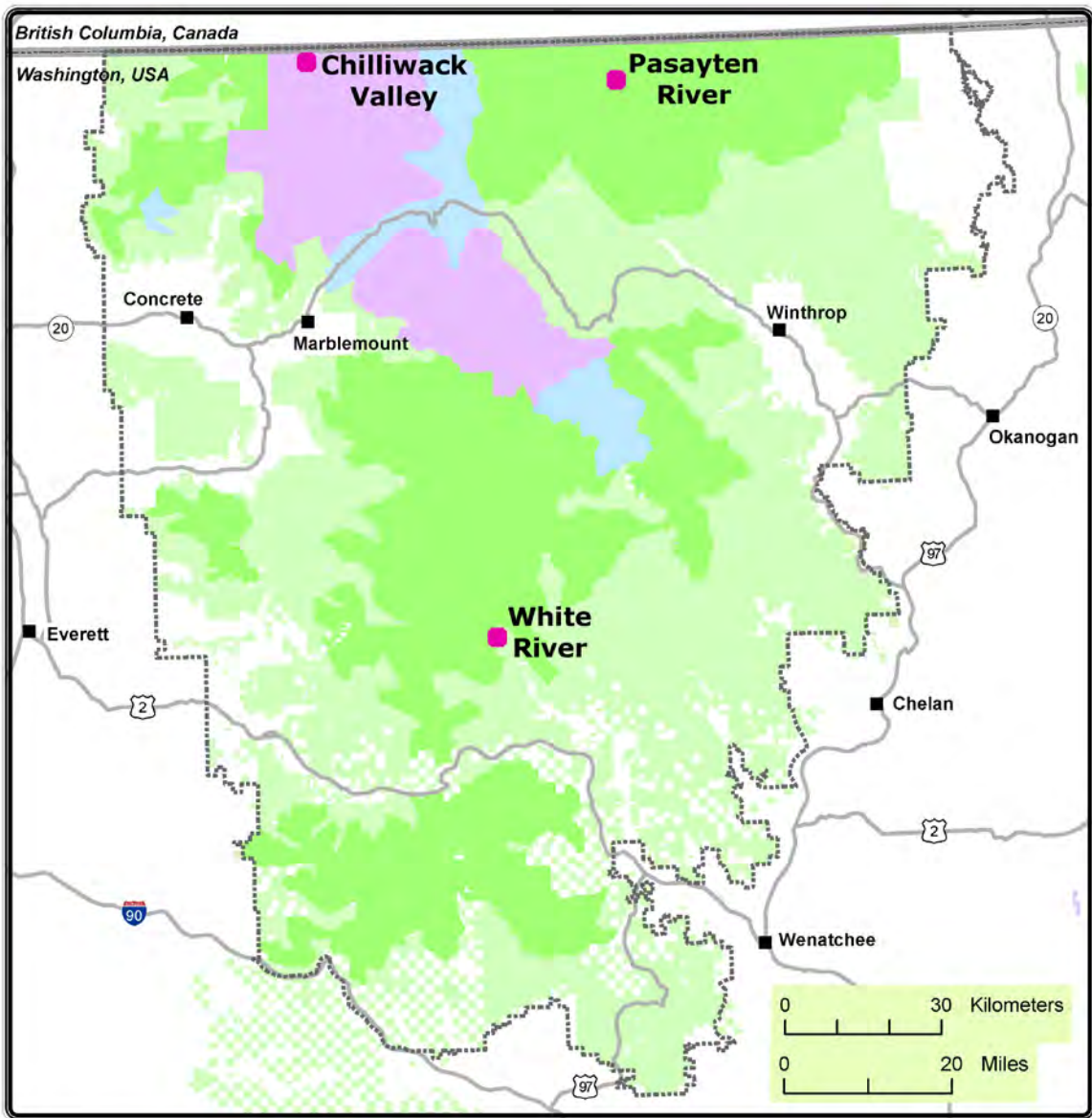
Figure 4. Scat sampling sites in the North Cascades Grizzly Bear Recovery Zone, May 14 - June 14, 2001.

At each sample location the following data were collected: time, weather conditions, estimated time since deposition, surrounding vegetation and substrate beneath the sample. A cursory examination was made of fecal content to determine approximately what the bear had consumed.

Each new sample was thoroughly mixed in the field using a gloved hand. The DNA which would be extracted for species identification was to be found in sloughed intestinal cells coating and distributed within the scat, so the mixing maximized the amount of cells available in each sample. Approximately 15 g of the sample were placed in screw-top vials containing 90% ethanol as a preservative, at a ratio of 4 mls ethanol per g feces.

GENETIC ANALYSES

All of the samples were freeze dried exactly one month after their respective collection and stored at –80°C until they were analyzed. All samples were extracted and amplified in duplicate. Freeze-dried samples were ground, sifted through a steel mesh, and thoroughly mixed. Fecal DNA were extracted based on modifications of Wasser et al. (1997, section 2.D). One thousand six hundred μl of Qiagen ASL Buffer (provided in the QIAmp stool kit, Qiagen, Chatsworth, California) were added to 200 mg of well-mixed, freeze-dried feces. Samples were vortexed for 10 seconds, incubated for one hour at 70°C, then centrifuged at 13,000 rpm for three minutes. All supernatant were transferred to a new tube containing inhibitex tablets for removal of PCR inhibitors (provided in kit), vortexed briefly, incubated for one minute at room temperature, then centrifuged again at 13,000 rpm for three minutes. All supernatant were again transferred to a clean tube and centrifuged. Six hundred μl of the supernatant were transferred to a fresh tube containing 25 μl of Proteinase K; 600 μl AL buffer (provided in kit) were then added, vortexed briefly and incubated for one hour at 70°C. After adding 600 μl of ethanol, all lysates were vortexed briefly and loaded in two to three centrifugations onto the spin columns. They were then washed with 500 μl AW1 (provided in kit), centrifuged for 20 seconds, washed with 500 μl AW2, centrifuged for another minute and the DNA eluted in 200 μl of Qiagen AE buffer after a one-minute incubation. Samples were then purified using glass milk (Geneclean III® non-spin Kit, Bio 101 Inc., Vista, California) at 55°C.

A portion of the control region of mitochondrial DNA (mtDNA) was polymerase chain reaction (PCR) amplified using fluorescent primers, then analyzed on an ABI 3100 Genetic Analyzer (Perkins Elmer Applied Biosystems, Foster City, California), and compared to known black and grizzly bear control samples interspersed throughout the same run to ascertain the taxonomic identity of the unknown fecal samples .

The samples were set up in 20 μl volumes containing 1.5mM MgCl2, 0.2μM dNTPs, 0.13μM 6-FAM labeled LTRPROB13, 0.13μM HSF21 , 0.5U Taq DNA Polymerase (Promega, Madison, Wisconsin) and 2.0μl of template DNA. The reactions were cycled in a 9700 Thermocycler (Perkins Elmer Applied Biosystems, Foster City, California) once for denaturation at 94°C for two minutes, annealing at 53°C for 30 seconds and extension at 72°C for 30 seconds, then repeated 34 times with the denaturation time shortened to 30 seconds at 92°C. A final elongation for five minutes at 72°C completed the amplification. Aliquots (1.5μl) of the amplified products were added to 13.5μl of deionized formamide containing 0.029% GeneScan TAMRA-500 and denatured for five minutes at 95°C. The samples were then subjected to capillary electrophoresis with a five-

second injection time on an ABI3100 using GeneScan parameters. The results were analyzed by GENOTYPER software (Perkins Elmer-Applied Biosystems, Foster City, California) and confirmed by visual inspection.

All samples were extracted in duplicate with each extract PCR amplified twice for nuclear DNA to increase the likelihood of detecting alleles subject to allelic drop-out. The multiple PCR strategy was similar to that recommended for hair by Taberlet et al. (1996). However, the additional extraction was better suited to the uneven distribution of DNA in feces.

Results:

The scat detection dogs were extremely focused on their work. Though none was observed, any wildlife disturbance would have been indirect, by virtue of the dogs' presence; they did not appear to acknowledge wildlife while they worked. For most specialized dogs such as these, the "job" is part of a game: the more enjoyable it is for the animal and the better the rapport with the handler, generally the more successful they are.

Given the short time in the field and the small search areas (approximately 10 km² total), the scat detection dogs were able to locate 280 samples: 91 in the Chilliwack Valley, 87 in the Pasayten Wilderness and 102 in the White River Valley. Samples of all ages were collected, but the majority of samples were estimated to be ≤ two weeks old.

The overall DNA amplification success rate for species identification was a very high 87%. Amplification success varied as a function of location: the rate was highest for samples collected in the Pasayten Wilderness (95%), followed by the Chilliwack Valley (88%), and the White River Valley (82%). This may be due to the relative exposures of samples in the White River Valley to direct sun, as UV light tends to degrade DNA in fully exposed fecal samples.

All of the amplified samples tested positive as black bears.

Discussion:

Null results (no grizzly bears) in a study of this scope must by no means be construed to indicate an absence of grizzly bears in the North Cascades Ecosystem. Current estimates are for 10-20 grizzly bears in the 25,300 km² US portion of the ecosystem. The scat DNA project was able to cover only about 10 km² (≈0.04%) of this area. Further, as discussed earlier, all indications are the population density of grizzly bears in this ecosystem is extremely low, with a likelihood of large homerange sizes. Although we sampled remote sites at a time of year when bears' foraging activities are constricted mostly to low elevation valley bottoms, we did so in only a very small portion of these low valleys.

Consensus was that the dogs' olfactory capabilities make them exceptionally effective and efficient bear scat locators. Their ability to differentiate among the species-origins of scats, and to sniff out samples hidden in brush or among rocks, create the opportunity to collect a large number of species-specific samples over a short period of time. For example even in the lower Chilliwack Valley, where scat samples were abundant, the density of vegetation (Figure 6) alone would have precluded unassisted field crews from locating but a small percentage of the samples the dogs

located.   Further, the dogs exhibited profound fidelity to the species (black and grizzly bear) for which they had been trained. At the beginning of the project one or two species mistakes were made by dogs as they tested their handlers: would they receive a reward for *any* scat? When they did not, they focused completely on *Ursus* depositions.

Although the DNA results have not yet undergone peer review, it appears that the capability for extracting mtDNA for species identification from scat is progressing well. The combination of the large sample sizes provided via the scat detection dogs and very high amplification rates, bodes well for this method as a means for identifying *species* from fecal samples.

Despite the apparent promise of the combination, there are many parameters to consider before embarking on a scat detection dog/DNA project.

The dogs used for this project were obtained from a pound, trained for one field season, then for the most part placed out to new homes at season's end. Ideally one would employ handlers who with their dogs work on scat detection projects year after year. This would reduce the time and cost of training both dogs and handlers. It would also allow more time for the team to develop a "pack bond" and field expertise, such as the most efficient and/or effective search patterns. As this field method catches on, more handlers have become available for hire as consultants specifically for this type of work (Murphy, pers. comm. 2001).

An advantage of using dogs for sample detection may be their ability to differentiate between up to 18 species' scent signatures (Wasser, pers. comm., 1999). However more work is required to test how well this succeeds in the field; dogs employed to locate lynx scat in known lynx habitat located many bear scats, but none from lynx (USFS unpublished data, 2002).

How rare the target species is/are will affect whether or how well dogs can be trained to scent signatures. Their training requires samples from wild individuals of the target species, preferably from the ecosystem or at least general ecotype in which the sampling will occur. This ensures the scent signature will contain foods most likely consumed in the study area. Fecal output from captive-fed diets is too dissimilar to be used for training purposes (Wasser, pers. comm. 1999). Thus while it is tempting to consider the use of scat dogs for detecting the presence of rare species such as wolverine or fisher (which may be extirpated in the Cascades), this would not be feasible without a satisfactory source of training materials.

Further challenges in this ecosystem include the difficulty of access, grizzly bears' potentially large homerange sizes and the very small number of grizzly bears. Grizzly bears in the North Cascades apparently spend at least a majority of their time in the most inaccessible areas, likely to avoid interaction with people.   A small number of confirmed observations have been made in areas near human development -- most notably just outside Leavenworth, a town of about 2,000 people on the eastern slope of the North Cascades. But as discussed earlier grizzly bears that have survived over the long term are likely those people rarely or never observe.

Therefore to succeed at producing a positive grizzly bear scat sample, even using a method as independent of confounding parameters as scat detection dogs, we would need to sample a much larger percentage of the ecosystem. Ideally sampling would occur throughout lower elevations in

spring, with additional, extensive sampling in high elevation meadows during berry season. It would call for a larger number of dog teams to sample many areas over the course of a few months. To be feasible such a project would necessitate helicopter access, with landings in both NPS- and US Forest Service-managed wilderness areas. Field costs would be much more substantial than expended on this project, and related laboratory costs would also be much greater. (To wit, we did not have NPS staff collect samples as we had originally proposed largely because the anticipated cost of analyzing the samples obtained by the University of Washington field crews would exhaust the available funding.) Further, the impact of numerous dog teams working in the low elevation spring habitat and critically important berry meadows could also be detrimental to wildlife -- including any grizzly bears in the area. Though working dogs are typically too focused on their work to actively displace or otherwise harass wildlife, their very presence may be enough to disturb wildlife (e.g. Karels et al. 2002). While a few dog teams in a limited area are in and gone very quickly, and therefore not likely to cause significant harm, we would need to consider whether the requisite additional effort in this ecosystem would pass over a threshold of disturbance. Any project with so large a scope would need to be scrupulously planned and meticulously justified.

There are additional concerns and limitations with using feces for sources of DNA. On the positive side, the science of extracting and analyzing DNA from scats for the identification of species is fairly straight forward (Foran et al. 1997, Clarke et al. 2001), and this project was exceptionally successful in this regard. Species identification is obtained from mitochondrial DNA (mtDNA), which is relatively robust and abundant in cells.

The problem lies with individual identification, necessary to determine from how many animals multiple samples originated. This information would also be useful for determining relatedness to other populations, and if enough samples were collected, the genetic health of a subpopulation. Genotypic information is gleaned from nuclear DNA (nDNA), which is present in only two copies per cell (Murphy et al. 2000). Source cells of DNA are scarce in scat compared to hair, blood or bone, making the already sparse nDNA less available to amplify. Nuclear DNA is also more susceptible to degradation over time than mtDNA. Waits and Murphy (2001) found only 20% of nDNA would amplify from scat samples just three days after deposition in a controlled, captive setting (and therefore not subjected to environmental variables which accelerate degradation). The rate continued to drop after the three days, with genotyping errors increasing over time in the samples that could be amplified. By comparison they achieved a 40% success rate for amplifying mtDNA from scat samples stored in ethanol for two months. As well, there are a number of materials that act as PCR inhibitors. Though many of these can be removed (Wasser et al. 1997, Murphy et al. 2000) some can seriously impair PCR amplification. For example, the presence of salmon in a scat significantly reduced the amplification success rate for both nDNA and mtDNA (Waits and Murphy 2001). On the other hand, in a study of mountain lions in southern California researchers were able to attain a 77% success rate for identifying individual animals from scat-derived DNA (Ernest et al. 2002). It may be only a matter of time before it becomes practicable to obtain genotypic data from bear scat on a consistent basis.

Further problems are encountered with determining the gender of the source animal. Because there is only one primer available for determining gender in mammals (Waits and Murphy 2001), there is no way to distinguish between the gender of a prey species a scat may contain and the bear that deposited the scat. Waits gave the example that even if a female bear ate a male rodent too small to detect in visual examination of the following feces, the mere presence of that male's Y chromosome would

result in a false-male determination for the scat. Therefore, scats are for the time being unreliable indicators of the gender of their manufacturer.

These concerns may be summed up by the title of a paper by Taberlet et al. (1999): "Non-invasive genetic sampling: look before you leap". While the problems are very real, they do not rule out the use of these methods given the right situation.

Conclusions, Both Years

The new field methods we tried are applicable to many other species and locations. They have been used with success in areas with relatively larger bear populations (e.g. Kendall, USGS, pers. comm. 2000; Mace et al. 1994; B. McLellan, pers. comm. 2000; Kohn and Knauer 1998; Paetkau & Strobek 1998; Waits et al. 1998; Washington Department of Fish and Wildlife 1998; Wasser et al. 1999 (Paper presented at the Society for Conservation Biology, Baltimore, MD, 2000); Wasser 2000; Woods et al. 1996). There are costs and cautions associated with each however, particularly when seeking wide-ranging individuals in a very small, remnant population.

Hair Snares: Romain (2002) recommends the use of hair-sampling and catch per unit models as potentially useful tools for quantifying small populations. Though this may be true, it was the conclusion of biologists in British Columbia that the low success rate in this ecosystem for "capturing" a grizzly bear DNA sample using hair snares (one) compared to visual observations of grizzly bears from the air while flying to hair snare sites (four) perhaps warranted further aerial surveys, as opposed to hair snares (Austin, Ministry of Water, Land and Air Protection, pers. comm. 1999). This may have been borne out last year when aerial surveys yielded two photographs of grizzly bears, including a female with a cub (Austin, Ministry of WLAP, pers. comm. 2001, Figure 7). Additionally, the sheer remoteness and inaccessibility of most of the ecosystem (Figure 8) present formidable barriers of both expense and inefficiency to reaching an adequate number of sampling sites to have a realistic chance of "capturing" resident grizzly bears. While locating positive grizzly bear DNA samples in this ecosystem is still most certainly a worthy venture in itself, we question whether funds expended on hair snare (or scat , per below) work might better be diverted to other recovery efforts.

Remote Cameras: The setting and maintenance of remote cameras is relatively inexpensive and has the potential for photographing any number of species of interest, including grizzly bears. Though most frames contain no wildlife, both lynx and wolverine have been detected by remote cameras not far from the Complex. Because this method is relatively inexpensive we would support continuing to set camera stations well sited for grizzly bears and other cryptic carnivores.

Scat Detection, DNA Extraction: This combination of sampling and DNA analysis may have uses for a wide variety of studies. Use of specialized dogs yielded large sample sizes despite very limited time in the field. If the purpose is to verify the presence of a species, at the right scale this method has merit. With advances in DNA technology, the capability for obtaining reliable genotyping results from a sufficiently large percentage of samples may be readily available in the foreseeable future. And with these capabilities would come the possibility of a number of inventory and monitoring options.

The key is "the right scale" at which this method might be a useful tool for detecting rare species. It appears the scope necessary to achieve one positive sample in as small a population as the North Cascades grizzly bears', and in so large and inaccessible an area, may be prohibitive. Identifying more than one may not be possible. An analogy might be playing the Lotto: you know the money is there, it's just that very few who play will ever obtain it, and they may go bankrupt in the process of trying. An exception for the North Cascades Ecosystem might be using scat detecting teams to follow up on promising reports of grizzly bears from agency employees or the public. Unfortunately this would require teams on call, and would necessitate adequate funds for sample analysis be available in the event they were needed.

At issue, then, is whether the end justifies the inevitably great expense of a project conducted at the appropriate scale. "Winning the Lotto" in this case would increase our knowledge of grizzly bears in this ecosystem at least one hundred -fold (as we know almost nothing at this juncture), and *could* have disproportionate influence on the initiation of a recovery EIS. Were this to lead to quantifiable progress toward species recovery within the following decade or so, few could argue it would not have been worth it. At the same time we may be expending money better spent on public education, wildlife -resistant food storage and waste disposal, access management issues and the initiation of an EIS to examine the alternatives for grizzly bear recovery in this ecosystem. At this point it is on these actions we would recommend concentrating.

BUDGET:

Directly Related Research:			**Funded**

1998
Hair snare grids in the North
Cascades, British Columbia $ 80,000
Ministry of Environment, Lands and Parks *(Canadian, approx. $59,000 US at current exchange)*
1999
Hair snare grids in the northern
      unit of NOCA, ROLA $ 61,331
2000
Hair snare grids in the northern
      North Cascades Recovery Zone,
      Including ROLA/NOCA $ 35,000
Remote Camera surveys, northern NC Recovery Zone (WDFW)
(Project uses existing camera gear & volunteers) $ 13,120

	TOTALS:	$ 0	$168,451

Year 1 (FY 2000):

a) Personnel:
      GS-486-09 seasonal team leader.
      GS-404-05 seasonal bio tech $ 16,462
b) Per diem for field crew @$15/day /mileage @ .32 per mile $ 1,017
c) truck rental $ 1,840
d) Cameras (purchase of 10 total: 6 passive
      monitors, 4 active monitors $ 5,030
e) Scent lure (mixtures of fish & mustelid odors) $ 65
f) Film and developing for remote photos $ 730
g) miscellaneous field supplies $ 24
h) Aerial reconnaissance flight $ 1,032
i) Contribution to Washington State University's hair
      FY2000: DNA analysis ($2,000) $ 2,000
j) Carry-over for Year 2 expenses: $ 25,800

	TOTAL:	$ 54,000

Year 2 (FY 2001):

	Funded
a) NPS wilderness ranger, GS-025-05 for 40 hours as escort for UW field crews, including per diem	$ 1,100
b) Personnel:	
• 8 biotechs hired by the UW, includes health benefits, medical, unemployment, per diem, other premiums.	$38,707
c) Transportation, including mileage for private vehicles (field crews)	$ 3,280
d) Dog food and Veterinary costs (vaccinations, check ups)	$ 663
e) Chemicals and chemical products	$ 5,832
f) Biological Assays	$ 383
g) DNA lab. analyses, other supplies and materials	$ 11,223
h) University of Washington overhead charges	$ 9,013
TOTAL FY 2001 FUNDS: $44,400 **(plus carry -over from FY2000 = $25,800)**	
Total funds expended during FY2001:	**$ 70,201***

SUM TOTALFUNDS FOR FY 2000 - 2001: $98,400

***(A $1.49 overage was covered by the University of Washington)

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