WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

Collection of Reports and Presentations

Holly Akenson & Jim Akenson
To the DeVlieg Foundation

Janet Pope

From: "Janet Pope" <janetdpope@clarkston.com>
To: "Taylor Ranch" <tayranch@direcway.com>
Sent: Tuesday, February 28, 2006 3:07 PM
Subject: You're welcome

Holly and Jim
Your letter to our board highlighting the present and past events and publications of the Predator Study is excellent. It will be very well received from all the board members. I will be making copies and mail each board member, not in attendance at our meeting this week, their own personal copy. It has been a few years, many board meetings, and many other topics, since your last presentation to us on this research subject. Thus, it is appropriate the board is informed on all the many presentations, writings and future writing schedule. Your summary of findings, the mentoring of young professionals, and the process of publishing your research is award enough to our board. Thank you for honoring us, and good luck with getting the draft out this spring.

Janet and Jim

Jim's comments were "very well done".

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Dear DeVlieg Foundation Board:

On behalf of the University of Idaho, Hornocker Wildlife Institute, and Wildlife Conservation Society we want to thank you for the generous funding the DeVlieg Foundation has provided over the years for our research, "Winter Predation and Interactions of Wolves and Cougars in the Central Idaho Wilderness". Your financial support and your appreciation for the value of wilderness research to understand the function of large carnivores in the ecosystem are truly appreciated.

We have learned much about how reintroduced wolves have settled in to the pre-existing large mammal community. Some of our results corroborated findings of other researchers. Some of our other results, such as the influences of fire on carnivores and predator – prey relationships have been new insights. In a nutshell: 1) We found that wolf and cougar diets were similar and that neither carnivore showed a preference between elk and deer, 2) We determined that cougars did not thrive in the presence of wolves: cougar numbers and reproductive success declined during our study, 3) We learned that wolves were more resilient than cougars to large-scale habitat change, as we found after the massive forest fire, when wolves were able to take advantage of their huge pack territory size and follow the elk herds to unburned areas, while cougars had to diversify their diets in order to find enough food in their smaller territories when the elk moved away, 4) Surprisingly, we found that elk and deer populations did not decline following wolf reintroduction, instead the effects of forest fire improving the food and habitat for ungulates was a more significant positive factor on prey populations than the adverse effects of predation, 5) We compared our cougar population and diet data to 3 past cougar studies at Taylor Ranch Field Station and found that contrary to conventional wisdom, this cougar population has fluctuated over time relative to prey populations rather than being self-regulated.

Your commitment to this wilderness carnivore project has contributed to the knowledge about large carnivores and their effect on each other and their prey, and has contributed to the conservation of large carnivores. We have produced a variety of reports and publications from this large carnivore – ungulate research.

The most notable publication to date is "Effects of wolf reintroduction on a cougar population in the central Idaho wilderness", published in the proceedings of the Mountain Lion Workshop. We continue to work on manuscripts and expect to send a draft of "Four decades of cougar – ungulate dynamics in the central Idaho wilderness" to our coauthors, including Maurice Hornocker, in the near future. We have shared the results from our carnivore – ungulate research through presentations at 10 scientific meetings at the state, regional, national, and international level. We have also made 9 presentations on this research to the public, other agencies, and to University of Idaho students. Attached are lists of reports & publications, scientific presentations, and educational presentations from our research project, "Winter Predation and Interactions of Wolves and Cougars in the Central Idaho Wilderness". We have given Janet Pope a copy of all of our reports, publications, and abstracts of presentations for the DeVlieg Foundation. We will continue to send copies of additional publications for your records. With your help we were able to share our research finding with wildlife researchers and managers, students and the public, and hopefully affect the conservation of wolves and cougars and an understanding of the role of large carnivores.

Your contributions to this carnivore research project have provided an opportunity to prepare young professionals for careers in wildlife or natural resources fields. We used your funding to hire 8 University of Idaho wildlife students or recent natural resources graduates, to provide these young professionals hands-on experience working in a naturally functioning ecosystem and to give them an appreciation for our natural heritage. The career paths of these young biologists include: graduate student research on wolves in Canada, developing and managing a wildlife consulting business, working as a forester, managing research data sets at a field station, initiating a graduate program in wildlife, teaching biology, working as a state wildlife habitat biologist, and managing a backcountry ranch.

Thank you for believing in us and our ability to conduct research on wolves and cougars in wilderness, despite the logistical and financial difficulties of wilderness research on large carnivores. Your assistance has contributed to the development of 8 young biologists who in their new careers will value and protect our natural resources in the future. You have also affected the conservation of wolves and cougars, as our research results continue to be disseminated through presentations and publications to scientists and the public, providing scientific insights and knowledge for an informed public. We couldn't have done it without you!

Sincerely,

Holly Akenson

Holly Akenson

Jim Akenson

Jim Akenson

"Winter Predation and Interactions of Wolves and Cougars in the Central Idaho Wilderness"

Research by Jim & Holly Akenson

Funded by the DeVlieg Foundation

SCIENTIFIC PRESENTATIONS

The Wildlife Society Northwest Section, 2006, Boise, ID. Effects of wolf reintroduction on a cougar population in the central Idaho wilderness.

Eighth Mountain Lion Workshop, 2005, Leavenworth, WA. Effects of wolf reintroduction on a cougar population in the central Idaho wilderness.

World Wolf Congress, 2004, Banff, Alberta, Canada. Wolves & cougars: large carnivore competition in Idaho.

The Wildlife Society Idaho Chapter, 2004, Moscow, ID. Four decades of cougar – ungulate dynamics in the central Idaho wilderness.

Seventh Mountain Lion Workshop 2003, Jackson, WY. Four decades of cougar – ungulate dynamics in the central Idaho wilderness.

The Wildlife Society Northwest Section, 2003, Eugene, OR. Carnivores, ungulates, and wildfire.

15th North American Interagency Wolf Conference, 2003, Chico, MT. Carnivores, ungulates, and fire.

13th North American Interagency Wolf Conference, 2001, Chico, MT. Winter predation and interactions of cougars and wolves in the central Idaho wilderness. Research update.

The Wildlife Society Idaho Chapter, 2000, Boise, ID. Wolf – cougar – ungulate research highlights.

11th North American Interagency Wolf Recovery Conference, 1999, Chico, MT. Predation and interactions of wolves and cougars on Big Creek in central Idaho.

EDUCATIONAL PRESENTATIONS

University of Idaho, Student Chapter The Wildlife Society, 2005, Moscow, ID. Man, wolves, and cougars: a history of competition.

Idaho Department of Fish & Game, 2004, Boise, ID. Carnivore – Ungulate Winter Research on Big Creek 1999-2003

University of Idaho, Student Chapter The Wildlife Society, 2004, Moscow, ID. Four decades of cougar – ungulate dynamics in the central Idaho wilderness.

University of Idaho, Wilderness Management Class, 2004, Moscow, ID. Carnivores, ungulates, and wildfire.

University of Idaho, The New West Class, 2004, Moscow, ID. Man, wolves, and cougars: carnivore competition in the Idaho wilderness.

Krassel Ranger District, US Forest Service public presentation, 2004, McCall, ID. Four decades of cougar – ungulate dynamics in the central Idaho wilderness.

University of Idaho, Wilderness Monitoring class, 2003, Moscow, ID. Four decades of cougar – ungulate dynamics in the central Idaho wilderness.

Krassel Ranger District, US Forest Service public presentation, 2003, McCall, ID. Carnivores, ungulates, and wildfire.

Idaho State University, Biological Sciences Department, 2003, Pocatello, ID. Predation and interactions of wolves and cougars on Big Creek in central Idaho.

PUBLICATIONS & REPORTS

Akenson, J. J., H. A. Akenson, and H. Quigley. 2005. Effects of wolf reintroduction on a cougar population in the central Idaho wilderness. Proceedings of the Eighth Mountain Lion Workshop 8:177-187.

Akenson, H., J. Akenson, and H. Quigley. 2002. Winter predation and interactions of cougars and wolves in the central Idaho wilderness: 2002 annual summary. Wildlife Conservation Society, Bozeman, MT. 2pp.

Akenson, H., J. Akenson, and H. Quigley. 2001. Winter predation and interactions of cougars and wolves in the central Idaho wilderness, Annual report 2001, Hornocker Wildlife Institute – Wildlife Conservation Society, Bozeman, MT. 10pp.

Akenson, H., J. Akenson, and H. Quigley. 2001. Winter predation and interactions of cougars and wolves in the central Idaho wilderness, Winter 2001 project overview. Hornocker Wildlife Institute, Bozeman, MT. 3pp.

Akenson, H., J. Akenson, and H. Quigley. 2000. Predation and interactions of wolves and cougars on Big Creek in central Idaho: Winter 2000 annual report. Hornocker Wildlife Institute, Bozeman, MT. 15pp.

Akenson, H. and J. Akenson. 2000. Winter predation and interactions of cougars and wolves in the central Idaho wilderness, Six month progress report December 2000, Hornocker Wildlife Institute – Wildlife Conservation Society, Bozeman, MT. 7pp.

Akenson, H. and J. Akenson. 1999. Predation and interactions of wolves and cougars on Big Creek in central Idaho: Highlights of the 1999 winter field season. Hornocker Wildlife Institute, Moscow, ID. 5pp.

Bagley, R. 2000. Seasonal migration patterns of mountain lions in central Idaho over a 35 year period. Undergraduate report, Department of Fish and Wildlife Resources, University of Idaho. 15pp.

EFFECTS OF WOLF REINTRODUCTION ON A COUGAR POPULATION IN THE CENTRAL IDAHO WILDERNESS

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Abstract: Wolves (*Canis lupus*) were reintroduced in the central Idaho wilderness in 1995 and 1996 and rapidly established packs in areas previously occupied by cougars (*Puma concolor*). We spent four winters studying the relationship between sympatric wolves and cougars in the Idaho wilderness, beginning work the first year the two carnivores coexisted. We examined the potential for competition during winter between resident cougars and a newly established wolf pack for food, space, and habitats through radio telemetry tracking and examination of 192 carcasses. We found that wolf and cougar diets were almost identical. Winter home ranges of wolves and cougars overlapped, although the wolf pack home range size was 2-20 times the size of individual cougar home ranges. We observed wolf utilization of cougar-killed prey and evidence of wolf avoidance by cougars. Although no interspecific killing was documented between wolves and cougars, the effects of competition, a declining prey population, and heavy hunter harvest of cougars were expressed by low recruitment, decreased adults, and disrupted social structure in the cougar population. A large-scale wildfire provided a unique opportunity to compare wolf and cougar responses to catastrophic environmental change. Wolves, with large home ranges, were more adaptable to change than were cougars. For cougars, the combination of decreased prey numbers, low reproductive rate, high hunter harvest, and large-scale habitat alteration from fire appeared to amplify the effects of competition from the recently established wolf pack and increased intraspecific strife. The cougar population experienced a period of instability during this study, as cougars adapted to coexistence with another large carnivore in a dynamically changing environment.

Mountain Lion Workshop 8:177-187

Key Words: Puma concolor, competition, cougar, wolf, Canis lupus, Idaho, predation, carnivore, ungulates, fire.

INTRODUCTION

Prior to 1900, wolves and cougars coexisted in central Idaho, but by the turn of the century settlers had moved into the Big Creek drainage in the rugged Salmon River Mountains to mine for gold, trap, and establish homesteads. Hunting, trapping, and poisoning of carnivores were common practices, and by 1895 sightings or evidence of wolves in the drainage were uncommon (Caswell 1895). Despite the remoteness of the area, ungulate and carnivore numbers varied dramatically over the next 100 years, often in response to human hunting, trapping, and poisoning efforts (Figure 1). The ecology and population dynamics of

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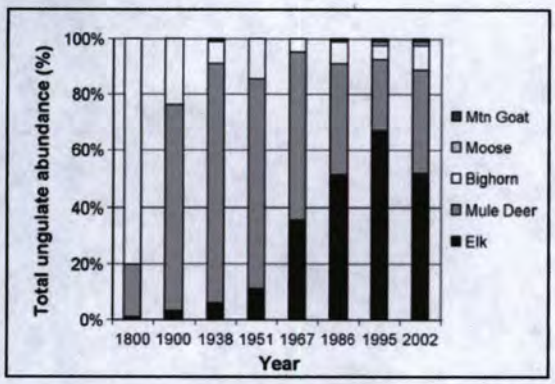

Figure 1. Relative ungulate abundance on Big Creek, from 1800 to 2002. (Unpublished data assimilated from Caswell 1895).

cougars in the Big Creek drainage have been well documented and described over the past 40 year, starting with Hornocker's benchmark cougar population and ecology research from the 1960's (Hornocker 1970). Seidensticker et al. (1973) then elucidated the social organization of cougars and contributed additional information on this cougar population and its food habits. Koehler and Hornocker (1991) compared resource use among cougars, bobcats, and coyotes. Quigley et al. (1989) found that cougar numbers in the Big Creek drainage had increased over a 20-year period in correlation with an increase in elk numbers since the 1960s. In 1995 and 1996 the U. S. Fish & Wildlife Service reintroduced 35 wolves into the central Idaho wilderness, as part of the restoration of wolves to the northern Rocky Mountains. Two of these wolves became the breeding pair of the Chamberlain Pack in 1996 and established a home range that included the Big Creek drainage.

There is strong potential for competition between the recently introduced wolves and resident cougars, because both large carnivores primarily prey on large ungulates and have similar diets when they occur together (Husseman et al. 2003, Kunkel et al. 1999, Ruth 2004b). Competition could be expressed through one species killing the other: as Boyd and Neal (1992) and Ruth (2004b) found with adult cougar mortality in Glacier National Park and Ruth (2004a) documented with cougar kitten mortality in Yellowstone National Park, or cougars could kill wolves. Exploitation competition can occur when these sympatric species share the same food, space, or habitat resources. Interference competition can occur when one species interacts with the other, such as wolf displacement of cougars from their kills. Competition can result in decreased reproductive success or survival of one or both species or lead to resource partitioning to decrease competition (Colwell and Futuyma 1971). Kunkel et al. (1999) found evidence of exploitation and interference competition following wolf recolonization of cougar habitat in northwest Montana, but stated that wolves and cougars had not yet partitioned food resources or space. In assessing the magnitude of the effect of wolf reintroduction on ungulate populations, it is necessary to understand whether wolf predation will be additive to other causes of mortality or be partially offset by changes in predation by other large carnivores such as cougars. Kunkel and Pletscher (2001) determined cougar and wolf predation on white tailed deer (Odocoileus virginianus) in Montana was primarily additive. Cougar numbers and distribution could decline as a result of wolf competition, affecting sport hunting harvest of ungulates as well as cougars. A simultaneous investigation of wolves and cougars provides valuable insights into the influence they have on each other and their combined effect on prey species. Results from this study will guide resource managers in understanding the integrated impact of these sympatric large carnivores on ungulate prey. Furthermore, information from this research is essential for predicting the outcome of wolf recolonization or reintroduction in other

areas where cougars occur. The objectives of our study were 1) to assess wolf-cougar-prey dynamics in a wilderness setting, 2) assess competition and resource partitioning of food, space, and habitat between cougars and wolves, and 3) document interspecific interactions and killing between cougars and wolves.

STUDY AREA

Research was conducted from University of Idaho's Taylor Ranch Field Station on Big Creek, in the Frank Church - River of No Return Wilderness (FC-RNRW) in Idaho (Figure 2). The Big Creek study area is in the center of the 9,550 km^2 FC-RNRW, and surrounded by an additional 6,450 km^2 of designated wilderness. The 550-km^2 study area is the Big Creek winter range for elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), and bighorn sheep (*Ovis canadensis*). Terrain is steep and dissected by the east flowing Big Creek drainage and its tributaries. Bunchgrass slopes, mountain mahogany (*Cercocarpus ledifolius*) outcrops, and open Douglas fir (*Pseudotsuga menziesii*) forests dominate south aspects; dense Douglas fir forests occur on north aspects, with deciduous vegetation (*Populus trichocarpa*, *Alnus incana*, *Betula occidentalis*) in narrow riparian zones. The winter range is semi-arid; annual precipitation at Taylor Ranch Field Station is 38 cm. Elevations range from 1,200 to 2,200 meters. Native ungulates are migratory and include elk, mule deer, bighorn sheep, moose (*Alces alces*), and mountain goats (*Oreamnos americana*). Over the past century, the Big Creek large carnivore community has consisted primarily of cougars, black bears (*Ursus americanus*), coyotes (*Canis latrans*), and bobcats (*Lynx rufus*), while wolverine (*Gulo gulo*), fisher (*Martes pennanti*), lynx (*Lynx canadensis*), and the occasional grizzly bear (*Ursus arctos*) have also been present. During the same time period, state and federal agency records and historical documents indicated that the numbers and relative abundance of the ungulate species have varied considerably (Figure 1). Bighorn sheep and mule deer were the most common ungulates on Big Creek 100 years ago (Caswell 1895), but elk colonized the area in the 1940s (Coski, Trueblood, and Manis. 1940. USFS unpublished winter range ungulate surveys of Big Creek, 1940, Payette National Forest, McCall, Idaho, USA) and increased in numbers until they peaked in the mid 1990s (Idaho Department of Fish and Game unpublished data, McCall, Idaho, USA). Elk productivity decline to 17 calves per 100 cows in 1995, a few years before the Chamberlain Wolf Pack established a winter home range on Big Creek, reached a low of 7 calves per 100 cows in 1999 and increased to 21 calves per 100 cows in 2003. Since 1986, elk numbers have exceeded mule deer numbers. Elk, mule deer, bighorn sheep, moose, cougars, black bears, and bobcats are hunted species. Mean population estimates for ungulates during 1999-2002 were 1185 elk, 650 mule deer, 150 bighorn sheep, and 30 moose.

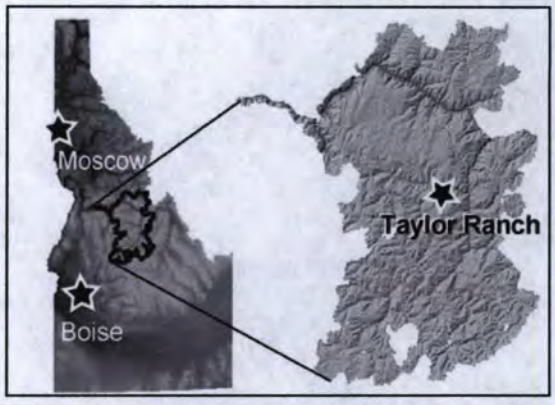

Figure 2. Frank Church River of No Return Wilderness in Idaho and location of Taylor Ranch Field Station on Big Creek.

METHODS

Our study began in the 1998-1999 winter and we monitored wolves and cougars four winters, December through April. The Chamberlain Pack breeding pair were both radio collared in Canada prior to their release in Idaho in 1995. They had their first litter of pups in 1996 and by 1998 there were 7 individuals in the pack. We captured and radio collared 8 cougars from 1999 to 2001 using trailing hounds. Cougars were immobilized with ketamine and xylazine in accordance with the Hornocker protocol (Quigley 2000). Cougar capture and handling was authorized through University of Idaho Animal Care and Use Committee Protocol 1999-23.

We evaluated carnivore competition by comparing food habits. To do this, we intensively searched for kill sites along trail systems, ridgelines, and canyon bottoms within the study area. We travelled up to 30 km daily searching for kill evidence including localized scavenger bird activity, tracking and back-tracking wolf and cougar tracks, and looking for carcasses and blood in the snow. All of our field logistics involved ground travel, either on foot, using snowshoes, or by riding mules, and was supported by aerial telemetry. Once a carcass was located we examined the carcass and surrounding area to determine cause of death and which carnivore made the kill if mortality was due to predation. We collected and dried marrow fat from femurs and calculated percent femur fat using techniques by Neiland (1970). We had an incisor tooth sample from each carcass aged through cementum annuli analysis (Matson's Laboratory, Milltown, MT, USA). We categorized our confidence in identifying the predator as possible, probable, or positive. The latter two categories, indicating higher certainty, were used for comparison following the protocol of Murphy (1998). We also used snow tracking or remote cameras to document scavenging activities.

Winter seasonal home ranges of a Chamberlain Wolf Pack member and 5 cougars were calculated from 95% and 50% fixed kernel home range analyses using the Animal Movement extension (Hooge and Eichenlaub 1997) in ArcView Geographic Information System (GIS, Environmental Systems Research Institute, Redlands, California, USA). A minimum of 30 locations per seasonal home range estimate were obtained through weekly aerial telemetry flights and ground locations at least 2 days apart. We used chi-square analysis to test for differences in sympatric cougar and wolf diets. Chi-square analysis was also used to compare the proportion of calf elk killed by cougars and wolves and the proportion, which occurred on the study area, as well as to compare age distributions. Differences in the two carnivores' intensity of scavenging and preying on animals in poor condition were also evaluated using chi-square analysis.

RESULTS

Reproduction and Mortality

Reproductive success was monitored for both species. The Chamberlain wolf pack size in winter was typically seven to ten wolves. The mean litter size for wolves was 4.8 pups per year. By contrast, the cougar population changed from ten to six resident adults during the study period. Four to six adult cougars were females, producing a total of 1.5 litters per year. Mean litter size was slightly under two kittens per litter. Mortality was monitored over the four-year period with two of five collared wolves dying from illegal human caused mortality. Six of seven radio instrumented cougars died during the study. A total of 20 cougar mortalities were documented in this four-year period, including 14 from hunting, 3 from intraspecific strife, 1 starvation, 1 foot

injury/starvation, and 1 killed by wildfire. Hunter harvest represented 44% annual removal of the adult resident cougar population.

Home ranges

The Chamberlain Wolf Pack's winter home range, 1,130 km^2 (95% fixed kernel), was significantly larger than individual cougar winter home ranges and encompassed two ungulate winter ranges. The wolf pack was very mobile, spending time in both the Big Creek and Chamberlain Creek ungulate winter ranges (Figure 3 and 4). In contrast, 3 female cougar winter home ranges were 40.9 km^2, 57.4 km^2, 261 km2, and two male cougar winter home ranges were 618 km^2 and 398 km^2 (95% fixed kernel). Aerial telemetry locations revealed a high degree of winter home range overlap between radio-collared cougars and the Chamberlain wolf pack, with the wolf home range encircling 4 of 5 cougar home ranges in 2000 (Figure 3). The proportion of time the wolf pack spent on the Big Creek winter range varied from 27% prior to the study period to 78% during the study (Figure 4). A large-scale wildfire (700 km^2) burned over 80% of the study area in August of 2000. The fire caused extreme habitat alteration, initially a loss of ungulate winter forage in 2001, then an abundance of nutrient rich grasses, forbs, and shrubs in the following years. In response to the lack of food on the burned winter range, many Big Creek elk migrated to the Chamberlain Creek winter range in the winter following the fire, but returned to the Big Creek the next winter. The wolf pack also avoided Big Creek in 2001; instead it switched its primary use to the Chamberlain winter range (Figure 4). Cougars remained in their Big Creek home ranges in winter 2001 despite the burn and preyed more on alternative food resources such as moose, beaver, coyote, and eagle since fewer elk were

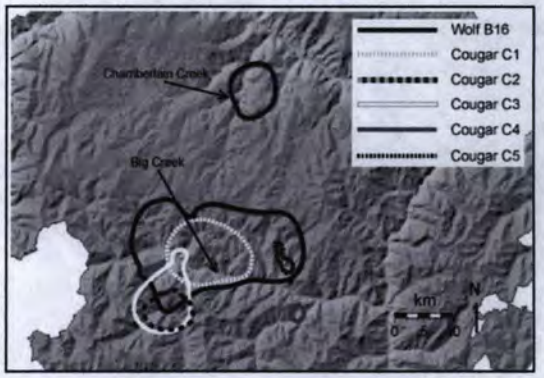

Figure 3. Chamberlain alpha male wolf B16 and 5 cougar winter home ranges (50% fixed kernel home ranges) in the FCRNR Wilderness.

available (Figure 5). As a result of the wildfire, there are two winters of pre-fire and two of post-fire data.

Food Habits

We investigated 192 carcasses during the four winters. Among these carcasses, 84 were cougar kills and 51 were wolf kills. Both cougars and wolves preyed predominantly on elk and mule deer, although cougars had a more diversified diet, particularly after the 2000 fire (Figure 5). In areas where both wolves and cougars occurred, their proportional utilization of elk and deer was the same (c2 $p = 0.747$; Figure 6). In these areas where home ranges overlapped, neither cougars nor wolves exhibited prey selection between elk and deer; instead, both carnivores killed the two ungulates in the same proportions as the relative abundance of elk and deer within the Big Creek winter range area of overlap (cougar c2 $p = 0.645$, wolf c2 $p = 0.997$; Figure 6). Wolves killed a higher proportion of calf elk (48%) than did cougars (24%; c2 $p = 0.048$) and both species selected for calves when compared to the proportion of calves in the elk population (11%; cougar c2 $p = 0.011$, wolf c2 $p = 0.001$). The Big Creek elk population had a high proportion of older aged cows, as suggested by the 9-

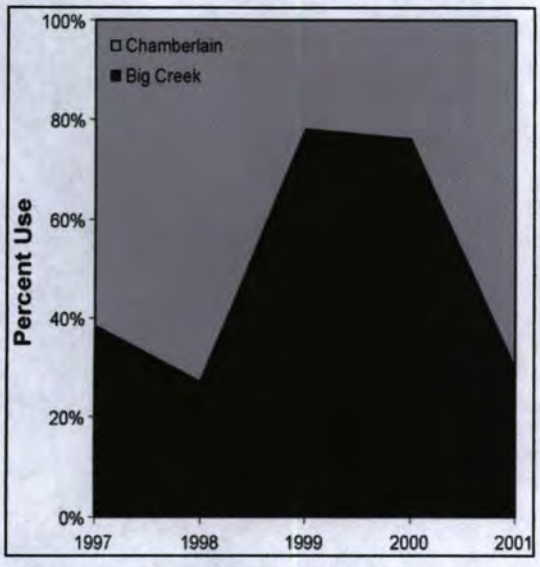

Figure 4. Chamberlain Wolf Pack use of two ungulate winter ranges: Chamberlain Creek and Big Creek.

year-old median age of hunter harvested cow elk during the study period. Cougars and wolves killed many older aged cow elk (cougar median elk age 13, wolf median elk age 11). There was no significant difference in the age distribution of elk killed by cougars and wolves ($c2 = 2.91$, $p = 0.406$; Table 1) and neither carnivore killed elk with a different age class distribution than hunters (cougar $c2 = 3.13$, $p = 0.372$; wolf $c2 = 7.30$, $p = 0.063$; Table 1). We found no difference in the proportion of kills that had severely depleted femur fat between wolf-killed elk (36%) and cougar-killed elk (20%; $c2$ $p = 0.194$).

Interactions

We did not document any fatal interspecific interactions between wolves and cougars; however, we did document three cases of mature male cougars killing other male cougars, one occurrence of a female cougar with kittens feeding on one of the dead male cougars, and one incidence of wolves feeding on one of the dead male cougars. Wolves visited or scavenged cougar kills much more often (18%) than cougars visited wolf kills (4%; $c2$ $p = 0.019$, $n = 84$ cougar kills and 51 wolf kills). The proportions of carcasses scavenged by wolves and cougars were nearly identical to the findings of Ruth (2004b) in Glacier National Park. We found evidence that two cougars were treed by wolves at cougar kills (mule deer and bighorn sheep); the cougars abandoned the carcasses and wolves usurped the kills. We documented long distance movements by 2 cougars up to 2 days after wolves arrived in their home range, but were unable to statistically evaluate these movements. The cougar often moved to a distant edge of its home range when wolves were present in its home range, suggesting avoidance behavior (Figure 7).

DISCUSSION

Potential for Competition

We found potential for interspecific competition between the resident cougar population and a reintroduced wolf pack on the Big Creek study area, including home range overlap and shared food resources.

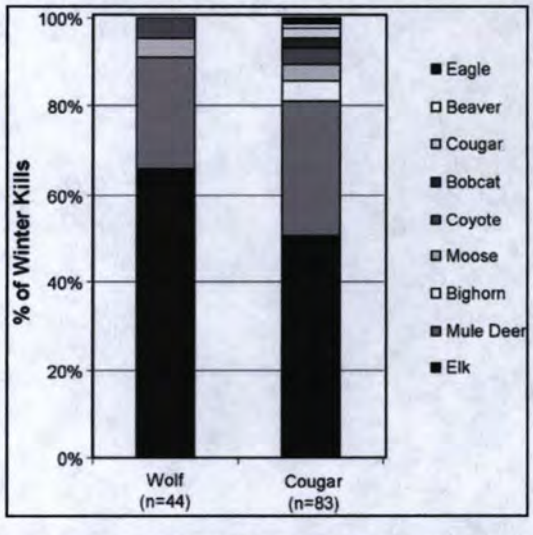

Figure 5. Winter food habits of wolves and cougars in the Big Creek study area, 1999-2002.

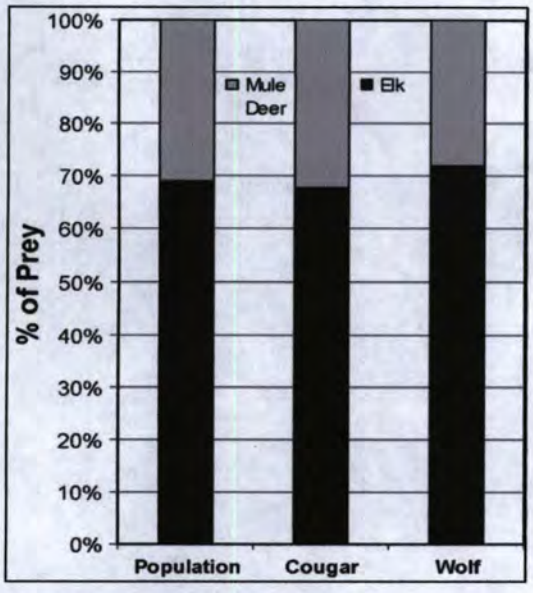

Figure 6. The proportion of elk versus deer killed by sympatric wolves and cougars during winters 1999-2002 and a comparison to the relative abundance of the two ungulates in the Big Creek area of home range overlap.

The 2 large carnivores shared much of the Big Creek ungulate winter range; the wolf pack home range encompassed most of the cougar home ranges on Big Creek except for those in steeper, rockier, and more arid section of the drainage. Sympatric cougars and wolves on Big Creek had similar food habits and shared the same prey populations, thus competing for the same food resources. While Kunkel et al. (1999) found cougars and wolves both selected white-tailed deer over elk, Husseman et al. (2003) found wolves selected elk over deer, and Hornocker (1970) documented that Big Creek cougars selected elk over deer; we did not find any diet selection by wolves or cougars. Like Husseman et al. (2003) we found besides having similar diets, wolves and cougars both selected calf elk over adult elk. The combined predation of cougars and wolves on ungulates could result in decreased prey numbers, further increasing competition. In fact, the Big Creek elk population did decline 20 percent during the study period, and it had declined 15 percent in the 4 years prior to research. The declining elk population, as well as large-scale wildfire, has exacerbated interspecific competition.

Many environmental and temporal factors play into interspecific competition. Koehler and Hornocker (1991) researched competition between mountain lions, bobcats and coyotes in this same study area from 1980-1985. They observed that during winter interspecific competition increased due to both predators and prey congregating at lower elevations. This increased density of food resources resulted in more frequent predator contact. Cougars proved to be the dominant competitor in this drainage 20 years ago, with both bobcats and coyotes incurring fatal consequences, particularly when visiting cougar kill sites.

Expression of Competition

Direct interspecific mortality was not observed between cougars and wolves on Big Creek, however, cougar behavior including treeing from wolves, moving from kills and avoiding wolf contact, and a low incidence of kittens suggested cougars experienced or perceived a threat from encounters with wolves. Interspecific competition can result in decreased reproductive success and increased mortality, leading to population declines. Reproduction and recruitment of subadult cougars on Big Creek was half that documented by Hornocker (1970) from the same study area in the 1960s. For 5 years, we monitored a newly independent resident female cougar that interacted with wolves. During that period, we did not find evidence that she had kittens with her, although we did document her (consorting) with male cougars on several occasions. In both study years post forest fire this cougar exhibited natal localization behavior described by

Table 1. Age distribution of female elk and calves killed by cougars, wolves, and hunters.

Elk Age	Cougar kills	Wolf kills	Hunter harvest
Calf	10	11	2
Yearling	3	0	0
2-8 yrs	8	4	9
9-20 yrs	21	8	14

Seidensticker (1973). However, follow-up monitoring did not verify that she had kittens at heel. Murphy (1998) defined female cougar reproductive success as the ability to raise a litter of kittens to dispersal age. Both Murphy (1998) and Logan (2001) noted that reproductive success of female cougars is highly variable and Robinette et al. (1961) found that one sixth of mature female cougars he sampled had never been pregnant, so we do not dare draw conclusions based on the reproductive success of only one female. However, during the same years post forest fire, we only documented one other female cougar track with a single kitten.

Cougar mortality during 1999-2001 was much greater than that reported for the same study area in 1960s (Hornocker 1970), 1970s (Seidensticker et al. 1973), and 1980s (Quigley et al. 1989), primarily due to high hunter harvest, but also due to intraspecific strife and starvation. High cougar harvest during the study period probably decreased interspecific competition, but wolf competition, coupled with low reproduction and apparent year-long vacancies in 2 female home ranges may slow or inhibit recovery of cougar numbers to previous levels. Logan's (2001) research in New Mexico indicated that when harvest of the adult cougars exceeds 28% a population decline occurs. The 44% annual harvest level on Big Creek exceeded that threshold, and age structure on harvested cougars has changed from primarily mature cougars to mostly subadults (Idaho Department of Fish and Game unpublished data, McCall, Idaho, USA).

Intraspecific strife was not observed during previous cougar research projects in this study area (Hornocker 1970, Seidensticker (1973). Seidensticker (1973) mentioned that male cougars he handled on Big Creek did not have scars from fighting. Hornocker (1970) suggested fighting should be rare in a stable cougar population. In contrast, we documented intraspecific strife among cougars in three cases of mature male cougars killing other males and we observed injuries and scars on males from fighting. Our findings were more similar to those of Logan et al. (1986), Murphy (1998), Ross and Jalkotzy (1992) and Ruth (2004b) and were indicative of a disrupted social structure. Ruth (2004b) suggested that increased intraspecific aggression among cougars might lend further support of exploitation competition between sympatric cougars and wolves in northwestern Montana. It is unclear whether this

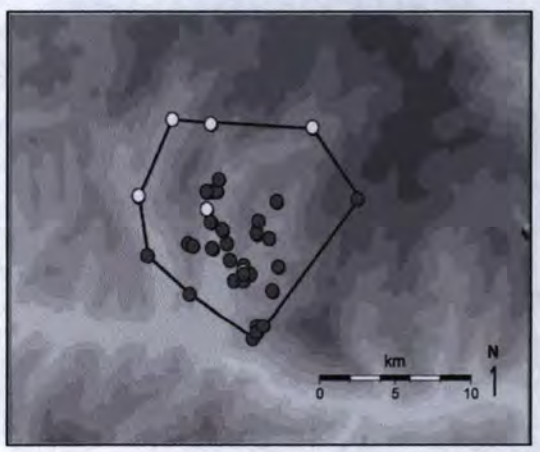

Figure 7. Cougar avoidance of wolves: Female cougar C-5's year 2000 winter home range (100% MCP) and locations. The 6 white circles were cougar locations immediately following the 6 occasions when wolves arrived in the cougar's home range; gray circle cougar locations were when wolves were not in the cougar's winter home range.

breakdown in social structure observed on Big Creek was precipitated by declining elk numbers, wolf arrival in the Big Creek drainage, or other factors, but the strife we observed occurred in the first two years of the study, prior to wildfire and heavy hunting pressure.

Interference competition can be difficult to quantify because it can occur at both individual and population levels (Ruth 2004b). Interference competition occurred on Big Creek when wolves adversely affected cougars when they visited cougar kills, usurped carcasses from cougars, and caused cougars to make long distance movements. These cougar responses could result in decreased food intake or starvation (Ruth 2004b) and increased physical and endocrine stress, and potentially decreased hunting success if cougars leave preferred hunting areas to avoid wolves. These factors could have contributed to the observed lower cougar reproductive success and survival on Big Creek, although Kunkel et al. (1999) believed that it was unlikely that interference competition by wolves resulted in an observed cougar population decline in Montana.

Conclusion

We found biological and social cougar responses that could be explained by interspecific competition with recently established wolves. Unfortunately, with confounding factors which can also affect cougar population dynamics - such as a declining prey population, high hunter harvest, large-scale environmental change from forest fire - it is difficult to assess the relative contributions of each factor in causing the observed decline in the cougar population and its productivity during the 1999-2002 study period. The combination of factors exacerbated the effects of interspecific competition. Wolves were more adaptable to large-scale environmental change than were cougars. Wolves are social animals so the wolf pack shared a very large home range. Therefore, the wolf pack was able to move long distances (35 km) within their home range to areas of higher prey density in another ungulate winter range when elk abandoned the burned Big Creek winter range after the fire. In contrast, cougars were limited by their smaller home range sizes from moving long distances to more suitable areas. When elk left the burned Big Creek winter range the first winter after fire, cougars responded to the lower prey density by diversifying their diets. Branch et al. (1996) observed a similar response by cougars in Argentina following a prey population decline. Wolves benefited more from their association with cougars than cougars did with their association with wolves, since wolves gained food from cougars more often. The timing of this study immediately after wolf reintroduction allowed us to examine cougar and wolf responses to "first encounters" with each other. The characteristics of this initial phase of coexistence may be transient and more overt compared to a future time period when the two large carnivores will act to minimize the effects of interspecific competition by partitioning habitat, food resources, and/or space, or one species' population will decline as a result of interspecific competition.

ACKNOWLEDGEMENTS

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Jay Mize, Mike Schlegel, and Renan Yanish. Ray Arnold piloted fixed wing aircraft used, and Jim Pope provided helicopter assistance.

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WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

Wildlife Conservation Society
2002 Annual Summary

by Holly Akenson, James Akenson, and Howard Quigley

Collaborators: Hornocker Wildlife Institute
DeVlieg Foundation
University of Idaho
Nez Perce Tribe
Idaho Department of Fish and Game

June 30, 2002

Each winter in the wilderness revealed new surprises about the lives and interactions of the large carnivores and their prey. Last winter was the fourth field season tracking wolves and cougars in the Idaho wilderness. This research project was initiated in 1998 following the reintroduction of wolves to Idaho in 1995. We are evaluating the effects of wolf and cougar predation on wintering elk, mule deer, bighorn sheep, and moose populations and investigating the interspecific interactions and competition between cougars and wolves.

Over the past 4 winters we have examined 183 large mammal carcasses. Twice as many carcasses were found of animals killed by cougars as those killed by wolves. An extensive forest fire burned most of the winter range 2 years ago and contributed to changes in animal numbers and distribution on the Big Creek winter range. A helicopter elk census last winter confirmed that elk numbers have declined 30% during the last 6 years, although observations of mule deer suggest that deer numbers are stable or increasing. Cougar and wolf diets were similar. Neither predator showed a strong diet preference between elk and mule deer. Being coursing predators, wolves killed more elk in poor condition than did cougars, which hunt by stalking and ambushing prey. The large home range of the wolf pack allowed the wolves to follow the elk when they migrated to a new unburned winter range the first winter after the wildfire. The cougar response to post-fire changes in elk numbers and prey health was to remain in their smaller home ranges and diversify their diets. Cougars even killed 3 moose that were starving after the fire burned up the riparian shrubs; moose are usually not vulnerable to cougar predation due to their large size. Elk calves and deer fawns were more vulnerable to wolf predation than cougar predation.

The cougar population experienced a high rate of replacement for resident cats due to mortality. The main causes of cougar mortality were hunter harvest, fighting between males, wildfire, and starvation. Strife among carnivores was documented on several occasions. Cougars killed 3 cougars, 3 coyotes, and 2 bobcats, while wolves killed 2 coyotes. Cougars appear to avoid wolves and their kills. Cougar kitten production has been low. In the 2 winters since the forest fire no kitten production was documented. Track surveys and carcass locations suggest there are several areas previously used by female cougars that are now unoccupied. During winter the Chamberlain wolf pack was comprised of 8-12 wolves, including the original alpha pair from the reintroduction and their offspring from the last few years. The wolf pack hunted in 2 ungulate winter ranges. Last winter was the first in which more kills were found made by wolves than cougars.

These large carnivores indirectly influence animal and plant populations and communities at lower trophic levels. For example, cougars and wolves repeatedly killed coyotes and bobcats during this study. These midsize carnivores strongly targeted fawns as a food source. If the large carnivores suppress the midsize carnivore populations, predation pressure could shift from deer fawns toward elk calves. In contrast, where female cougar home range areas have been unoccupied following the fire, coyote activity and predation on fawns has increased.

This next year we will be analyzing research data on prey and predator populations, comparisons of cougar and wolf diets and spatial use patterns, and interaction among cougars, wolves and mid-size predators. The cougar and ungulate data will be incorporated with information from 4 decades of cougar research on the Big Creek winter range, beginning with Maurice Hornocker's pioneering cougar research in the 1960s.

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WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

Wildlife Conservation Society
Annual Report

by Holly Akenson, James Akenson, and Howard Quigley
Hornocker Wildlife Institute
July 1, 2001

REPORT SUMMARY

This investigation of large carnivore predation was initiated in 1998 following the reintroduction of gray wolves into the central Idaho wilderness in 1995. The goals of this project are: 1) to understand the effects of large carnivore predation on prey populations, primarily elk and mule deer; 2) to understand the competitive relationship between the recently introduced wolf population and the established cougar population, including interactions between wolves and cougars and how these predators use the same food, habitat, and space resources. The Big Creek study area in the Frank Church River of No Return Wilderness is the same as that chosen by Maurice Hornocker in 1965 when he began the first major study of cougar ecology. This is the 4th decade of cougar investigations in this remote study area, providing a unique opportunity to compare current and historical cougar population characteristics. This Idaho wilderness study area is part of the Northern Rocky Mountains large carnivore project that includes research sites in Yellowstone National Park, Grand Teton National Park, and National Forest lands in Idaho where wolf and cougar predation is being investigated and compared among diverse habitats and prey populations. Results of this research will have strong practical and theoretical implications for understanding the dynamics of two competing large predators, their influence on prey populations and sport hunting opportunities, and predicting the outcome of wolf reintroduction in other areas.

Winter 2001 was the third season of wolf and cougar research. One wolf pack and 2-5 cougars have been monitored using radio telemetry. As in previous years, predation was the major cause of winter mortality for elk and mule deer. Elk calves were highly vulnerable to cougar and wolf predation, while mule deer fawns were not preferred more than adult deer by these predators. The difference in calf and fawn vulnerability to predation may be related to population status and vigor; the elk population reached record high numbers in recent years and is beginning to decline while the mule deer population is in a growth phase. In contrast, calf vulnerability may reflect the greater difficulty in killing a large animal like an adult elk. Preliminary elk age data suggest that the elk population decline began prior to wolf colonization of this area. The wolf pack winter home range was 15 times larger than those of 2 female cougars and encompassed several cougar home ranges. When the wolf pack moved into a cougar's home range the pack's presence displaced the cougar from preferred areas and disrupted cougar hunting and feeding patterns. Cougars did not appear to impact wolf activities.

In August 2000 a massive forest fire, twice the size of the Yellowstone fires created a significant environmental change in the Big Creek study area that affected predator–prey and predator–predator relationships, when 60% of the winter range was burned. The lack of food in the new burn caused many elk to migrate to a different winter range, while more of the elk that remained on the burned winter range were in poor condition than previous years, despite a mild winter. Wolves and cougars used different strategies to adapt to fire-caused changes in vegetation and prey abundance. The wolf pack moved long distances within their large home range and spent most of the winter in the unburned winter range where the Big Creek elk had migrated. In the previous 2 years that winter range had only been used incidentally by the wolf pack. Cougars responded to fire changes by remaining on the Big Creek winter range and opportunistically diversifying their diets relative to prey vulnerability; such as killing 3 moose that were in poor condition due to the destruction of winter browse by fire. Typically solitary, cougars were concentrated in unburned pockets following the fire. Cougar-to-cougar encounters and visits to one another's kills were more common while cougar-to-wolf interactions were less common in the winter following fire than previous winters.

The diverse responses of cougars and wolves and their prey to the fire-changed environment last winter has provided a much more thorough understanding of the dynamic interrelationships of large predators and their prey. The major ecological change caused by the extensive forest fire has provided a unique opportunity to evaluate the relationships of the same predators and prey in the same place under pre-fire and post-fire conditions. A continuation of this research for several years post-fire is crucial to capitalize on this unusual situation where environmental conditions have been significantly altered during ongoing research.

PROJECT TITLE: Winter Predation and Interactions of Cougars and Wolves in the central Idaho Wilderness

SUMMARY LINE: . The purpose of this study is to assess the effects of cougar and wolf predation on wintering prey populations of elk, mule deer, and bighorn sheep and to evaluate interspecific competition between wolves and cougars, including interspecific interactions and partitioning of food, habitat, and space resources.

PROJECT LEADERS: Jim Akenson, Holly Akenson, and Howard Quigley with Hornocker Wildlife Institute.

OTHER STAFF: All staff was part time. Chris McDaniel, Matt Jones, Pete Armichardy, and Scott Relyea worked as field biologists last winter and spring. Jay Mize was hired as the houndsman for cougar capture. There was no staff on the project during summer or fall.

COLLABORATORS AND INSTITUTIONAL AFFILIATIONS: Nez Perce Tribe, University of Idaho, Idaho Department of Fish and Game, and financial support from the DeVlieg Foundation.

PROJECT DURATION: This large carnivore predation project began in December 1998 and was originally scheduled to be a 4-year project. Winter 2000-2001 was the third year of the project. A major forest fire in the study area in August 2000 has created a unique opportunity to study predator–prey and predator–predator relationships following a significant environmental perturbation. Results of the first winter following the fire have revealed the dynamic, but differing strategies of wolves and cougars in response to changes in vegetation and prey species. The project duration needs to be extended so cougar and wolf predation and interactions can be compared pre- and post-fire. This is a rare opportunity to compare the same predators interacting with each other and their prey under 2 different environmental conditions.

2000-2001 BUDGET: $60,000. Next year's budget needs will be similar if this project is continued, with an additional $10,000 for GPS collars for 3 cougars: $70,000. New funding, possibly $20,000 is expected from U.S. Fish and Wildlife Service for next year. If fieldwork is terminated, budget needs will primarily be personnel, office, and travel expenses associated with data analysis and preparing reports, publications, and presentations to complete this phase of the predation project.

ACTIVITIES/PROGRESS: Last winter we located 51 large mammal carcasses, determined cause of death, and evaluated nutritional condition, health, and age of elk, mule deer, moose, and bighorn carcasses. We assessed elk population status, including age of females, pregnancy rates and calf recruitment. We located radiocollared cougars and wolves 1-2 times per week during winter and spring for home range analysis and comparisons between cougars and wolves. We conducted 2 predation sequences on cougars and documented cougar response to wolf activity in the cougar home range. We analyzed differences in cougar and wolf responses to large-scale wildfire. One additional cougar was radio instrumented in February. Results were presented at 2 professional conferences.

EXPLORATORY ACTIVITIES: A major forest fire caused a significant environmental change to the study area. We evaluated the effects of the fire on wolves, cougars, and their prey. We compared cougar and wolf pre- and post-fire movements, home range use, interactions, and diets to compare cougar and wolf strategies for adapting to fire-caused changes in vegetation and prey abundance. We backdated elk birth years from hunter and winter carcasses to determine whether there was a correlation between the timing of wolf reintroduction and the onset of poor calf elk recruitment.

PROBLEMS AND CONSTRAINTS: The greatest constraint to the project is the proposed termination of field investigations. The forest fire has created an unusual opportunity to explore the dynamic relationships and strategies of large carnivores and their prey as they adjust to a rapidly changing environment. Observations from the first winter following fire indicate that cougars and wolves readily adapt to changes in prey distribution and vulnerability. We should predict cougar and wolf responses to fire-caused environmental changes and test these hypotheses as plant succession and changes in prey numbers and distribution occur during the next few years. GPS radio collars are needed to more thoroughly evaluate interspecific and intraspecific interactions between cougars and wolves.

GOALS AND ACTIVITIES FOR THE NEXT YEAR: There are 2 scenarios for activities next year:

1.) If field activities are terminated the primary goal next year will be to conduct data analyses and report and publication writing based on 3 years of field data.

2.) If this project is extended for several years post-fire some cumulative data will be analyzed from this phase of the project, including home ranges and movements, cougar predation rates, and effects of wolves on cougar foraging patterns. Greater sample sizes are needed for statistical comparisons of wolf and cougar prey selection, interspecific and intraspecific interactions, cougar predation rates, and timing of the elk population decline. Additional hypotheses will be selected for testing in the post-fire environment. Field activities will be continued to assess predator–predator and predator–prey relationships post-fire and to increase sample sizes. Field activities will include:

- Radio collar 3 female cougars with GPS collars and evaluate collar effectiveness
- Document daily movements and activities of cougars and wolves when they are in close proximity to each other using GPS collars to enhance analysis of interspecific competition
- Conduct predation sequences on 2 cougars
- Continue aerial telemetry for winter home range and animal movements analyses
- Continue collection of winter carcass data
- Assess population parameters and health of elk and deer populations and carcasses
- Assist Idaho Department of Fish and Game with a helicopter elk sightability population survey
- Collect jaws and age elk from hunter harvested animals to determine the timing of the decline in elk productivity

CONSERVATION ACCOMPLISHMENTS AND EVALUATION:

This large carnivore predation research has provided new information about the influence of prey population status on the effects of predation; the nature of cougar and wolf competition; and the adaptability of cougars, wolves and their prey to significant environmental change. The predator and prey relationships that are being revealed in this wilderness study area are representative of wild lands throughout the western United States where ungulate and cougar populations are also managed by state wildlife agencies. We are in a pivotal position to provide knowledge of state, national, and international significance on wolf ecology and the effects of wolf colonization in the Idaho recovery area and to predict the outcomes of wolf reintroduction and colonization of other areas as wolves disperse into unoccupied habitats.

Conservation highlights (We need to caution that some of the relationships proposed here are based on preliminary findings and need to be validated.):

- Predator–Prey Relationships. Elk predation by reintroduced wolves may not be a population limiting factor for this central Idaho elk population that is at carrying capacity and appears to have started to decline in productivity prior to the establishment of wolves. As elk numbers decrease the influence of wolf and cougar predation may become more additive to other mortality causes. Mule deer productivity is greater than elk and may be increasing, despite predation by a recently established wolf pack.
- Cougar and Wolf Competition. Cougar and wolf diets are similar and the wolf pack home range encompasses multiple cougar home ranges. Interference competition adversely affects cougars more than wolves, as cougars avoid interactions with wolves by moving from wolves. We have observed examples where cougars have abandoned their kills and increased days between making kills when wolves were in the cougar home range.
- Adaptation to Environmental Perturbation. Large-scale wild fire provided an experimental situation where we could assess dynamic strategies used by cougars, wolves and their prey to optimize foraging and survival following a major environmental event. As plant succession continues to change this area, predator–prey and predator–predator relationships may differ from pre-fire relationships as a result of changes in ungulate carrying capacity, distribution, and species and age composition and their effects on competition between cougars and wolves.

PUBLICATIONS:

Cumulative results of this cougar and wolf predation project were presented at the North American Interagency Wolf Conference at Chico Hot Springs, Montana, April 2001 and at the annual meeting of the Idaho Chapter of The Wildlife Society at Boise, Idaho, March 2001.

Holly Akenson, Jim Akenson, Howard Quigley. 2000. Predation and interactions of wolves and cougars on Big Creek in central Idaho, winter 2000 annual report. 15 pages. Hornocker Wildlife Institute, Bozeman, Montana.

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TAYLOR RANCH FIELD STATION MANAGER, RESEARCH BIOLOGIST, 9/82 to 9/90, and 9/97 to present. University of Idaho. Cascade, ID.

- Coordinate and facilitate the research and educational use of Taylor Ranch Wilderness Field Station.
- Conduct research on cougar and wolf interactions and predation behavior on deer, elk, and bighorn sheep through the Hornocker Wildlife Institute and Wildlife Conservation Society.
- Host conferences, UI faculty, agency professionals, and field classes. Participate in class instruction.
- Hire and supervise 3-4 crew members for predation study conducted through the Hornocker Wildlife Institute.
- Supervise a summer student internship program, teach wildlife research techniques, backcountry horsemanship, and various wilderness skills.
- Collaborate with many organizations including the USFS (noxious weed management and cultural resource issues), Nez Perce Tribe (wolf monitoring and research), IDF&G (census of several game and non-game species), Idaho State University (post fire monitoring of aquatic invertebrates), and area high schools (teach natural history appreciation).

BLACK BEAR RESEARCH, WILDLIFE BIOLOGIST II, 7/93 to 9/97, Oregon Department of Fish & Wildlife. La Grande, OR.

- Supervised all field research activities on a 4-year study of the ecology of black bears in the Blue Mountains in NE Oregon. This included supervising from 1-3 ODFW personnel and from 2-6 volunteer houndsmen.
- Captured and radio-instrumented 80 different black bears. Conducted ground and air telemetry of their seasonal movements. Documented 140 winter dens over a 4-year period.
- Coordinated with other western states black bear researchers, and ODFW NE Region District Biologists. Also provided recommendations to state level species coordinators.
- Wrote annual reports, published 3 papers, and a brochure of our findings. Presented findings of denning ecology, population dynamics, and survey techniques at state and national professional meetings.

MOUNTAIN LION RESEARCH, WILDLIFE BIOLOGIST I, 11/91 to 7/93, Oregon Department of Fish & Wildlife. La Grande, OR.

- Coordinated all capture activities, including from 1-3 volunteer houndsmen. Tracked cougars on snowshoes and snowmobiles in the Wallowa Mountains of NE Oregon.
- Immobilized and radio-collared cougars on over 100 occasions. Climbed trees and lowered immobilized cats.
- Presented findings of the habitat use portion of our study at the 1996 Mountain Lion Workshop. Gave presentations to agency professionals, sportsmen groups, and community meetings, including a presentation at the annual winter meeting of the Eastern Oregon Cattlemen's Association.
- Wrote 2 progress reports and a final report of our findings.

CONTRACT WILDLIFE BIOLOGIST, 4/91 to 9/91, Oregon Department Fish & Wildlife. La Grande, OR.

- Conducted peregrine falcon surveys in Hells Canyon and the Wallowa Mountains.
- Used my saddle and pack mules for logistical support while conducting raptor surveys in wilderness areas.
- Mapped all falcon and other raptor sightings, including nest locations and flight routes.
- Wrote a report summarizing my survey finding.
- Worked cooperatively with the Peregrine Fund to establish and monitor hacking sites.

BIGHORN SHEEP RESEARCH, CO-PROJECT LEADER, 12/88 to 4/91, Idaho Department Fish & Game / University of Idaho.

- Developed research proposal, obtained a grant from FNAWS.
- Coordinated field activities and supervised field crew.
- Wrote a final report summarizing our findings of bighorn lambing areas and lamb survival.
- Presented findings at the 1992 Symposium of Wild Sheep and Goat Council, and published a paper in the proceedings of this symposium.

MASTER'S DEGREE RESEARCH, 1979 to 1985, Oregon State University, Geography Department.

- Evaluated environmental/ecological conditions in Harris Park and surrounding BLM lands in northeast Oregon.
- Measured ecological degradation to native flora and fauna within a 5,000-acre study area.
- Conducted 3 public meetings involving diverse interest groups including: horsemen, motorcyclists, fisherman, nature enthusiasts, and Boise Cascade Corporation foresters.
- Collaborated with Umatilla County Commissioners and the BLM recreation planner in conducting the research and public input process.
- Wrote a management plan that included my findings over a 2-summer period. I made written and oral recommendations to reduce recreational impacts, protect riparian vegetation, minimize disturbance to steelhead spawning areas, and establish a user input program to evaluate recreational satisfaction and environmental change.
- Presented the plan to the Umatilla County Commission and BLM officials who adopted the plan in 1983.
- The final plan met the research requirements for an M.S. degree in Resource Geography.

EDUCATION

- M.S. Resource Geography, Oregon State University, 1985.
- B.S. Environmental Studies, Eastern Oregon State College, 1979.

RECENT PUBLICATIONS

Akenson, J.A., M.G. Henjum, and T.J. Craddock. 2001. Estimating black bear densities in northeast Oregon utilizing trained strike dogs and mark-recapture methods. URSUS 12: in press.

Akenson, J.J., M.G. Henjum, and D.W. Carroll. 2001. Denning ecology of black bear in the Blue Mountains of northeastern Oregon. Proceedings of the 6th Western Black Bear Workshop 6, Oceanshore, Washington: in Press

Bull, E.L., J.J. Akenson, M.G. Henjum. 2000. Characteristics of black bear dens in trees and logs in northeastern Oregon. Northwestern Naturalist 81:148-153.

AWARDS

- Cooperative Education Employer of the Year 2001, University of Idaho.
- President's Medallion, UI, for community service during forest fires at Taylor Ranch during August 2000.
- Outstanding Performance, ODFW, for efforts and accomplishments on NE Oregon cougar and black bear studies, September 1997.

REFERENCES:

Mark Henjum, Regional Non-game Biologist, Oregon Department of Fish and Wildlife, La Grande. 541-963-2138

Craig Ely, Northeast Region Supervisor, Oregon Department of Fish and Wildlife, La Grande. 541-963-2138

Hanley Jenkins, Union County Planning Director, La Grande. 541-963-1014

Dr. Evelyn Bull, Scientist, USDA Forest Service, Pacific Northwest Research Station, La Grande. 541-962-6504

HOLLY A. AKENSON
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TAYLOR RANCH FIELD STATION MANAGER, RESEARCH BIOLOGIST
University of Idaho, 8/97 to present and 9/82 to 6/90.

- Coordinate and facilitate research, educational, and maintenance activities at Taylor Ranch Wilderness Field Station.
- Conduct carnivore research on cougar and wolf predation and interspecific relationships in wilderness through Hornocker Wildlife Institute and Wildlife Conservation Society: initiated, designed, supervise, and conduct research; coordinate with cooperators; manage budgets; write scientific reports and popular articles and present research results.
- Supervise a summer internship program: teach field research techniques, sampling design, and wilderness skills and horsemanship to undergraduate students. Supervise undergraduate wildlife students conducting independent research projects in the wilderness.
- Develop cooperative research and educational projects with state and federal natural resources agencies, secondary schools, and private organizations. Projects include long term monitoring of wildlife, vegetation, and climate and student research and education programs.

WILDLIFE CONSULTANT
Self Employed, 5/91 to 3/98.

- Developed wildlife habitat management plans and monitoring plans, evaluated habitat, and made recommendations to federal, state, and private organizations on the management of endangered, threatened, and sensitive species including peregrine falcons, bald eagles, upland sandpipers, and osprey.
- Conducted research and field surveys on endangered, threatened, and sensitive species.
- Served as the wildlife biologist on environmental analyses and wrote NEPA reports and annotated literature reviews.

WILDLIFE BIOLOGIST
Oregon Department of Fish & Wildlife and Idaho Department of Fish & Game, 1/93 to 7/97 short-term hires.

- Nongame Biologist: Made presentations and public contacts about nongame wildlife. Developed a computer wildlife database. Provided agency wildlife management recommendations to state and federal agencies.
- Research Biologist: Studied effects of a bighorn sheep disease die-off in Oregon. Published research in the proceedings of the Northern Wild Sheep and Goat Council. Assessed the status of a declining bighorn population in Idaho. Led a bighorn lamb mortality study in the Idaho wilderness and published results.

EDUCATION

- M.S. Wildlife Resources, University of Idaho, 1992.
- B.S. Education, Eastern Oregon University, 1983.
- B.S. Biology, Eastern Oregon University, 1979.

RECENT PUBLICATIONS

Akenson, H. A. 1999. Predicting summer lamb mortality in free ranging bighorn sheep. Biennial Symposium of the Northern Wild Sheep and Goat Council 11:70-76.

Akenson, J. J. and H. A. Akenson. 1992. Bighorn sheep movements and summer lamb mortality in central Idaho. Biennial Symposium of the Northern Wild Sheep and Goat Council 8:14-27.

Akenson, H. A. 1992. Spatial relationships and behavior of bighorn sheep sharing a winter range with mule deer and elk in central Idaho. M.S. Thesis, University of Idaho, Moscow. 75pp.

CERTIFICATIONS AND AWARDS

- Certified Wildlife Biologist, The Wildlife Society
- Cooperative Education Employer of the Year 2001, University of Idaho, for educational program for student interns at Taylor Ranch.
- President's Medallion Award, University of Idaho, for community service during wilderness forest fires in August 2000.

REFERENCES

Dr. Maurice Hornocker
Hornocker Wildlife Institute
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(406)522-9333

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La Grande, OR 97850
(541)963-2138
Email: mark.g.henjum@state.or.us

Dr. James Peek, Wildlife Professor Emeritus
Fish and Wildlife Department
P.O. Box 441136
University of Idaho
Moscow, ID 83844-1136
(208)885-7120
Email: peek@uidaho.edu

BIG CREEK PREDATION PROJECT BUDGET, Winter 2000-2001

PERSONNEL	
Project Coordinators	$22,680
Field Technicians	$22,050
Houndsmen	$2,100
TOTAL PERSONNEL	$46,830
EQUIPMENT	
Wall tent, cots	$770
TOTAL EQUIPMENT	$770
TRAVEL	
Air taxi transportation	$2,090
Lodging	$360
Meals	$360
Mileage	$300
TOTAL TRAVEL	$3,110
AERIAL TELEMETRY	
38 flights ($7,000 provided by cooperators)	$2,200
TOTAL AERIAL TELEMETRY	$2,200
OPERATING EXPENSES	
Field camp food	$1,200
Field camp supplies	$450
Horse feed and shoeing	$1,700
Veterinary expenses	$200
Taylor Ranch lodging	TR
Satellite telephone & communication	$450
Office expenses	$250
Conference registration	$310
Elk pregnancy testing	IDFG
Prey tooth aging	IDFG
Elk helicopter sightability survey	IDFG
TOTAL OPERATING EXPENSES	$4,560
TOTAL BUDGET 2000-2001	**$57,470**

Project Expenses provided by Cooperators:
Nez Perce Tribe = $5,000 for aerial telemetry; use of telemetry equipment.
Idaho Dept. Fish and Game = $1000 elk pregnancy testing, $500 elk and deer tooth aging.
University of Idaho = $860 lodging at Taylor Ranch; use of office equipment and computer programs

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WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

Winter 2001 Project Overview

by Holly Akenson, Jim Akenson, and Howard Quigley
Hornocker Wildlife Institute
And University of Idaho
June 8, 2001

This investigation of large carnivore predation was initiated in 1998 following the reintroduction of gray wolves into the central Idaho wilderness in 1995. The goals of this project are: 1) to understand the effects of large carnivore predation on prey populations, primarily elk and mule deer; 2) to understand the competitive relationship between the recently introduced wolf population and the established cougar population, including interactions between wolves and cougars and how these predators use the same food, habitat, and space resources. The Big Creek study area in the Frank Church River of No Return Wilderness is the same as that chosen by Maurice Hornocker in 1965 when he began the first major study of cougar ecology. This is the 4th decade of cougar investigations in this remote study area, providing a unique opportunity to compare current and historical cougar population characteristics. This Idaho wilderness study area is part of the Northern Rocky Mountains large carnivore project that includes research sites in Yellowstone National Park, Grand Teton National Park, and National Forest lands in Idaho where wolf and cougar predation is being investigated and compared among diverse habitats and prey populations. Results of this research will have strong practical and theoretical implications for understanding the dynamics of two competing large predators, their influence on prey populations and sport hunting opportunities, and predicting the outcome of wolf reintroduction in other areas.

A massive forest fire in August 2000 created a significant environmental change to the Big Creek study area and affected predator–prey and predator–predator relationships. Winter 2001 was the third winter season of research. The fire changed the distribution of ungulates and their ability to survive the winter. Many Big Creek elk migrated to the Chamberlain winter range to the north of Big Creek, while mule deer were concentrated in the 40% of the Big Creek winter range that had not burned. Despite mild winter temperatures and low snow depths, a greater proportion of deer and elk that died during winter had severely depleted bone marrow fat than those animals that died in the previous mild winter, indicating that food sources were more limited. Moose mortality increased in Winter 2001. Two of 3 cougar-killed moose had severely depleted bone marrow fat because riparian shrubs, their primary food source, had been burned extensively in the fire.

Wolf and cougar movements were also altered as a result of the forest fire. The Chamberlain Wolf Pack used the same home range as previous winters, but only spent 27% of the time on the Big Creek winter range in 2001, compared to 78% and 81% of their time in 2000 and 1999. Since the wolf pack home range includes 2 ungulate winter ranges their effect on ungulate populations on each winter range varies according to the proportion of time spent on each range. We investigated 51 large animal carcasses on the Big Creek winter range in Winter 2001. Cougars made most of the kills. Wolves made few kills on the Big Creek winter range, although some of the elk they preyed on in the Chamberlain winter range may have traditionally used the Big Creek winter range. The one cougar that was monitored in winters before and after

the fire had a contracted home range in Winter 2001. She used the same general area as previous winters, except avoided the severely burned drainages (30%) within her previous winter home ranges. She expanded her home range into higher elevation unburned areas in Winter 2001. Wolves and cougars used different strategies to adjust to fire-caused changes in vegetation and prey abundance. The wolf pack responded by moving long distances within their large home range to unburned areas with high prey concentrations, while cougars responded by remaining on the Big Creek winter range and diversifying their diets. In Winter 2001 cougars killed elk, mule deer, bighorn sheep, moose, coyote, bobcat, beaver, and a golden eagle, while in previous years they killed only 5 large animal species each winter. As evidence that food resources may have been more limited for cougars in the winter after the fire, 24% of cougar kills were used or visited by another cougar compared to 3% and 18% in pre-fire winters.

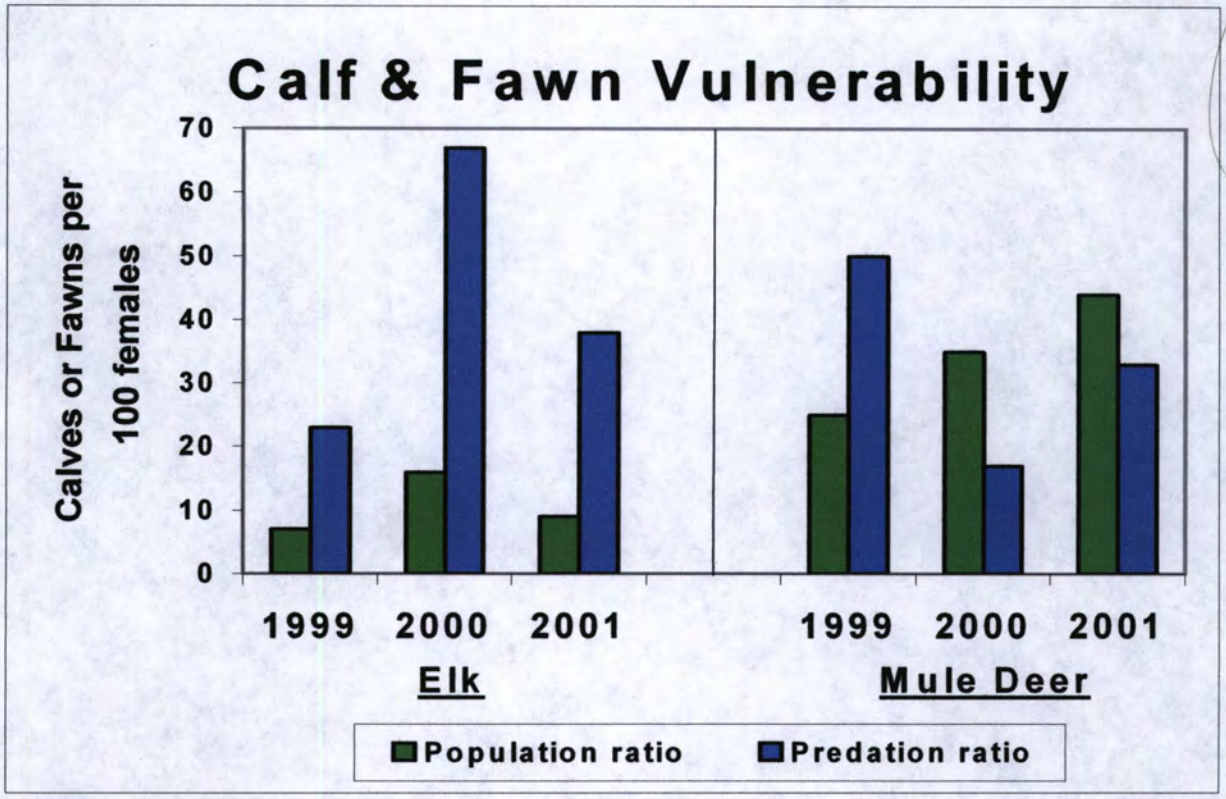
Cumulative data from multiple winters has revealed several interesting relationships: 1) timing of the Big Creek elk population decline and 2) elk calf and deer fawn vulnerability to predation. We calculated birth years based on tooth aging by cementum annuli for Big Creek cow elk that died in 1999 and 2000 during winter or from hunter harvest. Most cow elk had been born in 1979 to 1993; only 2 of 36 cows were born after 1993. This lack of young cow elk in the sample of dead elk reflects the poor calf production/survival observed in the Big Creek elk population in recent years. Of special interest is the apparent timing of the decline in calf production/survival. Many people are concerned that the wolves reintroduced in Idaho in 1995 and living on the Big Creek winter range since 1998 are directly responsible for lower elk recruitment. These data suggest that the Big Creek elk population had started to decline prior to wolf introduction. We looked at whether calf elk were more vulnerable than cow elk and fawns were more vulnerable than does to predation by cougars and wolves. Results were mixed. The ratio of calf elk to cow elk is very low (7-16 calves per 100 cows) in the Big Creek population, but calves were still selected for by the large predators. In contrast, the Big Creek mule deer fawn ratio is moderate (25-44 fawns per 100 does), but fawns were not favored by the large predators in 2 of 3 years. Perhaps only the cow elk is difficult for cougars and wolves to kill compared to calf elk and deer does and fawns, resulting in the greater vulnerability of calf elk to mortality by large predators. Although large predators did not favor fawns over does, medium sized predators: coyotes and bobcats killed fawns at a rate nearly 5 times greater than their ratio in the Big Creek population. The recent addition of wolves to the Big Creek large mammal community may result in a decrease in coyotes and bobcats, since wolves and cougars kill these medium sized predators, and therefore shift predation away from deer fawns toward elk calves.

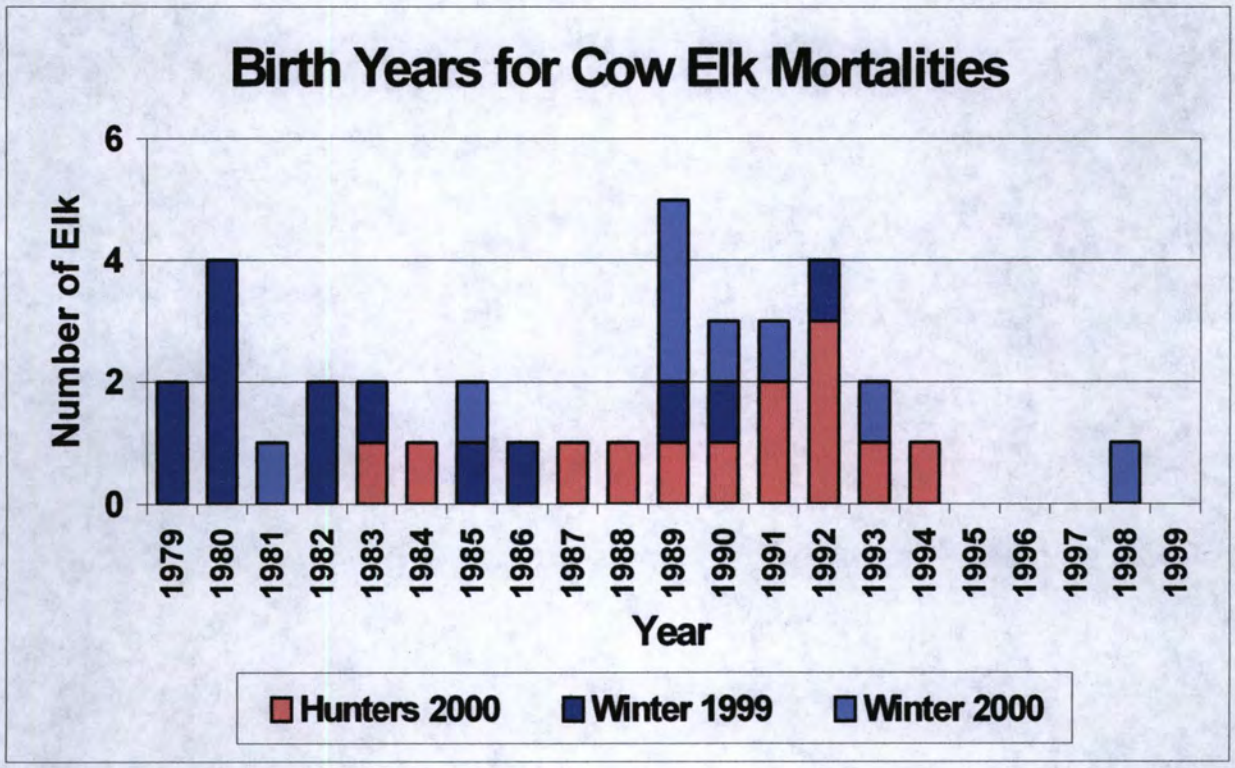
Big Creek elk and mule deer population trends differ. Historical data on elk population trends on the Big Creek winter range indicate that elk were scarce prior to 1940 then increased rapidly for 40 years. Since 1990 elk numbers stabilized and have recently began to decline; calf recruitment is so low that the elk population size is not sustainable. The Big Creek mule deer population size has historically been more variable with the highest population prior to 1950. This deer population has declined and recovered several times in the last century and recently appears to be increasing after a moderate decline. The status of prey populations, both the density and direction and rate of growth, influence the relative effects of predation on prey populations. Mortality from wolf and cougar predation on Big Creek elk may be more compensatory with other causes of death rather than additive if this elk population is at carrying capacity with zero to negative growth. Information on the effects of predation on Big Creek elk and mule deer is important for comparison with other areas where elk and mule deer populations at different stages of growth are preyed on by wolves and cougars.

There is a disparity in the status of Big Creek wolf and cougar populations. The Chamberlain Wolf Pack produced 5 pups each year from 1996-1999. In 2000 2 breeding females produced a total of 7 pups. By Winter 2001 one female and her pups left the Chamberlain Pack home range. Twelve wolves remained in the pack by late winter. In contrast, the Big Creek cougar population is experiencing low production. One female has been monitored for 2 1/2 years and has never been observed with kittens. Track evidence of females with kittens or yearlings and reproductive status of known females suggest that kittens are not common. The Big Creek cougar population was more productive 15, 25, and 35 years ago when Maurice Hornocker and his students studied this same population; when the elk population was growing and wolves were absent.

The forest fire of 2000 has created a major ecological change in the Big Creek drainage, acting like an experimental manipulation of variables. We have already observed changes in complex relationships that link fire and plants, plants and ungulates, and ungulates and large carnivores. In the first winter after fire, the loss of vegetation from fire simulated a severe winter where ungulate food was unavailable. Ungulates responded by being in worse condition during winter or migrating to another winter range with better food resources. Cougars responded by diversifying their diets; they concentrated where ungulates occurred, resulting in greater intraspecific competition among cougars. Meanwhile, the wolf pack moved to the other winter range like the elk. This caused a decrease in wolf predation on elk and deer and decrease in interspecific interactions and competition with cougars on the Big Creek winter range.

The response of large carnivores and their prey to ecological changes that will occur several years after this fire will provide important insights into predator–prey and predator–predator relationships. For example, if elk carrying capacity on the Big Creek range increases due to fire effects on vegetation, will the elk population and calf recruitment begin to increase again, despite predation by cougars and wolves? Will cougar population productivity increase if elk numbers increase or will the cougar population be suppressed by interspecific competition with wolves? How will changes in elk and deer numbers affect calf and fawn vulnerability and diet selection of wolves and cougars? It is difficult to experimentally manipulate variables in wildland predator–prey studies. The major ecological change caused by the extensive forest fire on Big Creek has provided a unique opportunity to evaluate the relationships of the same predators and prey in the same place under 2 sets of conditions, a pre-fire and post-fire environment. As a result of the fire predator–prey dynamics can be evaluated during consecutive time periods as if this research had been designed as an experiment to compare 2 habitats and prey populations with 2 different growth rates. We have the pre-fire baseline data. We need to capitalize on this opportunity to continue this project, enhance the data base, and answer questions like those posed here that can only be addressed by manipulating environmental conditions.


Calf & Fawn Vulnerability
Calves or Fawns per 100 females
70
60
50
40
30
20
10
0
1999
2000
2001
1999
2000
2001
Elk
Mule Deer
Population ratio
Predation ratio


Birth Years for Cow Elk Mortalities
Number of Elk
6
4
2
0
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
Year
Hunters 2000
Winter 1999
Winter 2000

WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

Funding needs for project continuation in Winter 2001-2002

We are seeking $44,000 to continue this predation research for a fourth year. The DeVlieg Foundation has generously provided half of the total funding for this project over the past two years. With a new commitment of $15,000-$20,000 of seed money from the DeVlieg Foundation for the upcoming year we feel that we can obtain the remaining funding needs from government agencies and other private organizations. Carter Neimeyer of the US Fish & Wildlife Service has expressed interest in providing financial support for this project, possibly $20,000. We are sending small grant applications to the Rocky Mountain Elk Foundation, Pope and Young Club, and Professional Bowhunter Society for additional funds. The project will be administered through the University of Idaho College of Natural Resources. Please see our recent project overview to find out what we have learned in the past 3 years and how forest fire affected the activities of cougars and wolves and their prey. We hope you can continue to support this predation project for one more field season. We sincerely appreciate your past support that enabled this project to become a reality.

Holly & Jim Akenson, Taylor Ranch Field Station Managers/Scientists

Plans for next year

This upcoming winter field season we are focusing on several activities to enhance our ability to address the study objectives.

- We plan to increase the rate of data collection by instrumenting and monitoring 3 cougars and 1 wolf with geographic positioning system (GPS) radio collars. These collars will provide multiple locations daily for each animal and will allow us to evaluate animal movements and interspecific and intraspecific interactions between the two predators. Our preliminary observations indicate that cougars move from their kills, the wolves, and preferred sites when wolves are present. The intensive monitoring by the GPS collars will greatly enhance the data set for analysis of cougar-wolf relationships.
- We will increase our efforts to assess population parameters and health of elk and deer populations by conducting herd composition counts and assisting IDF&G with elk helicopter surveys, evaluating carcasses, and collecting jaws from hunter harvested elk to determine the nature of the decline in elk productivity
- We will continue collection of winter carcass data to assess the significance of predation on elk and deer populations and to obtain a large enough data set to compare cougar and wolf diets.
- We will continue intensive aerial telemetry monitoring of all radio collared animals for analysis of winter home ranges and animal movements.

BIG CREEK PREDATION PROJECT PROPOSED BUDGET, Winter 2001-2002

PERSONNEL	
Project Coordinators (4 months UI replacement salary + 35% benefits)	$14,900
Field Technician (4 months wages + 10% benefits)	$6,600
TOTAL PERSONNEL	$21,500
COUGAR CAPTURE	
Contract for houndsman and/or dogs	$3,000
TOTAL CAPTURE	$3,000
EQUIPMENT	
GPS Radio Collars (4)	$12,000
TOTAL EQUIPMENT	$12,000
TRAVEL	
Air taxi transportation	$1,200
Lodging, meals, mileage	$1,000
TOTAL TRAVEL	$2,200
AERIAL TELEMETRY	
10 flights	$2,500
TOTAL AERIAL TELEMETRY	$2,500
OPERATING EXPENSES	
Field camp food and supplies	$600
Horse feed, shoeing, veterinary expenses	$1,550
Satellite telephone & communication	$200
Office expenses	$150
Conference registration	$300
TOTAL OPERATING EXPENSES	$2,800
TOTAL BUDGET NEEDS 2001-2002	**$44,000**

Additional Project Expenses provided by Cooperators:

UNIVERSITY OF IDAHO	
Project Coordinators (4 months UI salary & benefits)	$14,900
Lodging for technician at Taylor Ranch	$250
Use of Taylor Ranch office equipment and computer programs	
NEZ PERCE TRIBE	
Aerial telemetry (20 flights)	$5,000
IDAHO FISH & GAME	
Elk pregnancy tests (80 elk)	$1,200
Elk and deer tooth aging	$600

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WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

By Holly Akenson and Jim Akenson
Hornocker Wildlife Institute
Six Month Progress Report, December 15, 2000

REPORT SUMMARY

This predation study was initiated in 1998 following the reintroduction of gray wolves into the central Idaho wilderness in 1995. The goals of this study are: 1) to understand the effects of large carnivore predation on wintering ungulates including elk, mule deer, and bighorn sheep; 2) to understand the competitive relationship between the recently introduced wolf population and the established cougar population, including interspecific interactions and how the two predators share food, habitat, and space resources. The Big Creek study area in the Frank Church River of No Return Wilderness is the same as that chosen by Maurice Hornocker in 1965 when he began the first major study of cougar ecology. This project represents the 4th decade of cougar investigations in this remote study area. The long-term record from this cougar population provides a unique opportunity to compare current and historical cougar population characteristics.

The public has expressed concern about the effects of introduced wolves on populations of elk, deer, and bighorn sheep; species which are highly valued by humans. Little is known about the impacts that wolves and other large carnivores will have on each other as they compete for the same food sources. Results of this research will have strong practical and theoretical implications for understanding the dynamics of two competing large predators, their influence on ungulate populations, and how they impact hunting opportunities and wildlife management alternatives. Furthermore, the information will be important for predicting the outcome of wolf reintroductions in other areas where cougars occur, such as the Mexican wolf reintroduction in the southwestern United States. The results of this study will be integrated with the findings from other study areas in the northern Rocky Mountains: Yellowstone National Park; Panther Creek, Idaho; and Teton National Park. All 4 study areas have the same research goals and methods but diverse habitats and prey populations, so the integration of results will provide a strong analysis of the impacts of cougars and wolves on prey populations and each other.

Data has been collected during 2 winter seasons of this 4-6 year study. Radiocollared cougars and wolves were intensively monitored on the ground and from the air during winter and spring. Predation was the major cause of mortality for the 86 large mammal carcasses located in the study area. Elk and mule deer were the primary prey of cougars and wolves. Calf elk were favored by both predators although there were not many calves in the elk population, so cow elk were the most common food item. Most cow elk killed by predators were very old; the average age in the first year of research was 15 years old. Four cougar predation sequences have been completed. Wolves moved into cougar territories and appeared to cause cougars to move from favored areas.

Winter 2000-2001 plans include radiocollaring additional cougars, increasing the number of predation sequences, assessing predator kills, determining cougar and wolf winter home ranges, documenting daily movements and activities of cougars and wolves when they are near each other, and determining the size and status of the elk population.

PROJECT TITLE: Winter Predation and Interactions of Cougars and Wolves in the central Idaho Wilderness

SUMMARY LINE: . The purpose of this study is to assess the effects of cougar and wolf predation on wintering prey populations of elk, mule deer, and bighorn sheep and to evaluate interspecific competition between wolves and cougars, including interspecific interactions and partitioning of food, habitat, and space resources

RESEARCHERS: Jim Akenson, Holly Akenson, Howard Quigley

STAFF: Renan Bagley, Pete Armichardy, Mike Schlegel, Holly Akenson and Jim Akenson worked as field biologists last winter and spring. There were no staff on the project during summer or fall.

COLLABORATORS AND INSTITUTIONAL AFFILIATIONS: Nez Perce Tribe, University of Idaho, Idaho Department of Fish and Game

PROJECT DURATION: The project began in December 1998 and was originally slated to be a 4-year project. The project may be extended several more years to compare with predation and interactions following a major forest fire in the study area in August 2000. Winter 2000-2001 will be the third year of the project.

APPROVED 2001 BUDGET: $60,000

RECENT ACTIVITIES: Last winter we conducted 3 predation sequences on cougars. We located 53 large mammal carcasses and determined that at least 45 were a result of predation. We located radiocollared cougars and wolves 1-2 times per week during winter and spring and calculated home ranges. We determined elk pregnancy rates and population information and assessed nutritional condition and age of elk and mule deer carcasses.

EXPLORATORY ACTIVITIES: We evaluated movements of cougars immediately following the presence of wolves in the cougar's home range. During cougar predation sequences we compared days spent at kill sites and days spent hunting when wolves were in the cougar home range and when absent from the home range.

PROBLEMS AND CONSTRAINTS: We are anticipating more difficult and dangerous travel in the wilderness this winter and spring due to falling trees, rock slides, snow slides, eroding trails and unusual flood events following the major forest fire that burned a large proportion of the study area. Work in the wilderness is further constrained by the difficulty of ground tracking wolves that travel up to 20 miles in a day.

GOALS AND ACTIVITIES FOR THE NEXT 6-MONTHS: Winter and spring 2001 is a busy field period for the project. A field crew of 5-7 full or part time biologists will rotate between a tent camp and 2 cabin camps, traveling by mules, hiking, or snowshoeing. These will be the primary activities:

- Radiocollar 3 female cougars
- Conduct predation sequences on 3-4 cougars and 1-2 wolves
- Collect 35 aerial telemetry locations on each radiocollared cougar and wolf for home range analysis
- Document daily movements and activities of cougars and wolves when they both occur within a cougar home range
- Assist Idaho Department of Fish and Game with a helicopter elk sightability population survey
- Locate and evaluate carcasses of large mammals that died during winter and spring
- Assess population parameters and health of elk and deer populations and carcasses

CONSERVATION ACCOMPLISHMENTS: This is an ongoing project, so final reports and analyses have not been completed.

BIG CREEK PREDATION PROJECT BUDGET, Winter 2000-2001

PERSONNEL	
Project Coordinators	$22,680
Field Technicians	$22,050
Houndsmen	$2,100
TOTAL PERSONNEL	$46,830
EQUIPMENT	
Wall tent, cots	$770
TOTAL EQUIPMENT	$770
TRAVEL	
Air taxi transportation	$2,090
Lodging	$360
Meals	$360
Mileage	$300
TOTAL TRAVEL	$3,110
AERIAL TELEMETRY	
38 flights ($7,000 provided by cooperators)	$2,200
TOTAL AERIAL TELEMETRY	$2,200
OPERATING EXPENSES	
Field camp food	$1,200
Field camp supplies	$450
Horse feed and shoeing	$1,700
Veterinary expenses	$200
Taylor Ranch lodging	TR
Satellite telephone & communication	$450
Office expenses	$250
Conference registration	$310
Elk pregnancy testing	IDFG
Prey tooth aging	IDFG
Elk helicopter sightability survey	IDFG
TOTAL OPERATING EXPENSES	$4,560
TOTAL BUDGET 2000-2001	**$57,470**

Project Expenses provided by Cooperators:
Nez Perce Tribe (potential support) = $5,000+ for aerial telemetry.
Idaho Dept. Fish and Game (potential support) = $2,000 aerial telemetry, $675 elk pregnancy testing, $500 prey tooth aging, and $10,000+ elk helicopter sightability surveys.
University of Idaho (potential support) = $860 lodging at Taylor Ranch

BIG CREEK PREDATION PROJECT WORK PLAN, Winter 2000-2001
Tiered to Testing of Major Hypotheses

NOVEMBER
- Planning, organizing, hiring for winter field season
- Purchase groceries and supplies, set up Acorn Camp

DECEMBER
- Capture/collar 1 female cougar
- Set up Cabin Creek Camp, cut firewood for camps, clear trails
- Aerial telemetry weekly

JANUARY
- Crew orientation and training
- Predation sequence on 2 cougars
- Capture/collar 2 female cougars
- Aerial telemetry 2-3 times per week
- Monitor wolf predation rate when wolves are available
- Document kills, assess elk & deer age/sex composition

FEBRUARY
- Aerial telemetry weekly, complete predation sequences
- Monitor wolf predation rate when wolves are available
- Document kills, assess elk & deer age/sex composition
- Process early winter bone marrow samples

MARCH
- Helicopter elk sightability population survey
- Predation sequence on 1 cougar
- Predation sequence on wolf pack
- Aerial telemetry 2-3 times per week
- Document kills, assess elk & deer age/sex composition

APRIL
- Aerial telemetry weekly, complete predation sequences
- Document kills, assess elk & deer age/sex composition
- Prepare presentation and attend Interagency Wolf Conference
- Take down camps, organize gear
- Collect and mail elk fecal samples for pregnancy testing
- Process bone marrow samples, send elk & deer jaws for tooth aging

MAY
- Data analysis
- Write annual report

BIG CREEK PREDATION PROJECT WORKING HYPOTHESES, Winter 2000-2001

Hypothesis 1: The combined effect of wolf and cougar predation will impact prey populations.

Tests:

- Evaluate change in elk and deer population sizes since wolf introduction, based on IDF&G helicopter elk sightability surveys and helicopter deer surveys. Compare central Idaho management units with and without wolf packs.
- Evaluate change in elk and deer population productivity and recruitment since wolf introduction as measured by calf: cow ratios, based on IDF&G helicopter surveys and ground observations, and elk pregnancy rates. Compare central Idaho management units with and without wolf packs.
- Calculate winter predation rates of cougars and wolves on Big Creek, based on predation sequences and for wolves consecutive daily aerial, ground, or snowtracking locations and kills. Compare among study areas.

Hypothesis 2a: There is a difference between prey killed by wolves and prey killed by cougars.
Hypothesis 2b: Cougars and wolves select prey that are more vulnerable than the available prey population.

Tests:

- Compare prey species composition, age and sex composition, femur fat, and injuries of wolf kills, cougar kills, and winter prey populations, based on investigated carcasses, % femur fat, tooth aging, and field surveys and elk helicopter surveys.
- Compare results from Big Creek, Panther Creek, and Yellowstone study areas to test for consistencies.

Hypothesis 3: Cougars and wolves use different habitats and temporal use of space.

Tests:

- Compare cougar and wolf home ranges, overlap, and animal movements, based on aerial and ground telemetry and snow tracking. Compare among study areas.
- Compare percent slope, elevation, and vegetation of cougar and wolf locations based on aerial telemetry and of cougar and wolf kills based on carcass investigations. Compare among study areas.
- Compare elk density for cougar and wolf locations in February and March based on subunit elk estimates from IDF&G helicopter elk sightability surveys. Compare with Panther Creek study area.

Hypothesis 4: Cougar predation rates are greater when wolves are present than when absent.

Tests:

- Compare cougar predation sequences with and without wolves.
- Compare days spent feeding on a carcass and days between carcasses for cougars when wolves are present or absent, based on data from predation sequences.

Hypothesis 5: Cougars and wolves exhibit avoidance or attraction.

Tests:

- Compare distance to the home range center (core) of random cougar locations with cougar locations 1-3 days after wolves are present in the cougar home range, based on aerial telemetry, home range analysis and cougar predation sequences.
- Compare interspecific scavenging at wolf and cougar kills. Compare among study areas.
- Compare daily distance travelled by cougars for random dates with daily distance travelled 1-3 days after wolves are present in the cougar home range, based on cougar predation sequence locations and telemetry.

Hypothesis 6: Cougars wintering on Big Creek pre- and post-wolf introduction differ in their habitat use, movements, and feeding behavior.

Tests:

- Compare Big Creek cougar data from 3 pre-wolf research projects to results from this study including: cougar home range sizes, locations, and characteristics; movements within and between winters; and species composition of kills.

PUBLICATIONS DURING PAST 6 MONTHS

Holly Akenson, Jim Akenson, Howard Quigley. 2000. Predation and interactions of wolves and cougars on Big Creek in central Idaho, winter 2000 annual report. 15 pages. Hornocker Wildlife Institute, Bozeman, Montana.

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(in Endnote under Hornocker)

PREDATION AND INTERACTIONS OF WOLVES AND COUGARS ON BIG CREEK IN CENTRAL IDAHO
Winter 1999-2000 Annual Report

A Report to The Charles DeVleig Foundation
August 2000

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In Cooperation With
The Nez Perce Tribe, University of Idaho, and Idaho Department of Fish and Game

SUMMARY

This report summarizes results from the second winter season of a 4-year research project. The results and relationships presented have provided insights into the activities and food habits of wolves and cougars in the Idaho wilderness. Until this project is completed, results should be considered preliminary. The effects of cougar and wolf predation on elk and deer populations and the effects of wolves and cougars on each other will be fully evaluated following completion of field research.

During Winter 1999-2000, field efforts were intensified to include a crew of 5 people and more frequent aerial telemetry flights. We located 53 large mammal carcasses and determined that at least 45 were a result of predation. We confirmed 26 ungulate kills made by cougars and 14 ungulate kills made by wolves. Deer were favored as prey by cougars, but deer and elk were killed in proportion to their abundance by wolves. Elk calves were more vulnerable to predation than elk cows, although deer fawns were not selected over adult deer.

Incisor tooth aging of 1998-1999 elk carcasses revealed that most elk that died during winter were old-aged cow elk (12-19 years old), although over 95% of live cow elk sampled on the Big Creek winter range in spring 1999-2000 were pregnant. A majority of deer carcasses was located in lower Big Creek while most of the elk carcasses were found in upper Big Creek.

We documented variation in individual cougar and wolf food habits. We completed 3 predation sequences on cougars. We have not determined a predation rate for the wolf pack, since we were unable to obtain sequential wolf locations every day due to the short time the pack spent on kills and its wide ranging movements.

Winter 1999-2000 was less severe than Winter 1998-1999, allowing ungulates to utilize a larger winter range. In Winter 1999-2000, the Chamberlain wolf pack spent a significant amount of time on the upper elevation periphery of the Big Creek winter range, and only occasionally hunted the core winter range area used in Winter 1998-1999. Less overlap occurred between radio-collared wolves and cougars in Winter 1999-2000. Preliminary observations indicate that the presence of wolves in a cougar's home range affects the movements of that cougar.

ACKNOWLEDGEMENTS

Funding for this project was provided by a generous grant from The Charles DeVlieg Foundation, and additional support from the Liz Claiborne and Art Ortenberg Foundation, the Ripley Comegys Foundation and the Michael Cline Charitable Foundation. The Nez Perce Tribe provided field equipment and funding for wolf telemetry. We thank Curt Mack, Nez Perce Tribe Wolf Project Manager, for his commitment to this collaborative effort. We also received considerable support from the Idaho Department of Fish and Game on cougar telemetry, elk population data, elk pregnancy analysis, and aging of dead elk. We want to express our gratitude to Jeff Rohlman, Regional Wildlife Manager for Idaho Department of Fish and Game in McCall for his time and assistance.

We were able to conduct this logistically-difficult study through the dedicated effort of our field crew, and the skillful flying of a few backcountry pilots. We greatly appreciate the hard work conducted on this project last winter by Renan Bagley, Pete Armichardy, and Mike Schlegel. We would like to thank pilots Ray Arnold, Pat Dorris, and John Lancaster for many hours of safe and productive radio telemetry flights. We also appreciate the professional cougar capture efforts of houndsmen Wes Craddock and Ron Sherer, and cougar monitoring assistance from Matt O'Connell of IDF&G. We are grateful to the U.S. Forest Service for the use of their cabin at Cabin Creek.

BACKGROUND AND PROBLEM STATEMENT

The U.S. Fish and Wildlife Service introduced 33 gray wolves (Canis lupus) into the central Idaho wilderness in 1995 and 1996 as part of the restoration of wolves to the northern Rocky Mountains. The Nez Perce Tribe is responsible for monitoring the Idaho wolf population. The introduced Idaho wolves have been successful in establishing home ranges, reproducing, and forming packs. The public has expressed concerns about the effects of the introduced wolves on ungulate species including deer, elk, moose, and bighorn sheep. The effect of these wolves on other animals is still unknown. Thus, a field study was designed to address this need. This report describes the second year of work on cougar and wolf predation in central Idaho. It is the first study of wolf predation in Idaho.

While public concern has been focused on the effects of wolves on prey animals, little attention has been devoted to the impact wolves and other large carnivores will have on each other as they compete for the same food sources. An issue that has not been addressed is the potential for wolves to affect cougars. Interactions between wolves and cougars may influence cougars directly through aggression and killing by wolves, or indirectly through effects on cougar habitat selection, activity patterns, and use of space.

JUSTIFICATION

Results of this research will have strong practical and theoretical implications for understanding the dynamics of two competing large predators and their influence on ungulates. Long-term research has been conducted on cougars of the Big Creek drainage in central Idaho. In 1966, Maurice Hornocker began the first major study of cougar ecology. Projects in the 1970s and 1980s provided new information on cougar biology, food habits, population characteristics,

and changes in the cougar population and home ranges over time. The long-term record from this cougar population provides a unique opportunity to compare current and historical cougar population characteristics, home ranges, and predation and the effects of wolves on a known cougar population. Studying cougar-wolf interactions in the Big Creek study area will provide an important comparison for the research project initiated in 1998 by the Hornocker Wildlife Institute in Yellowstone National Park to examine cougar and wolf interactions.

Data collected in this study will guide resource managers in understanding both wolves and cougars. The information will be important for predicting the outcome of similar reintroductions in other areas where cougars occur, such as in the southwestern United States with the Mexican wolf reintroduction.

Information from this study will provide insights into the effects of predation on current deer and elk populations in central Idaho and aid in the management of ungulate prey of cougars and wolves. These ungulates are of primary economic importance to rural communities in the western United States where hunting of deer and elk is a multimillion-dollar business. When wolves displace cougars from cougar kills, cougars may increase their predation rates by killing more prey to compensate for their loss of food to wolves. This may decrease sustainable harvest levels for human hunters of these ungulates. Alternatively, if wolves reduce the number of cougars in an area, total number of prey taken by the two predators may be the same as pre-wolf reintroduction. By studying these two carnivores simultaneously, we will learn about the influence they have on each other and their effects on prey species, which are also highly valued by humans.

STUDY GOALS

The goals of this study are to: 1) assess the cumulative effects of wolves and cougars on elk, mule deer, and bighorn sheep populations; 2) assess competition between cougars and wolves, including interspecific interactions and partitioning of food, habitat, and space resources.

STUDY AREA AND METHODS

Predation and wolf-cougar interactions are being studied in two winter ranges in central Idaho. This report provides results from the Big Creek study area, a tributary of the Salmon River. The Chamberlain Wolf pack has established a home range in the Big Creek winter range. In addition, the study area supports between 8 and 14 resident adult cougars. The Big Creek area is in Game Management Unit 26, in the Frank Church-River of No Return Wilderness (FCRNRW). The second study area includes Panther and Napias Creeks, east of the FCRNRW in Game Management Unit 28. This report summarizes the results of the second winter of a four-year project. Full analysis of results will not be performed until completion of the project. Fieldwork was conducted from December to April. Field activities on Big Creek were conducted on foot, snowshoes, and horseback from the University of Idaho's Taylor Ranch Wilderness Research Station, a winter tent camp, and a USFS cabin.

The Chamberlain Wolf pack of 8-11 wolves spent most of the winter and spring, 2000 in the Big Creek drainage. The pack included 3 wolves radio instrumented by the Nez Perce Tribe. Five cougars were radio instrumented on Big Creek in 1999. During winter, cougars and wolves were radio-located 1-2 times weekly from aircraft. They were monitored daily from the ground

when cougars and wolves occurred in the same area. Cougar and wolf kills were documented in detail when located during routine field activities. Cougar and wolf predation rates on elk and mule deer were estimated by searching consecutive daily radiolocation sites and snow tracking for periods of 20-45 days.

The size and composition of elk and mule deer populations were assessed through calf: cow and fawn: doe ratios from aerial and ground counts and elk helicopter sightability population surveys. Elk pregnancy rate was determined from the level of pregnancy hormone progesterone in fecal samples collected from 45 cow elk in March and April 2000. Carcass femur marrowfat content and age were used to evaluate the health status of animals found dead in the study area. Femur Marrow was collected from carcasses and oven dried for 48 hours. Percent marrow fat was calculated for each sample from dry weight divided by wet weight. Carcasses were examined for pre-existing injuries, parasites, or disease. First incisor teeth from elk and deer carcasses were aged by tooth cementum annuli (Matson's Lab).

PRIMARY FINDINGS

Ungulate Prey Population Status: Elk and Mule Deer

- Elk sightability surveys conducted in the last decade indicates that the elk population size in the Big Creek drainage (Game Management Unit 26) was constant after a strong increase in elk numbers in the 1980s (Appendix A). The population may have declined slightly by 1999, when the population was estimated to be 1320 elk.
- Calf: cow ratios have declined in recent years to 7 calves: 100 cows in winters 1998 and 1999 and 16 calves: 100 cows in Winter 1999-2000 (Appendix B). During Winter 1999-2000, the calf ratio declined from 21 calves: 100 cows in early winter to 13 calves: 100 cows in late winter (Table 1a). The deer fawn: doe ratio was 38 fawns: 100 does in early and late Winter 1999-2000 (Table 1b).
- The pregnancy rate for 45 cow elk sampled in March and April 2000 was at least 95% pregnant (41 confirmed pregnant, 3 probably pregnant and 1 not pregnant).
- Most elk appeared to be in good body condition in Winter 1999-2000, compared with late Winter 1998-1999 when many elk appeared deficient in subcutaneous body fat.
- We documented several ectoparasites on elk and deer including lice, spinose ear ticks, wood and winter ticks, and nasal bots. Only 2 animals died with severe infestations: a mule deer had 99 ear ticks in the ear canals and an emaciated elk calf was infested with wood ticks.
- Winter 1998-1999 snow depths were greater and temperatures were colder than Winter 1999-2000 (Figure 1, Figure 2).

Figure 1. Snow depths (monthly median) reported at Taylor Ranch National Weather Service Station in Winter 1998-1999 and Winter 1999-2000.

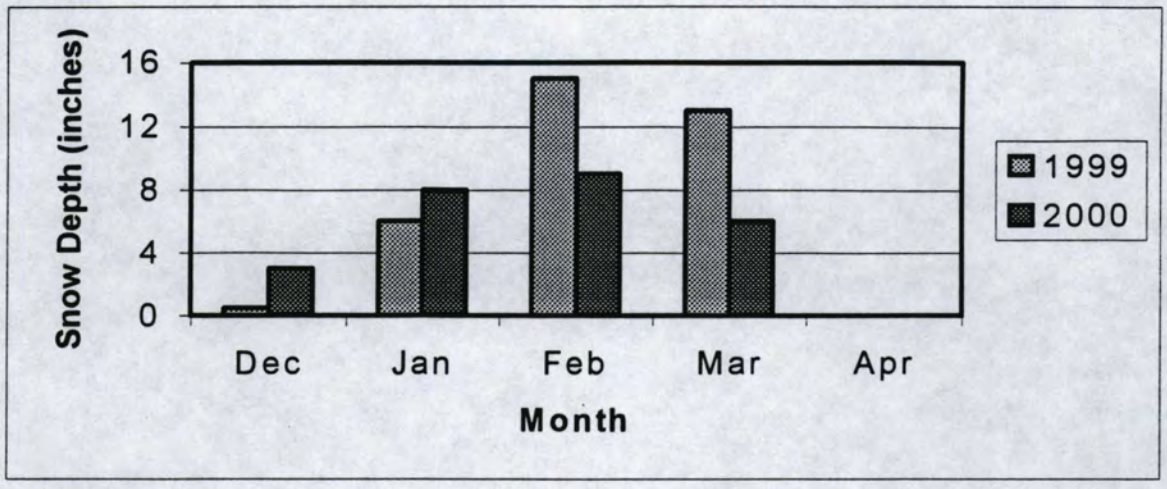


Figure 2. High and low mean monthly temperatures reported at Taylor Ranch National Weather Service Station in Winter 1998-1999 and Winter 1999-2000.

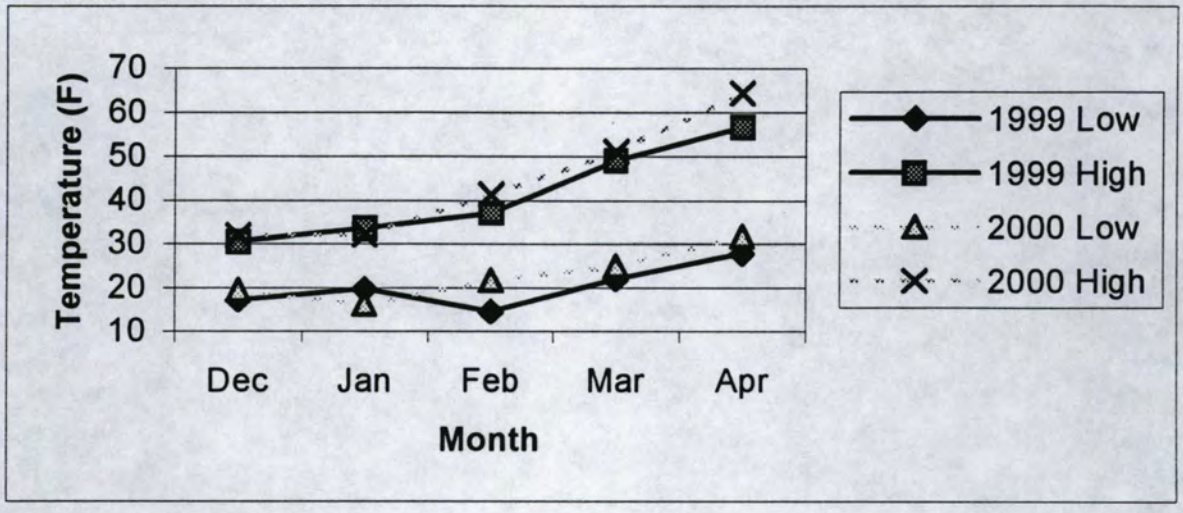


Table 1a. Big Creek Winter 1999-2000 elk calf: 100 cow ratios from ground counts.

	Early Winter Dec-Jan			Late Winter Mar-Apr			All Winter (mean of Early and Late Winter)
	Cows	Calves	Ratio	Cows	Calves	Ratio	
Cougar Creek Cliff Creek Rush Creek Lobauer Basin Gooseneck Basin	128	33	25.8	149	20	13.4	19.6
Browns Basin Cabin Creek Cow Creek Spring Creek Cave Creek	252	49	19.4	285	43	15.1	17.3
Doe Creek Garden Creek Mile High Coxey Creek Lime Creek	97	17	17.5	245	22	9.0	13.3
All of Big Creek	477	99	20.8	679	85	12.5	15.9*

*This ratio is from a total count of 1156 cows and 184 calves (includes multiple counts of the same elk).

Table 1b. Big Creek Winter 1999-2000 mule deer fawn: 100 doe ratios from ground counts.

	Early Winter Dec-Jan			Late Winter Mar-Apr			All Winter
	Does	Fawns	Ratio	Does	Fawns	Ratio	Ratio
Cliff Creek to Acorn Creek	22	8	36.4	76	29	38.2	37.8*

*This ratio is from a total count of 98 does and 37 fawns.

Winter Ungulate Prey Mortality

- Age was determined for 15 of 18 elk that died on Big Creek in Winter 1998-1999 (Figure 3). Twelve cow elk were aged by cementum annuli analysis, and 3 calf elk were aged by tooth eruption pattern. The median age of all elk carcasses was 13 years old and the median age of

adult elk was 15.5 years old. The very old ages of the elk carcasses suggest that the Big Creek elk population also has a high proportion of old-aged cows.

- Percent marrow fat was variable for deer and elk in both winters (Figure 4). Some marrow samples from animals in poor condition in 1998-1999 were desiccated when collected and weighed, so actual percent marrow fat in 1998-1999 was much lower than reported here. There were no detectable differences in femur marrow fat for elk and deer carcasses from Winter 1998-2000 (z=0.067) or Winter 1999-2000 (z=0.84).

Figure 3. Elk carcass ages on Big Creek, Winter 1998-1999.

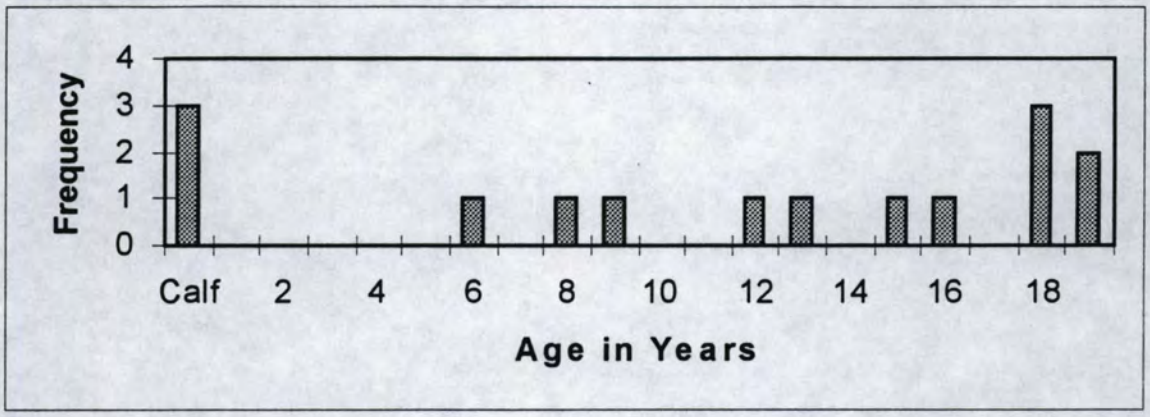
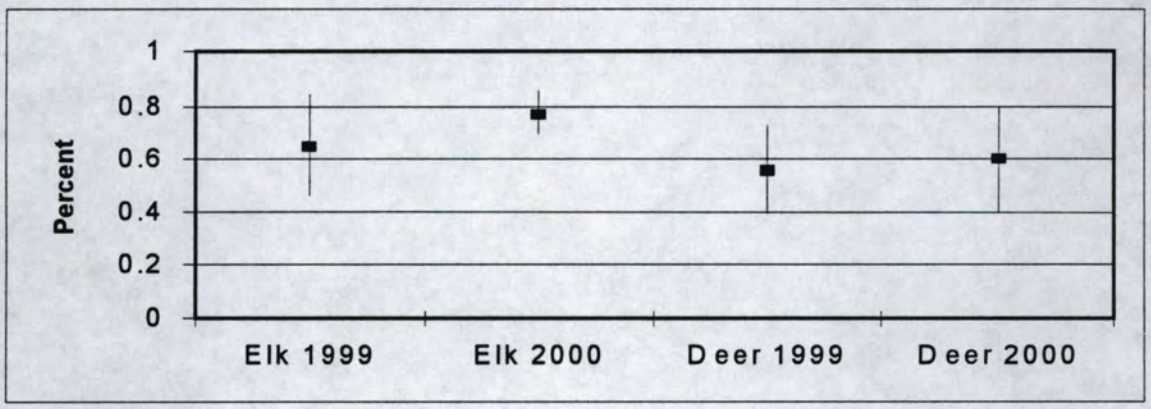


Figure 4. Femur fat percent (mean with 95% CI) for elk and deer carcasses in Winter 1998-1999 and Winter 1999-2000.



Carcass Summary 2000

- We investigated 53 carcasses of large mammals that died on the Big Creek winter range in Winter 1999-2000 and 34 carcasses in Winter 1998-1999 (Table 2). Most mortality was attributed to predation (Figure 5).
- Adult females were the predominant age/sex class of ungulate carcasses in both winters (Figure 6).
- There were 2.2 elk for every mule deer on the Big Creek winter range in Winter 1999-2000. However, deer were killed in a greater proportion than their relative abundance on Big Creek (Z=2.05). Cougars disproportionately selected deer as prey over elk (Z=2.70), while wolves killed elk and deer in similar proportions to their relative abundance on Big Creek winter range (Z=0.19) (Figure 7).
- A greater proportion of calf elk were killed by predators in Winter 1999-2000 than the proportion of calves in the Big Creek population (Z=3.51) (Figure 8).
- During Winter 1999-2000, cougars and wolves did not favor fawns over adult deer (Z=-1.08) (Figure 8).
- The proportion of mule deer and elk in the carcass samples of Winter 1999-2000 and Winter 1998-1999 were similar (chi-square p=0.365) (Table 2).
- Individual cougars and the wolf pack showed variation in food selection, some preferred elk and others primarily ate deer (Table 3).
- Deer kills were more often found in lower Big Creek winter range, while elk-kills were more common in the upper portion of Big Creek winter range (Figure 9).

Table 2. Species composition of large mammal carcasses found dead on the Big Creek winter range in Winter 1998-1999 and Winter 1999-2000.

	Elk	Mule deer	Bighorn	Moose	Coyote	Cougar	Bobcat	Total
98/99	18	11	2	0	2	0	1	34
99/00	24	24	1	1	1	2	0	53

Figure 5. Cause of death for large mammals found dead on the Big Creek winter range in Winter 1998-1999 and Winter 1999-2000.

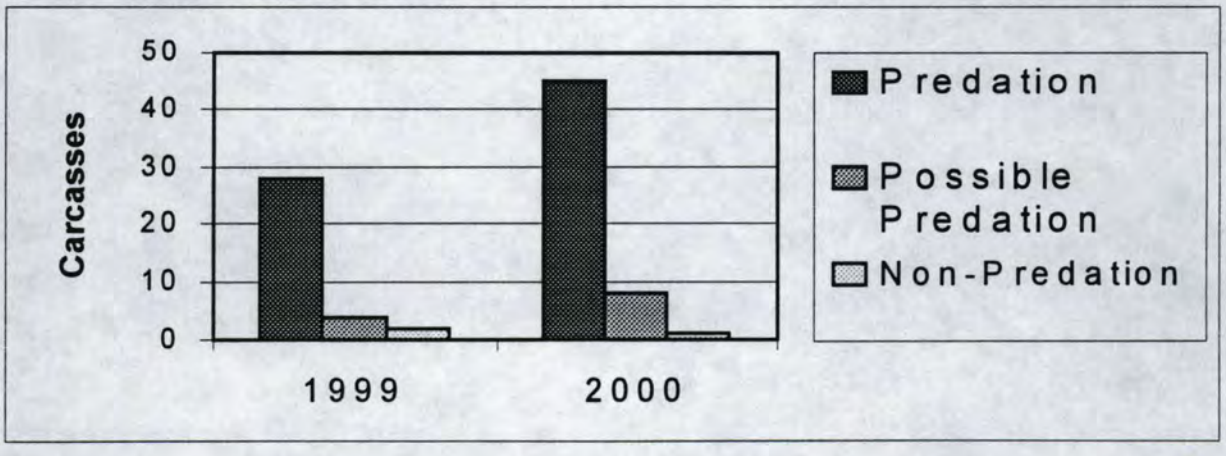


Figure 6. Sex and age of elk and deer found dead on Big Creek in winter 1998-1999 and Winter 1999-2000.

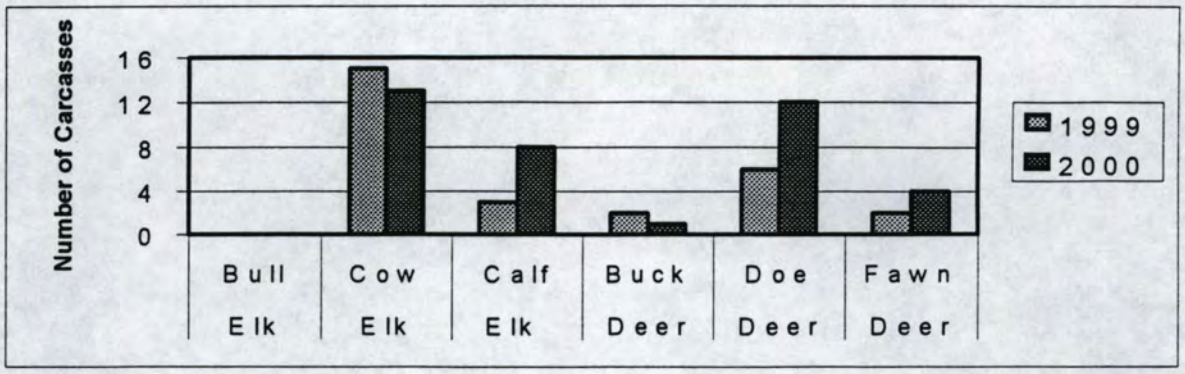


Figure 7. Wolf and cougar predation on elk and deer in Winter 1998-1999 and Winter 1999-2000.

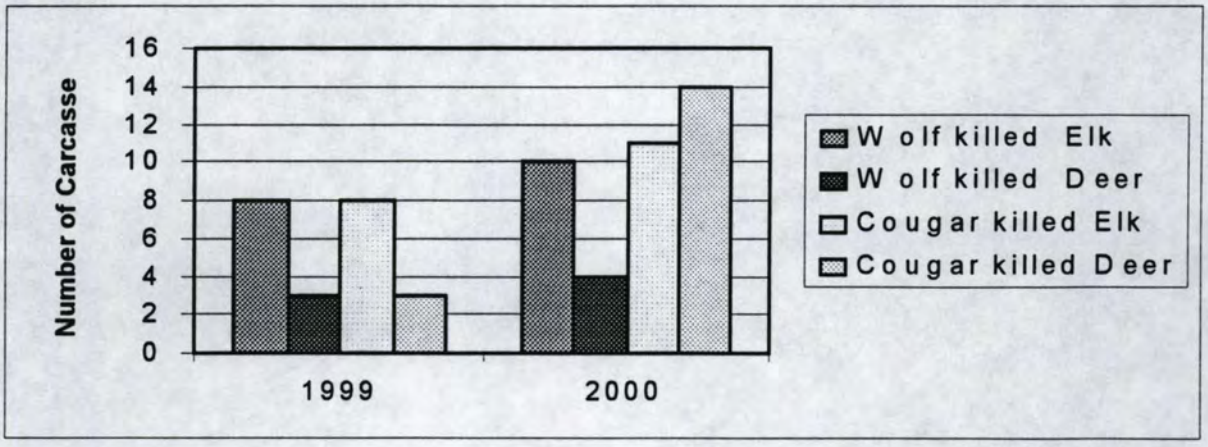


Figure 8. Age ratios of Big Creek elk and mule deer populations and elk and mule deer killed by cougars and wolves, winters 1998-1999 and 1999-2000.

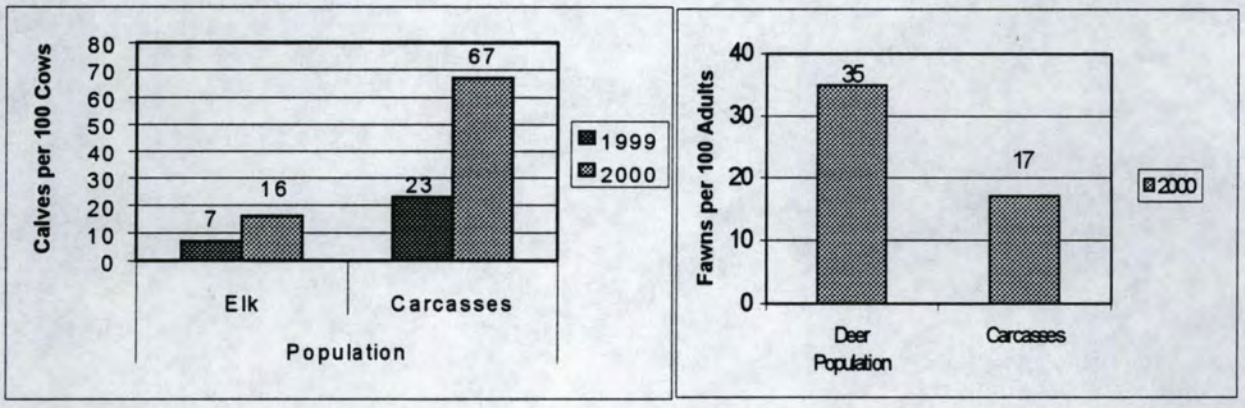
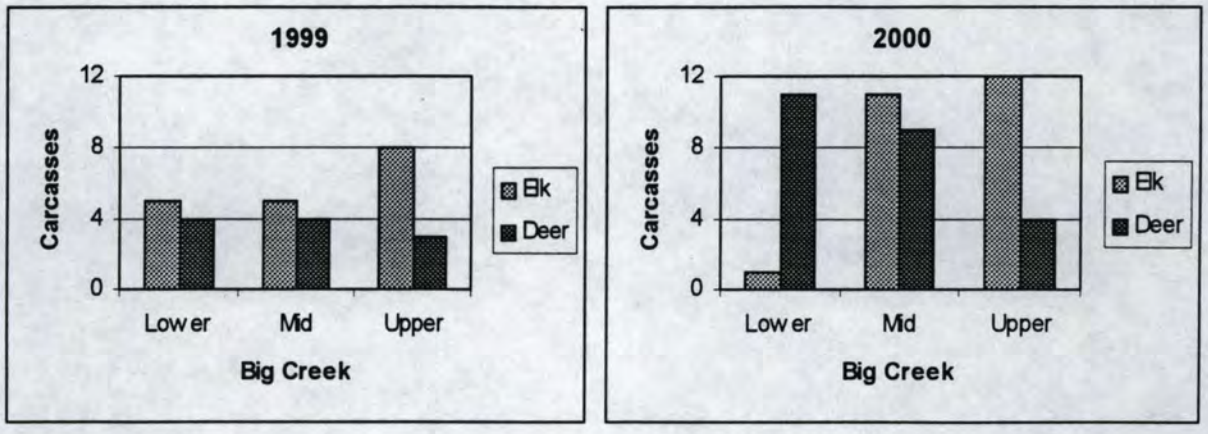


Table 3. Individual variation in prey killed by known cougars and wolves in Winter 1999-2000.

	Deer	Elk	Other	Total
Female & Kitten	5	0	Bighorn	6
Rush Cr. Female	4	1	Coyote	6
Cabin Cr. Female	3	5	0	8
Chamberlain Pack	4	9	0	13

Figure 9. Location of elk and mule deer kills on the Big Creek winter range, Winter 1999-2000.



Predator Population Status: Wolves and Cougars

- The Chamberlain Wolf pack produced 5 pups in April, 1999. In Winter 1999-2000 pack size was as large as 11 wolves, but may have declined to 8 animals in late winter. The alpha female wolf was localized at a den site in April, 2000. A subadult wolf, B-50, also denned in April, 2000, with an unknown male and produced her first litter of 2 pups. Her den site is within the home range of the Chamberlain Pack. Four wolves of the Chamberlain pack are radio collared.
- Other wolves: The Thunder Mountain Pack occasionally used the southeast section of the Big Creek drainage in summer and winter. The Chamberlain Pack did not use most of this area. A subadult female wolf (B-38) left the Stanley Pack in 1999 and moved to the south fork of the Salmon River. She occasionally traveled in upper Big Creek in Winter 1999-2000. Her movements did not overlap the area used by the Chamberlain pack. A female pup from the Jureano Pack (B-80) was relocated to the Selway River drainage in Winter 1999-2000. She moved through the Chamberlain pack's territory for a month in spring 2000 and may be establishing residency in lower Big Creek, on the edge of the Chamberlain Pack's territory.
- We radio collared 5 cougars in 1998-1999 (3 females and 2 males). None of the collared female cougars produced kittens in the past year. One of the radio-collared male cougars

killed the other radio collared cougar, apparently as a result of a territorial fight after both cougars moved to an area that had not been used by either male.

- Hunters harvested 5 cougars from Big Creek, 3 males and 2 females. An unmarked adult male cougar was found dead in a cave. He had a front paw injury and had lost 2 toes, which likely prevented him from effectively pursuing and killing large prey. His emaciated condition suggested he had starved to death. The skeleton of a female cougar that had died the previous year (1999) was found while investigating the remains of a cougar killed bighorn.
- Other cougars: We saw cougar kittens or kitten tracks in 3 areas along Big Creek (Taylor Ranch, Coxey Creek, Monumental Creek). We saw unmarked cougars, their tracks and kills throughout the Big Creek drainage. We documented cougar-killed prey in 8 drainages not typically used by radio-collared cougars.

Predator Movements: Seasonal Migrations

- All 5 cougars moved between discrete higher elevation summer ranges and lower elevation winter ranges. The distances between a cougar's summer and winter ranges varied from 2-35 miles apart.
- Both male cougars moved to different winter home ranges in 1999-2000 than the ones they occupied in 1998-1999. One female cougar moved to a new home range in mid-winter 1999-2000.
- The Chamberlain pack occupied the higher elevation middle section of their home range in summer and the lower elevation southern and northern sections in winter.
- The Chamberlain pack winter home range encompassed winter home ranges of several cougars on Big Creek.
- In each winter, 1996-2000, the Chamberlain Pack has varied the use of its winter home range. In 1996 through 1998, the pack primarily occupied the big game winter range on the south side of the main Salmon River around Chamberlain Creek. In Winter 1998-1999, the pack spent most of the time in the central part of the Big Creek big game winter range. In Winter 1999-2000, the pack remained at mid elevations on the upper fringes of the Big Creek winter range.
- Annual differences in wolf and cougar winter home ranges in 1998-1999 and 1999-2000 may be related to differences in winter severity. The 1998-1999 winter had colder temperatures and deeper snow that lasted longer into spring than in Winter 1999-2000. Elk were more concentrated in the mid Big Creek area in Winter 1998-1999 than in Winter 1999-2000.
- Wolf and cougar seasonal home ranges will be calculated and mapped for the final analysis. Comparisons of size and overlap will be made of 1) cougar winter home ranges each year, 2) wolf winter home ranges each year, 3) comparisons of cougar and wolf winter home ranges, comparisons among years of home ranges of individual cougars and the Chamberlain wolf pack.

Predation Sequences

- We conducted 3 predation sequences on individual cougars to assess how often the predator made a kill and how many days it stayed on a kill. We located the sequence animal every day using triangulation on the radio collar signal. We continued to monitor that cougar for the earlier of 40 days or 3 kills.
- We observed the effects of wolf interactions with the C-5 cougar during a late winter predation sequence on the C-5 cougar. Table 4 shows a calendar of C-5 activities and the presence of wolves in her home range. Table 5 displays potential relationships between the length of time the cougar spent on kills when wolves were present or absent and the number of days the cougar travelled between kills when wolves were present or absent.

Table 4. Predation sequence of Cabin Creek female, cougar C-5, during February 26-April 12, 2000. Each day the cougar was either localized near a kill site or moving into another area. Wolf presence within the cougar home range is designated "wolf", wolf presence near the home range with a possibility of wolf activity in the cougar home range is designated "(wolf)", an unknown wolf location that could be within the cougar home range is designated "(?)".

						Kill Elk
Feed	Feed	Day 1 Feed	2 Feed (wolf)	3 Feed wolf	4 Feed (?)	5 Feed
6 Feed	7 Feed	8 Feed	9 Move	10 Move	11 Move	12 Kill Deer
13 Feed	14 Feed	15 Feed	16 Feed	17 Feed	18 Move	19 Move
20 Kill Deer	21 Feed	22 Feed	23 Feed	24 Feed	25 Feed	26 Feed
27 Move	28 Move	29 Move	30 Move (wolf)	31 Move wolf	32 Move wolf	33 Move wolf
34 Move	35 Move	36 Move	37 Move	38 Move	39 Kill Deer	40 Feed (?)
41 Feed wolf	42 Kill Elk (wolf)	43 Feed wolf&human	44 Move wolf			

Table 5. Summary of predation sequence of Cabin Creek female, cougar C-5, during February 26-April 12, 2000.

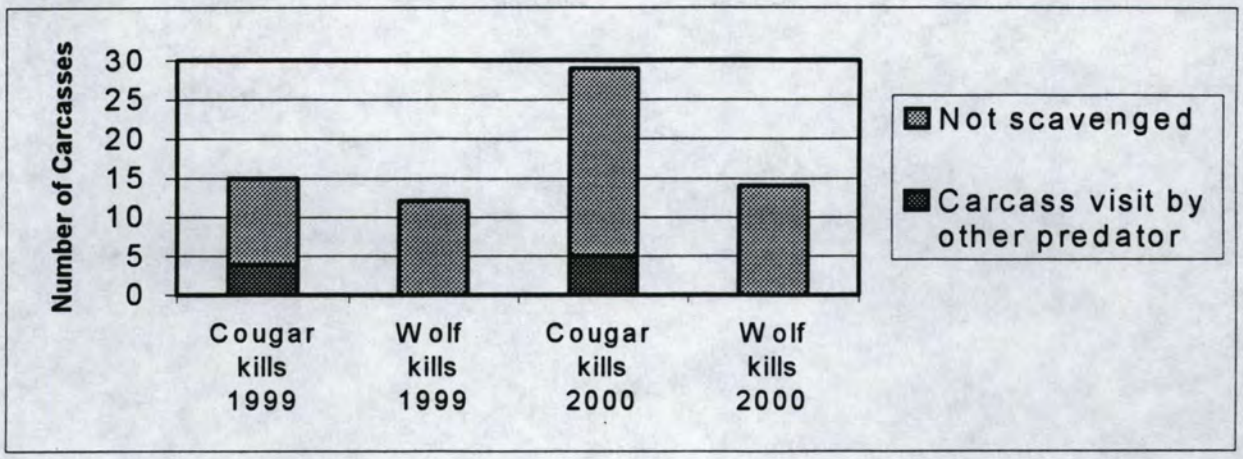
Days spent on kills Wolf activity	11 (elk) yes	6 (deer) no	7 (deer) no	3 (deer) yes	2 (elk calf) yes
Days spent moving between kills Wolf activity	3 no	2 no	12 yes	<1 (yes)	
Inter-kill interval (days)	14	8	19	3	

Predator Interactions

- Direct killing of one predator by another was observed twice in Winter 1999-2000.
  1. A mature resident male cougar killed another mature resident male cougar (the 2 collared males).
  2. A young female cougar killed a young coyote near the carcass of a deer killed by the cougar.

  In 1999 cougars killed a bobcat and a coyote and wolves killed a coyote.
- The Chamberlain pack periodically occupied the home ranges of 2 collared cougars in Winter 1999-2000. Each cougar usually responded to the presence of wolves by moving away, often several miles to the edge of its home range. On several occasions, the pack visited a site where a cougar had been resting or feeding on the previous day.
- Scavenging by carnivores occurred in both years. Wolves visited cougar kill sites, but we did not document cougars visiting wolf kill sites, even though cougars visited other cougar kill sites and carcasses not from predation (Figure 10).
- Cougars and wolves were less often in the vicinity of each other in Winter 1999-2000 than in 1998-1999. This difference was due to the decreased use of the center of the Big Creek winter range by the wolves in Winter 1999-2000. The wider distribution of elk in Winter 1999-2000 due to milder winter temperatures and snow depths likely influenced wolf movements and frequency of interactions with monitored cougars.

Figure 10. Wolf visits to cougar kills and lack of cougar visits to wolf kills on Big Creek in winter 1998-1999 and Winter 1999-2000.

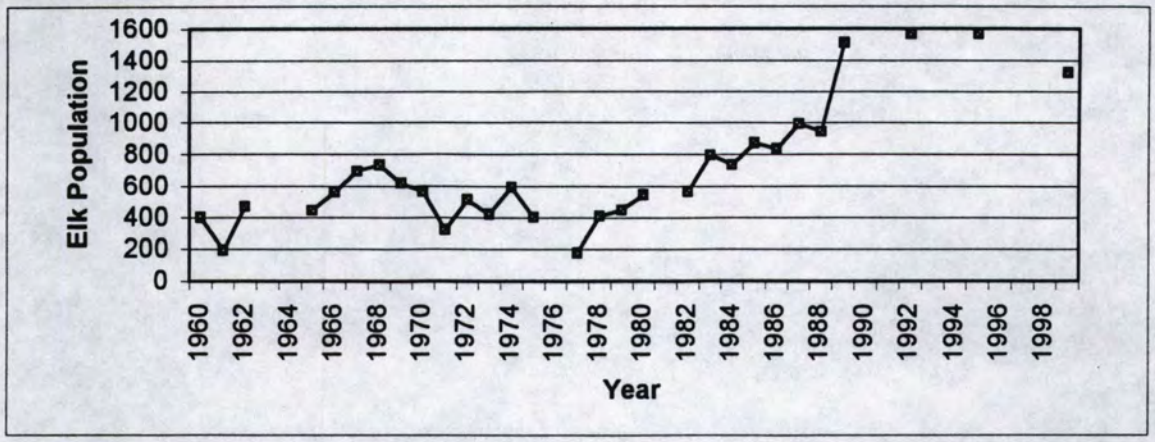


FUTURE ACTIVITIES

Monitoring of cougars and wolves will continue in winter 2000-2001 to assess movements, interactions, and kill rates. We will radiocollar additional cougars to better assess the cougar population and allow choice for alternate animals in predation-sequence data collection. We will determine the reproductive status of radio-collared female cougars and wolves in summer 2000. We will assist the Nez Perce Tribe in replacing radio collars on wolves.

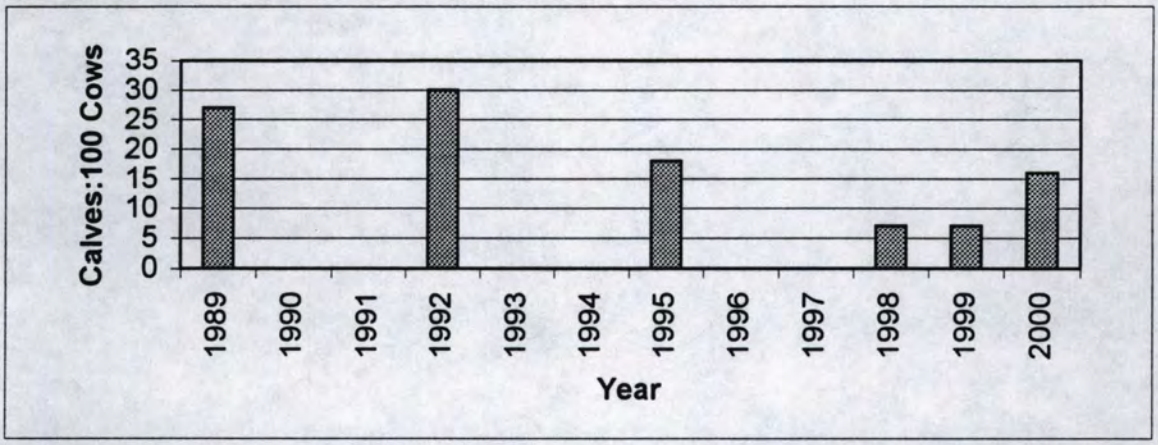
We will continue to monitor prey populations to determine changes in numbers, pregnancy rates, recruitment and the status and trend of these populations. We will analyze winter prey mortalities to find differences in predator strategies and prey vulnerability. We will use home range programs and GIS to evaluate home ranges and movements of cougars and wolves.

Appendix A. Idaho Department of Fish and Game elk population surveys of Unit 26.



Years 1960-1988 were fixed-wing green-up counts. Years 1989, 1992, 1995, and 1999 were spring helicopter sightability population estimates.

Appendix B. Late-winter age ratios of elk in Unit 26.



Age ratios were determined from Idaho Department of Fish and Game helicopter sightability surveys in 1989, 1992, 1995, 1999 and 2000, and from ground counts in 1998, 1999, and 2000.

PREDATION AND INTERACTIONS OF WOLVES AND COUGARS ON BIG CREEK IN CENTRAL IDAHO
Winter 2000 Annual Report

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In cooperation with
Nez Perce Tribe and University of Idaho

June 2000

SUMMARY

This report summarizes results from the second winter season of a 4 year research project. The results and relationships presented in this report may provide insights into the activities and food habits of wolves and cougars in the Idaho wilderness. Until this project is completed results should be considered preliminary and not be over interpreted. The effects of cougar and wolf predation on elk and deer populations and the effects of wolves and cougars on each other will be fully evaluated following completion of all field research.

During winter 2000, field efforts were increased with a crew of 4-5 people and more frequent aerial telemetry flights. We located 53 large mammal carcasses and determined that at least 45 were a result of predation. We confirmed 26 ungulate kills made by cougars and 14 ungulate kills made by wolves. Deer were favored as prey by cougars, but deer and elk were killed in proportion to their abundance by wolves. Elk calves were more vulnerable to predation than elk cows, although deer fawns were not selected for over adult deer. Incisor tooth aging of 1999 elk carcasses revealed that most elk that died during winter were very old-aged cow elk (12-19 years old), although we found that over 95% of live cow elk sampled on the Big Creek winter range in spring 2000 were pregnant. A majority of the deer carcasses were located in lower Big Creek while most of the elk carcasses were found in upper Big Creek. We documented variation in individual cougar and wolf food habits. We completed 3 predation sequences on cougars. We have not determined a predation rate for the wolf pack, since we were unable to obtain sequential wolf locations every day due to the short time the pack spent on kills and its wide ranging movements.

Winter 2000 was less severe than winter 1999, which allowed ungulates to utilize a larger winter range. In winter 2000, the Chamberlain wolf pack spent a significant amount of time on the upper elevation periphery of the Big Creek winter range, and only occasionally hunted the core winter range area that they used in winter 1999. Less overlap occurred between radio-collared wolves and cougars in winter 2000. Preliminary observations indicate that the presence of wolves in a cougar's home range affects the movements of that cougar.

ACKNOWLEDGEMENTS

Funding for this project was provided by a generous grant from the DeVlieg Foundation. The Nez Perce Tribe provided field equipment and funding for wolf telemetry. We thank Curt Mack, Nez Perce Tribe Wolf Project Manager for his commitment to this collaborative effort. We also received considerable support from the Idaho Department of Fish and Game on cougar telemetry, elk population data, elk pregnancy analysis, and aging of dead elk. We want to express our gratitude to Jeff Rohlman, IDF&G Regional Wildlife Manager in McCall for his time and assistance.

We were able to conduct this logistically difficult study through the dedicated effort of our field crew, and the skillful flying of a few backcountry pilots. We greatly appreciate the hard work conducted on this project last winter by Renan Bagley, Pete Armichardy, and Mike Schlegel. We would like to thank pilots Ray Arnold, Pat Dorris, and John Lancaster for many hours of safe and productive radio telemetry flights. We also appreciate the professional cougar capture efforts of houndsmen Wes Craddock and Ron Sherer, and cougar monitoring assistance from Matt O'Connell of IDF&G. We are grateful to the US Forest Service for the use of their cabin at Cabin Creek.

BACKGROUND AND PROBLEM STATEMENT

The U.S. Fish and Wildlife Service introduced 33 gray wolves into the central Idaho wilderness in 1995 and 1996 as part of the restoration of wolves to the northern Rocky Mountains. The Nez Perce Tribe is responsible for monitoring the Idaho wolf population. The introduced Idaho wolves have been successful in establishing home ranges, reproducing, and forming packs. The Chamberlain Wolf Pack has established a home range in the Big Creek winter range. The public has expressed concerns about the effects of the introduced wolves on ungulate species including deer, elk, moose, and bighorn sheep. The effect of these wolves on other animals is still unknown. This is the first study of wolf predation in Idaho.

While public concern has been focused on the effects of wolves on prey animals, little attention has been devoted to the impacts that wolves and other large carnivores will have on each other as they compete for the same food sources. An issue that has not been addressed is the potential for wolves to affect cougars. Interactions between wolves and cougars may influence cougars directly through aggression and killing by wolves or indirectly through effects on cougar habitat choices, activity patterns, and use of space.

JUSTIFICATION

Results of this research will have strong practical and theoretical implications for understanding the dynamics of two competing large predators and their influence on ungulates. Long-term research has been conducted on cougars of the Big Creek drainage in central Idaho.

In 1966 Maurice Hornocker began the first major study of cougar ecology. Projects in the 1970s and 1980s provided new information on cougar biology, food habits, population characteristics, and changes in the cougar population and home ranges over time. The long-term record from this cougar population provides a unique opportunity to compare current and historical cougar population characteristics, home ranges, and predation and the effects of wolves on a known cougar population. Studying cougar-wolf interactions in the Big Creek study area will provide an important comparison for the research project initiated in 1998 by the Hornocker Wildlife Institute in Yellowstone National Park to examine cougar and wolf interactions.

Data collected in this study will guide resource managers in understanding both wolves and cougars. The information will be important for predicting the outcome of similar reintroductions in other areas where cougars occur, such as in the southwestern United States – with the Mexican wolf reintroduction.

Information from this study will provide insights into the effects of predation on current deer and elk populations in central Idaho and aid in the management of ungulate prey of cougars and wolves. These ungulates are of primary economic importance to rural communities in the western United States where hunting of deer and elk is a multimillion-dollar business. When wolves displace cougars from cougar kills, cougars may increase their predation rates by killing more prey to compensate for their loss of food to wolves. This may decrease sustainable harvest levels for human hunters of these ungulates. Or, if wolves reduce the number of cougars in an area, total number of prey taken by the two predators may be the same as pre-wolf reintroduction. By studying these two carnivores simultaneously, we will learn about the influence they have on each other and their effects on prey species, which are also highly valued by humans.

STUDY GOALS

The goals of this study are to: 1) assess the cumulative effects of wolves and cougars on elk, mule deer, and bighorn sheep populations; 2) assess competition between cougars and wolves, including interspecific interactions and partitioning of food, habitat, and space resources.

STUDY AREA AND METHODS

Predation and wolf-cougar interactions are being studied in two winter ranges in central Idaho. This report provides results from the Big Creek study area, a tributary of the Salmon River. The Big Creek area is in Game Management Unit 26, in the Frank Church-River of No Return Wilderness (FCRNRW). The second study area includes Panther and Napias Creeks, east of the FCRNRW in Game Management Unit 28. This report summarizes the results of the second winter of a four-year project. Analysis of results will not be done until completion of the project. Field work was conducted from December to April. Field activities on Big Creek were conducted on foot, snowshoes, and horseback from the University of Idaho's Taylor Ranch Wilderness Research Station, a wall tent camp, and a USFS cabin.

The Chamberlain Wolf Pack of 8-11 wolves spent most of the winter and spring in the Big Creek drainage. The pack included 3 wolves radio instrumented by the Nez Perce Tribe. Five cougars were radio instrumented on Big Creek in 1999. During winter cougars and wolves were radio-located 1-2 times weekly from aircraft. They were monitored daily from the ground when cougars and wolves occurred in the same area. Cougar and wolf kills were documented in detail when located during routine field activities. Cougar and wolf predation rates on elk and mule deer were estimated by searching consecutive daily radio-location sites and snow tracking for periods of 20-45 days.

The size and composition of elk and mule deer populations were assessed through calf:cow and fawn:doe ratios from aerial and ground counts and elk helicopter sightability population surveys. Elk pregnancy rate was determined from the level of pregnancy hormone progesterone in fecal samples collected from 45 cow elk in March and April 2000. Carcass femur marrow fat content and age were used to evaluate the health status of animals found dead in the study area. Femur marrow was collected from carcasses and oven dried for 48 hours. Percent marrow fat was calculated for each sample from dry weight divided by wet weight. Carcasses were examined for pre-existing injuries, parasites, or disease. First incisor teeth from elk and deer carcasses were aged by tooth cementum annuli by Matson's Lab.

PRIMARY FINDINGS

Ungulate Prey Population Status: Elk and Mule Deer

- Elk sightability surveys conducted in the last decade indicate that the elk population size in the Big Creek drainage (Game Management Unit 26) was constant after a strong increase in elk numbers in the 1980s (Appendix A). The population may have declined slightly by 1999, when the population was estimated to be 1320 elk.
- Calf: cow ratios have declined in recent years to 7 calves:100 cows in winters 1998 and 1999 and 16 calves:100 cows in winter 2000 (Appendix B). During winter 2000 the calf ratio declined from 21 calves:100 cows in early winter to 13 calves:100 cows in late winter (Table 1a). The deer fawn:doe ratio was 38 fawns:100 does in early and late winter 2000 (Table 1b).
- The pregnancy rate for 45 cow elk sampled in March and April 2000 was at least 95% pregnant (41 confirmed pregnant, 3 probably pregnant and 1 not pregnant).
- Most elk appeared to be in good body condition in winter 2000, compared with late winter 1999 when many elk looked like they were deficient in subcutaneous body fat.
- We documented several ectoparasites on elk and deer including lice, spinose ear ticks, wood and winter ticks, and nasal bots. Only 2 animals died with severe infestations: a mule deer had 99 ear ticks packed in the ear canals and an emaciated elk calf was infested with wood ticks.
- Winter 1999 snow depths were greater and temperatures were colder than winter 2000 (Figure 1, Figure 2).

Figure 1. Snow depths (monthly median) reported at Taylor Ranch National Weather Service Station in winter 1999 and winter 2000.

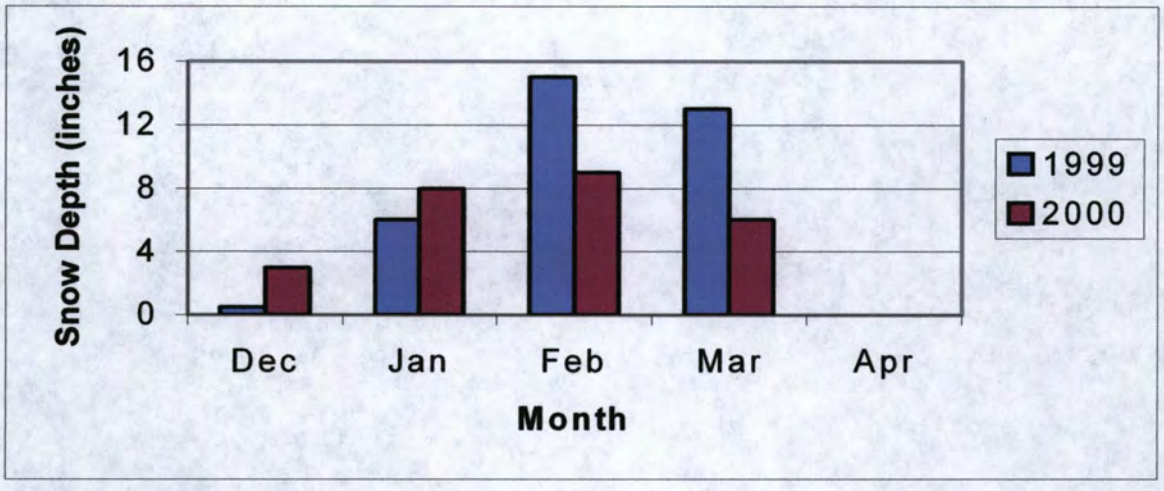


Figure 2. High and low mean monthly temperatures reported at Taylor Ranch National Weather Service Station in winter 1999 and winter 2000.

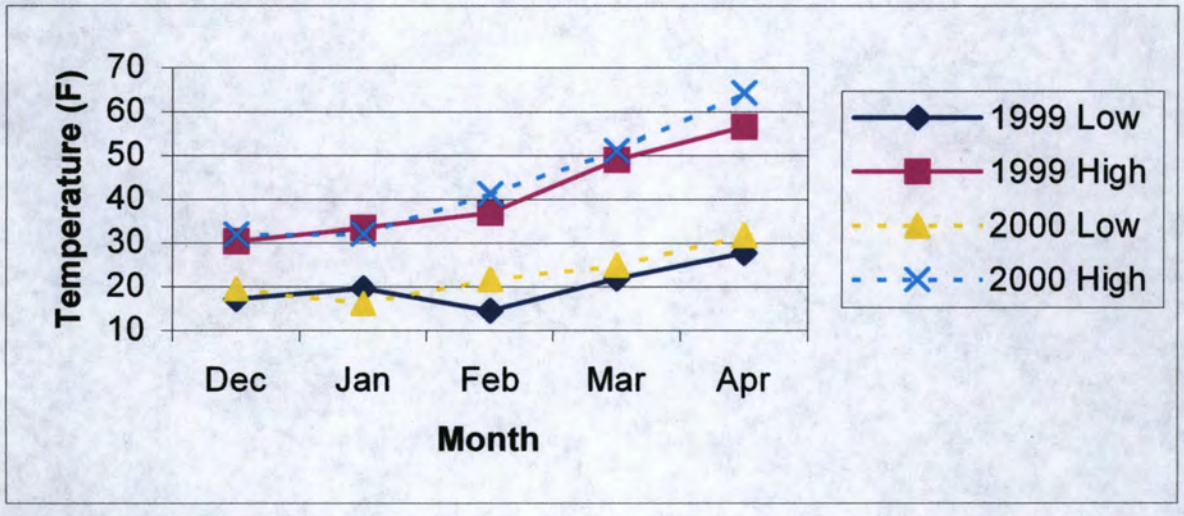


Table 1a. Big Creek Winter 2000 elk calf: 100 cow ratios from ground counts.

	Early Winter Dec-Jan			Late Winter Mar-Apr			All Winter (mean of Early and Late Winter)
	Cows	Calves	Ratio	Cows	Calves	Ratio	
Cougar Creek Cliff Creek Rush Creek Lobauer Basin Gooseneck Basin	128	33	25.8	149	20	13.4	19.6
Browns Basin Cabin Creek Cow Creek Spring Creek Cave Creek	252	49	19.4	285	43	15.1	17.3
Doe Creek Garden Creek Mile High Coxey Creek Lime Creek	97	17	17.5	245	22	9.0	13.3
All of Big Creek	477	99	20.8	679	85	12.5	15.9*

*This ratio is from a total count of 1156 cows and 184 calves (includes multiple counts of the same elk).

Table 1b. Big Creek Winter 2000 mule deer fawn: 100 doe ratios from ground counts.

	Early Winter Dec-Jan			Late Winter Mar-Apr			All Winter
	Does	Fawns	Ratio	Does	Fawns	Ratio	Ratio
Cliff Creek to Acorn Creek	22	8	36.4	76	29	38.2	37.8*

*This ratio is from a total count of 98 does and 37 fawns.

Winter Ungulate Prey Mortality

- Age was determined for 15 of 18 elk that died on Big Creek in winter 1999 (Figure 3). Twelve cow elk were aged by cementum annuli analysis, and 3 calf elk were aged by tooth eruption pattern. The median age of all elk carcasses was 13 years old and the median age of adult elk was 15.5 years old. The very old ages of the elk carcasses suggest that the Big Creek elk population also has a high proportion of old-aged cows.

- Percent marrow fat was variable for deer and elk in both winters (Figure 4). Some marrow samples from animals in poor condition in 1999 were desiccated when collected and weighed, so actual percent marrow fat in 1999 was much lower than reported here. There were no detectable differences in femur marrow fat for elk and deer carcasses from winter 1999 (z=0.067) or winter 2000 (z=0.84).

Figure 3. Elk carcass ages on Big Creek, winter 1999.

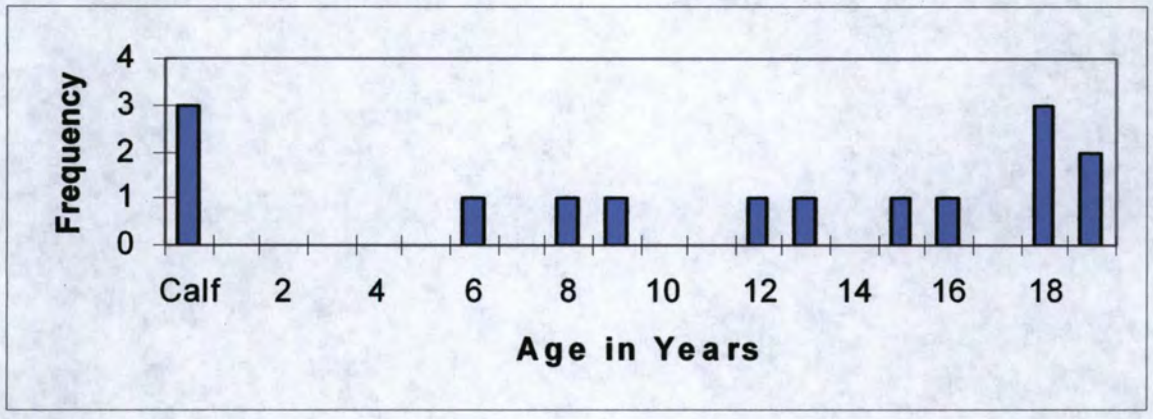
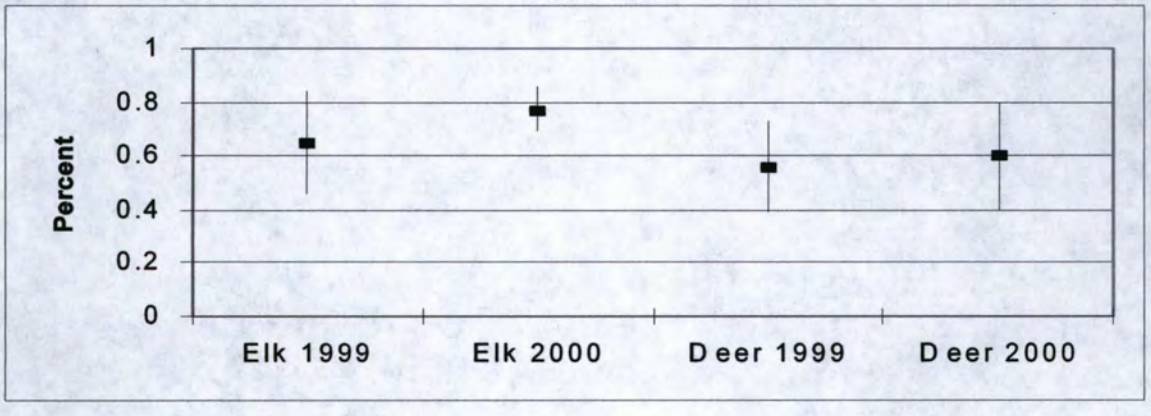


Figure 4. Femur fat percent (mean with 95% CI) for elk and deer carcasses in winter 1999 and winter 2000.



Carcass Summary 2000

- We investigated 53 carcasses of large mammals that had died on the Big Creek winter range in winter 2000 and 34 carcasses in winter 1999 (Table 2). Most mortality was attributed to predation (Figure 5).

- Adult females were the predominant age and sex class of ungulate carcasses in both winters (Figure 6).
- There were 2.2 elk for every mule deer on the Big Creek winter range in winter 2000. However, deer were killed in a greater proportion than their relative abundance on Big Creek (Z=2.05). Cougars disproportionately selected deer as prey over elk (Z=2.70), while wolves killed elk and deer in similar proportions to their relative abundance on Big Creek winter range (Z=0.19) (Figure 7).
- A greater proportion of calf elk were killed by predators in winter 2000 than the proportion of calves in the Big Creek population (Z=3.51) (Figure 8).
- During winter 2000, cougars and wolves did not favor fawns over adult deer (Z=-1.08) (Figure 8).
- The proportion of mule deer and elk in the carcass samples of winter 2000 and winter 1999 were similar (chi-square p=0.365) (Table 2).
- Individual cougars and the wolf pack showed a variation in food selection, some preferred elk and others primarily ate deer (Table 3).
- Deer kills were more often found in lower Big Creek, while elk kills were more common in the upper portion of the Big Creek winter range (Figure 9).

Table 2. Species composition of carcasses of large mammals found dead on the Big Creek winter range in winter 1999 and winter 2000.

	Elk	Mule deer	Bighorn	Moose	Coyote	Cougar	Bobcat	Total
1999	18	11	2	0	2	0	1	34
2000	24	24	1	1	1	2	0	53

Figure 5. Cause of death for large mammals found dead on the Big Creek winter range in winter 1999 and winter 2000.

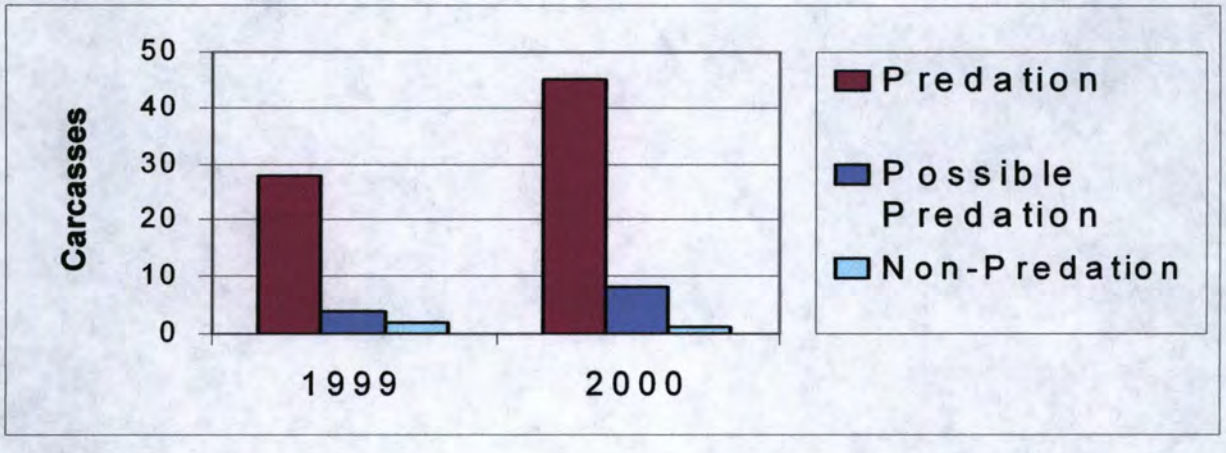


Figure 6. Sex and age of elk and deer found dead on Big Creek in winter 1999 and winter 2000.

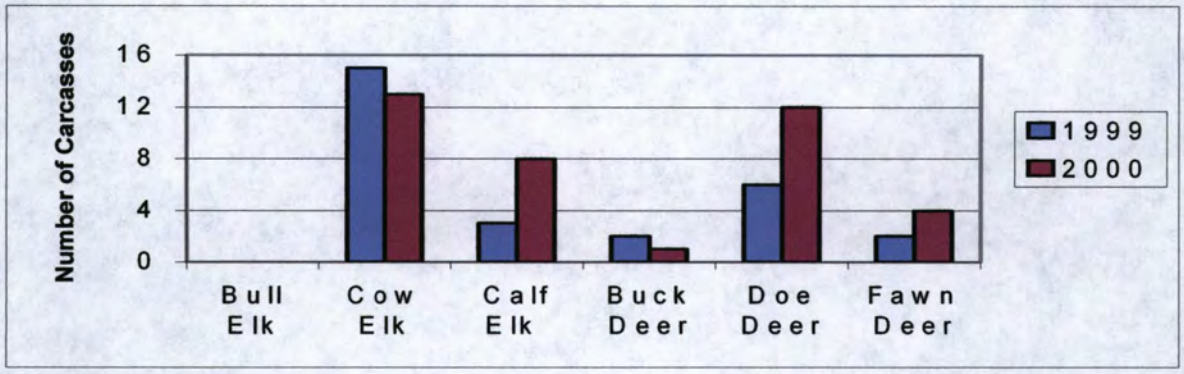


Figure 7. Wolf and cougar predation on elk and deer in winter 1999 and winter 2000.

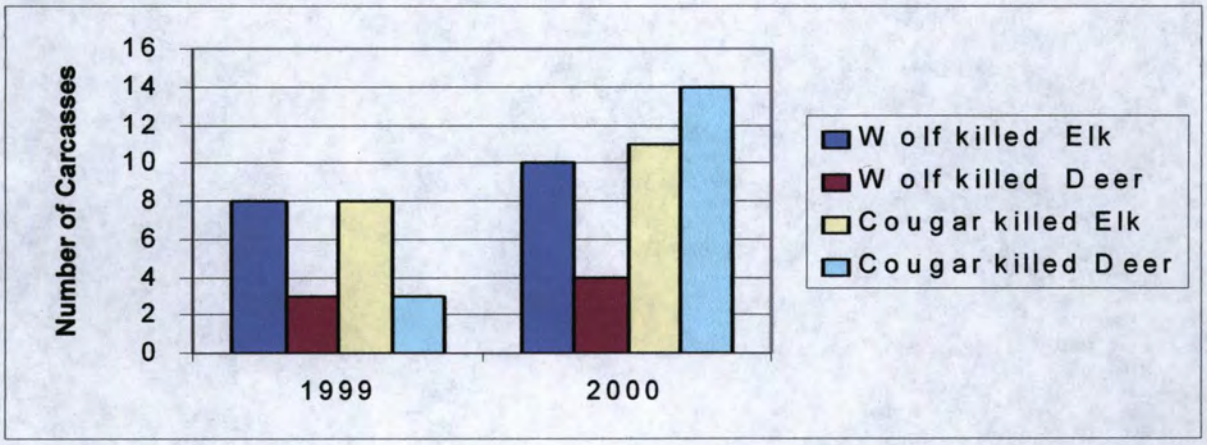


Figure 8. Age ratios of Big Creek elk and mule deer populations and elk and mule deer killed by cougars and wolves, winters 1999 and 2000.

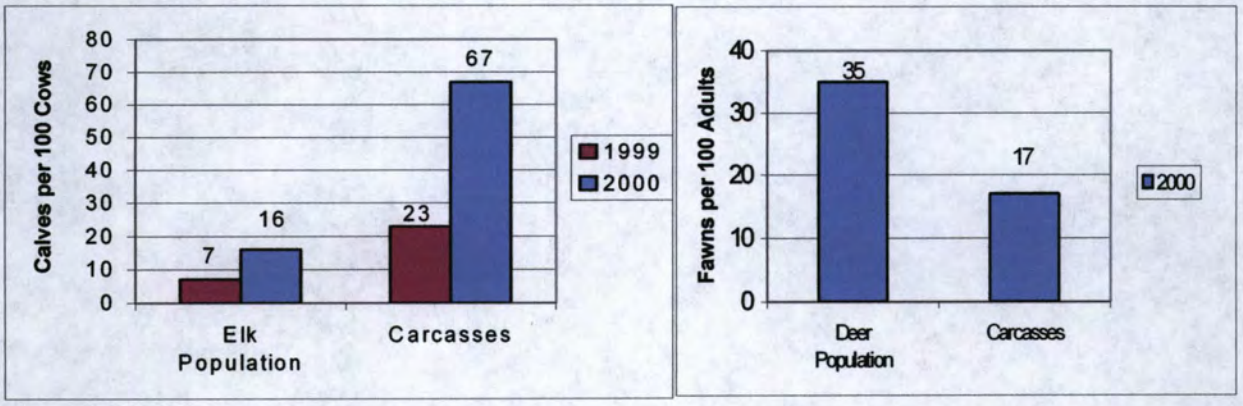
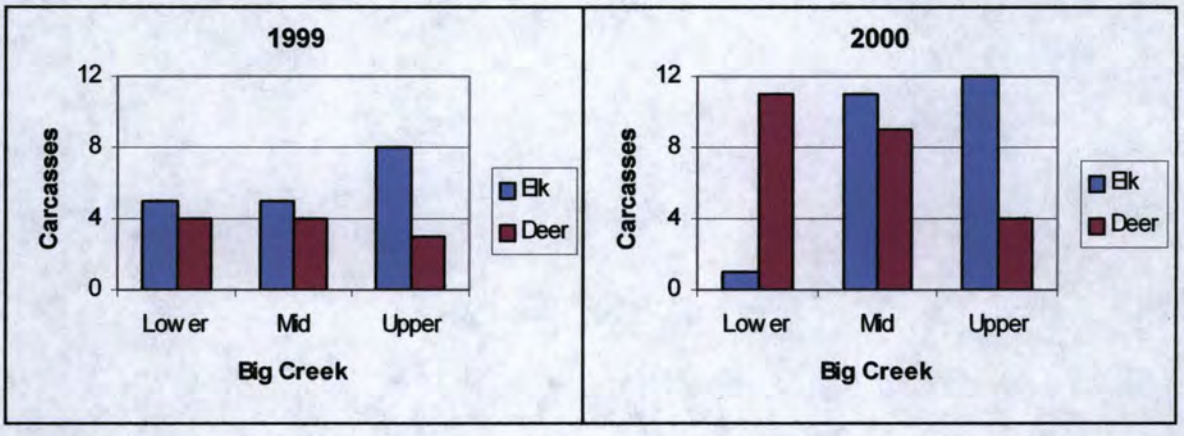


Table 3. Individual variation in prey killed by known cougars and wolves in winter 2000.

	Deer	Elk	Other	Total
Female & Kitten	5	0	Bighorn	6
Rush Cr. Female	4	1	Coyote	6
Cabin Cr. Female	3	5	0	8
Chamberlain Pack	4	9	0	13

Figure 9. Location of elk and mule deer kills on the Big Creek winter range, winter 2000.



Predator Population Status: Wolves and Cougars

- The Chamberlain wolf pack produced 5 pups in April 1999. In winter 2000 pack size was as large as 11 wolves, but may have declined to 8 animals in late winter. The alpha female wolf was localized at a den site in April 2000. A subadult wolf, B-50 also denned in April 2000 with an unknown male and produced her first litter of 2 pups. Her den site is within the home range of the Chamberlain Pack. Four wolves of the Chamberlain pack are radio collared.
- Other wolves: The Thunder Mountain Pack occasionally used the southeast section of the Big Creek drainage in summer and winter. The Chamberlain Pack did not use most of this area. A subadult female wolf (B-38) left the Stanley Pack in 1999 and moved to the South Fork of the Salmon River. She occasionally traveled in upper Big Creek in winter 2000. Her movements did not overlap the area used by the Chamberlain Pack. A female pup from the Jureano Pack (B-80) was relocated to the Selway River drainage in winter 2000. She moved through the Chamberlain Pack's territory for a month in spring 2000 and may be establishing residency in lower Big Creek, on the edge of the Chamberlain Pack's territory.
- We radio collared 5 cougars in 1999 (3 females and 2 males). None of the collared female cougars produced kittens in the past year. One of the radio collared male cougars killed the other radio collared cougar, apparently as a result of a territorial fight after both cougars moved to an area that had not been used by either male.

- Hunters harvested 5 cougars from Big Creek, 3 males and 2 females. An unmarked adult male cougar was found dead in a cave. He had a front paw injury and had lost 2 toes, which prevented him from effectively pursuing and killing large prey. His emaciated condition suggested he had starved to death. The skeleton of a female cougar that had died a year ago was found while investigating the remains of a cougar killed bighorn.
- Other cougars: We saw cougar kittens or kitten tracks in 3 areas along Big Creek (Taylor Ranch, Coxey Creek, Monumental Creek). We saw unmarked cougars, their track and kills throughout the Big Creek drainage. We documented cougar killed prey in 8 drainages that were not typically used by radio collared cougars.

Predator Movements: Seasonal Migrations

- All 5 cougars moved between discrete higher elevation summer ranges and lower elevation winter ranges. The distances between a cougar's summer and winter ranges varied from 2-35 miles apart.
- Both male cougars moved to different winter home ranges in 2000 than the ones they occupied in 1999. One female cougar moved to a new home range in mid winter 2000.
- The Chamberlain pack occupied the higher elevation middle section of their home range in summer and the lower elevation southern and northern sections in winter.
- The Chamberlain pack winter home range encompassed winter home ranges of several cougars on Big Creek.
- In each winter, 1996-2000, the Chamberlain Pack has varied the use of its winter home range. In 1996 through 1998 the pack primarily occupied the big game winter range on the south side of the Main Salmon River around Chamberlain Creek. In winter 1999 the pack spent most of the time in the central part of the Big Creek big game winter range. In winter 2000 the pack remained at mid elevations on the upper fringes of the Big Creek winter range.
- Annual differences in wolf and cougar winter home ranges in 1999 and 2000 may be related to differences in winter severity. The 1999 winter had colder temperatures and deeper snow that lasted longer into spring than in winter 2000. Elk were more concentrated in the mid Big Creek area in winter 1999 than in winter 2000.
- Wolf and cougar seasonal home ranges will be calculated and mapped for the final analysis. Comparisons of size and overlap will be made of 1) cougar winter home ranges each year, 2) wolf winter home ranges each year, 3) comparisons of cougar and wolf winter home ranges, comparisons among years of home ranges of individual cougars and the Chamberlain wolf pack.

Predation Sequences

- We conducted 3 predation sequences on individual cougars to assess how often the predator made a big game kill and how many days it stayed on a kill. We located the sequence animal every day using triangulation on the radio collar signal. We continued to monitor that cougar for the earlier of 40 days or 3 kills.
- We observed the effects of wolf interactions with the C-5 cougar during a late winter predation sequence on the C-5 cougar. Table 4 shows a calendar of C-5 activities and the

presence of wolves in her home range. Table 5 displays potential relationships between the length of time the cougar spent on kills when wolves were present or absent and the number of days the cougar travelled between kills when wolves were present or absent.

Table 4. Predation sequence of Cabin Creek female cougar C-5 during February 26-April 12, 2000. Each day the cougar was either localized near a kill site or moving into another area. Wolf presence within the cougar home range is designated "wolf", wolf presence near the home range with a possibility of wolf activity in the cougar home range is designated "(wolf)", an unknown wolf location that could be within the cougar home range is designated "(?)".

						Kill Elk
Feed	Feed	Day 1 Feed	2 Feed (wolf)	3 Feed wolf	4 Feed (?)	5 Feed
6 Feed	7 Feed	8 Feed	9 Move	10 Move	11 Move	12 Kill Deer
13 Feed	14 Feed	15 Feed	16 Feed	17 Feed	18 Move	19 Move
20 Kill Deer	21 Feed	22 Feed	23 Feed	24 Feed	25 Feed	26 Feed
27 Move	28 Move	29 Move	30 Move (wolf)	31 Move wolf	32 Move wolf	33 Move wolf
34 Move	35 Move	36 Move	37 Move	38 Move	39 Kill Deer	40 Feed (?)
41 Feed wolf	42 Kill Elk (wolf)	43 Feed wolf&human	44 Move wolf			

Table 5. Summary of predation sequence of Cabin Creek female cougar C-5 during February 26-April 12, 2000.

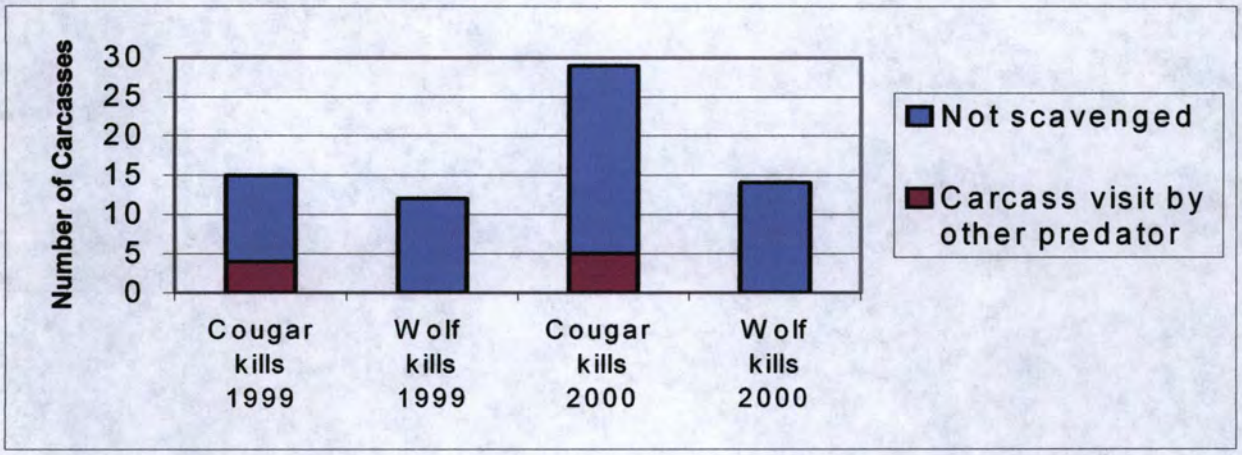
Days spent on kills Wolf activity	11 (elk) yes	6 (deer) no	7 (deer) no	3 (deer) yes	2 (elk calf) yes
Days spent moving between kills Wolf activity	3 no	2 no	12 yes	<1 (yes)	
Inter-kill interval (days)	14	8	19	3	

Predator Interactions

- Direct killing of one predator by another was observed twice in winter 2000.
  1. A mature resident male cougar killed another mature resident male cougar (the 2 collared males).
  2. A young female cougar killed a young coyote near the carcass of a deer killed by the cougar.

  In 1999 cougars killed a bobcat and a coyote and wolves killed a coyote.
- The Chamberlain Pack periodically occupied the home ranges of 2 collared cougars in winter 2000. Each cougar usually responded to the presence of wolves by moving away, often several miles to the edge of the cougar home range. On several occasions the pack visited a site where a cougar had been resting or feeding on the previous day.
- Scavenging by carnivores occurred in both years. Wolves visited cougar kill sites, but we did not document cougars visiting wolf kill sites, even though cougars visited other cougar kill sites and carcasses not from predation (Figure 10).
- Cougars and wolves were less often in the vicinity of each other in winter 2000 than in 1999. This difference was due to the decreased use of the center of the Big Creek winter range by the wolves in winter 2000. The wider distribution of elk in winter 2000 due to milder winter temperatures and snow depths likely influenced wolf movements and frequency of interactions with monitored cougars.

Figure 10. Wolf visits to cougar kills and lack of cougar visits to wolf kills on Big Creek in winter 1999 and winter 2000.



PLANS FOR NEXT YEAR

Monitoring of cougars and wolves will continue in winter 2001 to assess movements, interactions, and kill rates. We will put radio collars on additional cougars to better assess the cougar population and allow for alternate animals for predation sequences. We will determine the reproductive status of radio collared female cougars and wolves in summer 2000. We will assist the Nez Perce Tribe in replacing wolf radio collars.

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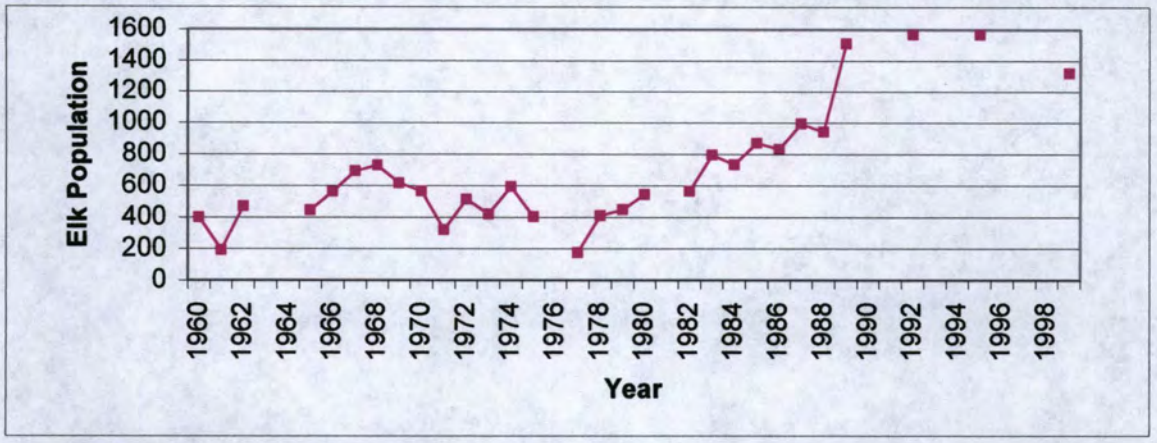

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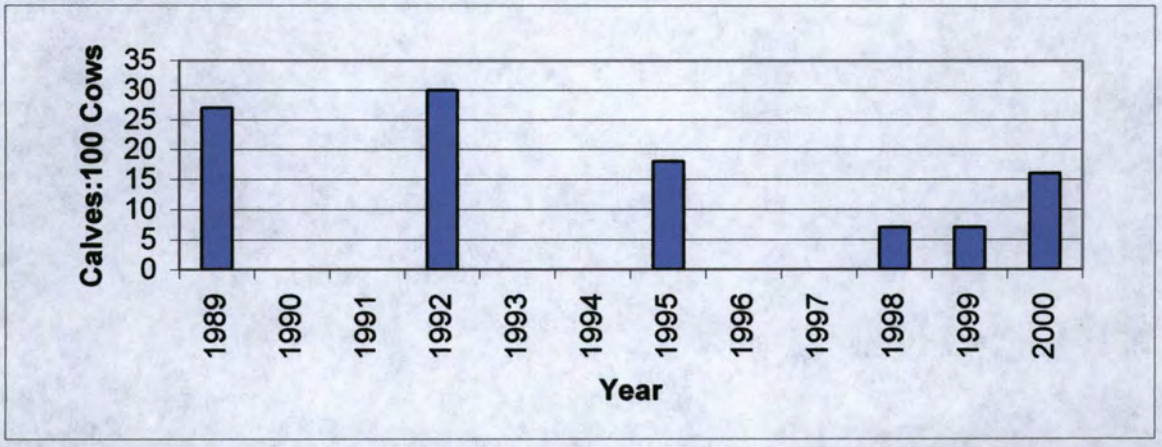

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PREDATION AND INTERACTIONS OF WOLVES AND COUGARS ON BIG CREEK IN CENTRAL IDAHO

Highlights of the 1999 Winter Field Season

Holly Akenson and Jim Akenson

Hornocker Wildlife Institute
In cooperation with
Nez Perce Tribe and University of Idaho
May 17, 1999

SUMMARY

In January 1999 we began field research on a 4-year study of predation and interactions between wolves and cougars on the Big Creek winter range. Our objectives were: 1) to assess the cumulative effect of wolves and cougars on wintering populations of deer, elk, and bighorn sheep, and 2) to determine the relationship between wolves and cougars competing for winter food and space. During January and March we monitored 5 cougars that we radio instrumented in January and 3 wolves from the Chamberlain Pack that had been radio instrumented previously. We investigated 33 carcasses; 13 were known cougar kills and 12 were known wolf kills. We documented scavenger visits to carcasses by wolves (6 times), bobcats (4 times), coyotes (4 times), and cougars (2 times). We found 2 coyotes and a bobcat killed by cougars and wolves. The proportion of elk and mule deer carcasses found killed by wolves was similar to that of cougars. Both predators primarily killed older aged cow elk. We suspect the age structure of kills may reflect the elk population age structure. Arthritis, hoof and leg injuries, an abdominal hernia, and jaw necrosis were found in elk carcasses killed by wolves and cougars. Two wolf-killed elk were in poor condition and were not significantly consumed by wolves. We did not document direct interactions between wolves and cougars, but the radio-instrumented predators were often segregated on the winter range. We presented the findings of the first winter of this project at the 11th Annual Rocky Mountain Interagency Wolf Recovery Conference 1999 at Chico Hot Springs, MT.

PRIMARY FINDINGS

- During the 1998-99 winter and spring the Chamberlain Wolf Pack primarily occupied the central part of the Big Creek ungulate winter range. In the previous 2 years this pack spent most of the winter and spring along the main Salmon River. Non-radio instrumented single wolves were documented in lower Big Creek.

- Five cougars were radio instrumented in the lower half of the Big Creek winter range. In January and March 33 carcasses were examined. We confirmed cause of death for 14 cougar kills and 12 wolf kills (Table 1). All elk and mule deer kills found were female animals.

- A high proportion (50%) of elk killed by cougars and wolves had previous injuries (Table 2). Most elk kills (63%) were "older" animals according to wear in their dentition (Table 3). All carcasses will be aged by tooth cementum annuli analysis.

- Our small sample suggests that elk and deer were killed by wolves and cougars in a similar proportion to their populations estimated by Idaho Department of Fish & Game. Elk were killed more often by both predators than were deer (Table 1).

- We found a low proportion of elk carcasses from calves and yearlings, contrary to typical predation behavior of cougars and wolves. The Big Creek elk population has experiencing very poor calf recruitment for 2 years (7-10 calves per 100 cows in winter 1999). The kill data reflect the lack of young age classes available for predation and the prevalence of injured and older aged cow elk.

- Cougar kills were scavenged more often than wolf kills (Table 4). On several occasions we documented 3 predator species visiting a carcass. We found a coyote and a bobcat killed by a cougar at elk carcasses and a coyote killed by the wolf pack on the trail.

- A subadult female cougar spent 22 days feeding on a cow elk she killed during a predation sequence.

- The remote camera was a valuable tool for documenting scavenging. It could be used to record predator interactions.

TABLES

TABLE 1: Prey carcasses investigated on Big Creek and causes of death, January and March 1999.

Prey	Cougar	Wolf	Coyote	Unknown	Non-Predation	Accident	Total
Elk	8	8	0	0	1	0	17
Mule deer	2	3	1	4	0	1	11
Bighorn	2	0	0	0	0	0	2
Coyote	1	1	0	0	0	0	2
Bobcat	1	0	0	0	0	0	1
Total	14	12	1	4	1	1	33

TABLE 2: Occurrence of injuries in cougar and wolf killed prey on Big Creek, January-March 1999.

Prey	Cougar		Wolf		Total prey with injury	Total prey
	Injury	No injury	Injury	No injury		
Elk	5	3	3	5	8	16
Mule Deer	0	2	0	3	0	5
Bighorn	1	1	0	0	1	2

TABLE 3: Age structure of cougar and wolf killed elk on Big Creek, January-March 1999.

Predator	Calf	Yearling	Young adult	Old adult	Unknown adult	Total elk
Cougar	1	0	0	7	0	8
Wolf	2	0	2	3	1	8
Total	3	0	2	10	1	16

TABLE 4: Incidental observations of visits to carcasses by other predators on Big Creek in January and March 1999.

Predator	Cougar kills	Wolf kills	Unknown/Not predation	Total
Cougar	3	0	3	6
Wolf	4	0	2	6
Bobcat	3	0	1	4
Coyote	2	2	1	5
Unknown small carnivore	1	1	0	2

KEY ISSUES AND QUESTIONS

We noted several interesting observations in the first winter field season regarding the status of the elk population, wolf-cougar locations, and scavenger activity. These topics need further examination in order to address the objectives of this study.

I. Elk Population Status

Key Issue

- The Big Creek elk population appears to be at/beyond carrying capacity and on the verge of declining. Our sample of elk carcasses had a high proportion of older aged cows, injuries, and low levels of femur fat in late winter. Helicopter and ground counts showed extremely low calf recruitment (birth rate and/or first year survival) in 1997 and 1998. We observed elk in late winter in poor body condition and found lice infestations and intestinal parasites. Idaho Fish and Game is concerned about the Big Creek elk population status and will pay for tooth aging of our carcasses.

Questions

- How will the status of the elk population influence the effect of wolf and cougar predation on the elk population? If the elk population declines will the calf recruitment rate increase due to more food available per elk or will it be further reduced due to increased predation on calves? Will predators increase the proportion of mule deer in their diet if elk numbers decline?
- Can the effects of predation be distinguished from the effects of exceeding carrying capacity in a declining elk population?

II. Wolf-Cougar Segregation

Key Issue

- The Chamberlain Wolf Pack shifted their winter territory from the Salmon River to Big Creek in 1999. The pack spent most of the time in the mid section of the Big Creek ungulate winter range. Cougars were radio instrumented in the lower half of the Big Creek winter range. Three cougars captured in areas used by the wolf pack moved downstream to areas not visited by the pack. One cougar moved upstream into the wolf use area and 1 cougar remained outside the wolf territory.

Questions

- Why did cougars move from capture sites? Were these movements coincidental or in response to the arrival of the wolf pack in cougar winter territories?

III. Scavenger Activity

Key Issue

- Ungulate carcasses were frequently visited by other predators/scavengers. Some carcasses were fed on by scavengers; others showed no fresh feeding or did not have any meat remaining for scavengers. Subadult cougars, wolf singles or pairs, or bobcats and coyotes made most scavenger visits. Track evidence on one occasion indicated that a wolf had tracked a cougar to several scrapes and scent marking sites.

Questions

- How important is scavenging to the relationship between cougars and wolves? Are carcass visits for information about other predators as well as food? Are scavenged carcasses abandoned, unattended, or usurped?
- How does the interaction of scavenging wolves and cougars affect ungulate populations? Could the bighorn sheep population decline from predation if a cougar specializing in bighorn killing was routinely usurped from kills by a wolf? Can remote cameras be used at carcasses to measure scavenging activity?

PLANS FOR NEXT WINTER FIELD SEASON

- Radio instrument cougars in the central section of the Big Creek drainage to optimize observations of cougar-wolf encounters and spatial relationships.
- Monitor more intensively, especially where cougars and wolves are in close proximity.
- Increase the sample of prey carcasses.
- Return to carcasses to assess consumption rates and scavenger activity.
- Assess prey rates of wolves and cougars, through predation sequences and intensive monitoring periods.

COUGAR AND WOLF PREDATION AND INTERACTIONS IN CENTRAL IDAHO

A Proposal to the Charles DeVlieg Foundation
August 1999

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Frank Church River of No Return Wilderness, Idaho

Amount Requested from the Charles DeVlieg Foundation: $31,086

EXECUTIVE SUMMARY

A four-year study of the impact wolf and cougar populations have on each other, and on their major prey, is now underway in central Idaho. The goals of the study are to 1) understand the impact wolves and cougars have on prey populations, especially in winter, and 2) understand the interactions between cougars and recently introduced wolves. These interactions may include wolves killing cougars, or cougars killing wolves, and competition for food, space, and habitats. Radio-collared wolves and cougars are intensively monitored on the ground during winter and spring in two study areas. The project will provide greatly needed information on competition between these predators, the overall impacts the two carnivore species have on deer, elk, big horn sheep and other prey, and how this might impact hunting opportunities and management alternatives of the agencies involved.

After one winter field season, the project investigators have radio-collared 5 cougars and monitored them weekly. Cooperating scientists from the Nez Perce Tribe have monitored radio-collared wolves from the Chamberlain Pack, which live in the same area as the cougars in the study. Thirty-three known kill sites in the study area, of both cougars and wolves, have been examined.

BACKGROUND

The U.S. Fish and Wildlife Service released 33 gray wolves into the central Idaho wilderness in 1995 and 1996 as part of a regional program to restore wolves to the northern Rocky Mountains. The Nez Perce Tribe has responsibility for monitoring the Idaho wolf population. Work by Tribal biologists has determined that introduced Idaho wolves have been successful in establishing themselves, reproducing, and forming packs. However, wildlife managers and the public are concerned about the effects of the introduced wolves on prey species, including deer, elk, moose, and bighorn sheep. No studies of wolf predation have been conducted in Idaho, and the effect of these wolves on their prey is still unknown for this area.

While the public has questioned the effects of wolves on prey animals, little attention has been devoted to the potential impacts wolves may have on other large carnivores, such as cougars, and what the results may be for the large prey of the carnivores. Interactions with the newly-reintroduced wolves may influence cougars directly through attacks and threats by wolves. Or, the impact may be indirect; wolves may effect cougar habitat choices and activity.

Research on several carnivores in one ecosystem has rarely been undertaken simultaneously anywhere, and has not been conducted in central Idaho to date. These carnivores compete for many of the same prey species. Understanding the fundamental aspects of the situation with cougars and wolves in central Idaho is necessary to successfully sustain the natural ecosystem. Wildlife managers will need this information to manage the cougars, wolves, and the prey they depend on. This will also be vital to making sure that opportunities for the hunting public remain a part of the outdoor scene in central Idaho, as well.

JUSTIFICATION

Results of this project will have strong practical implications for understanding the dynamics of two competing large predators and their influence on ungulates. Long-term research has been conducted on cougars of the Big Creek drainage in central Idaho. In 1966, Maurice Hornocker began the first major study of cougar ecology. Projects in the 1970s and 1980s provided new information on cougar biology, food habits, population characteristics, and changes in the cougar population and home ranges over time. Dr. Hornocker is currently the Director of the Hornocker Wildlife Institute, and thus the complete, long-term record from the study of this cougar population is available to our project. This provides a unique opportunity to compare current and historical cougar population characteristics, home ranges, and predation and the effects of wolves on a known cougar population. Studying cougar-wolf interactions in the Big Creek study area will allow credible extrapolation of the data to other areas throughout the West.

The second study area, in Panther Creek, will provide information on cougars, wolves, and ungulates form a more human-impacted system. This study area not only contains both wolves and cougars, but more hunter activity and stock grazing. Measuring characteristics such as prey choice in this system will provide an ideal comparison to the Big Creek wilderness data.

Data collected in Big Creek and Panther Creek will focus on ungulate predation rates, diet comparisons, detailed information on prey taken by the predators (including age, sex, health and condition, and carcass consumption rates), and habitat information related to predation. These data will guide resource managers in understanding both wolves and cougars, and their integrated impact on ungulate prey. This information will aid in the management of ungulate prey of cougars and wolves. These ungulates are of primary economic importance to rural communities in the western United States, where hunting deer and elk is a multimillion dollar business.

When wolves displace cougars from cougar kills, cougars may increase their predation rates by killing more prey, compensating for their loss of food to wolves. This may decrease harvest levels for human hunters of these ungulates. Or, if wolves reduce the number of cougars in an area, total number of prey taken by the two predators may be the same as that prior to wolf re-introduction. A simultaneous, systematic field study of these two carnivores will provide valuable insights into the influence they have on each other, and their combined effect on prey species. Additionally, the information will be requisite to predicting the outcome of similar wolf re-introductions in other areas where cougars occur, such as in the southwestern United States (with the Mexican wolf re-introduction) or the Olympic Peninsula in Washington state (where wolves have recently been proposed for re-introduction).

STUDY GOALS AND HYPOTHESES

We propose a three-year field study of predator-prey and predator-predator relationships in two study areas in central and southern Idaho. Field activities will be confined to winter months (November – April) beginning November, 1998, through April, 2001; and additional six months will be required for analysis and write-up. A budget has been developed for Year 1 of the project.

The goals of this study are to: 1) assess the effects of wolves on elk and mule deer populations; 2) assess wolf-cougar-prey dynamics in a human-impacted landscape (through comparison to the wilderness study site); 3) assess competition and resource partitioning (food, space, and habitat) between cougars and wolves; and 4) document interspecific interactions and killing between cougars and wolves.

The hypotheses to be tested include:

1) H_o: There is no significant difference between the prey killed by wolves and the prey killed by cougars.
   H_1: There is a difference between the prey killed by wolves and the prey killed by cougars.

2) H_o: Prey killed by both predators are similar (age, sex, nutritional value) to those available in the prey population (i.e. no differential vulnerability can be detected).
H_1: Prey killed by both predators are not similar to those available in the prey population.

3) H_o: Cougar predation rates do not differ when wolves are present or absent.
H_1: Cougar predation rates are greater when wolves are present than when wolves are absent.

4) H_o: There is no significant difference in cougar and wolf use of habitats and temporal use of space.
H_1: Cougars and wolves use different habitats and temporal use of space.

5) H_o: Spatial interactions between cougars and wolves are random.
H_1: Cougars and wolves exhibit avoidance or attraction.

STUDY AREAS AND METHODS

Predation and wolf-cougar interactions will be studied in two study areas in central Idaho. The first area, or the Primary Site, comprises the lower 25 miles (40 kilometers) of Big Creek in the Frank Church River of No Return Wilderness (FCRW). The second area, or the Comparison Site, includes Panther and Napias Creeks, just east of the FCRW. These two areas were chosen for a variety of reasons. First, both study areas currently contain established wolf packs (two in each area). Secondly, the Primary Site has been the focus of more than 13 years of field work and three intensive projects on cougars (Hornocker 1970, Seidensticker et. al. 1973, Koehler 1991, Quigley et. al. 1989). In combination, these studies make the Big Creek cougar population one of the best understood populations anywhere. In addition, the presence of the study area in the FCRW means the information gathered will provide a baseline for wolf-cougar interactions and impacts in a setting where human impacts are minimal. Lastly, the Wilderness Research Center at Taylor Ranch provides an ideal, and unique, base from which to conduct this work, offering scientific and logistical support unavailable elsewhere in a wilderness setting.

On both study areas, radio-telemetry will be essential for data gathering. Each of the four wolf packs that use the two study areas include one to four radio-collared wolves. Additional wolves are slated to be added to this list of monitored wolves, through efforts of the Nez Perce Tribal biologists, following the Nez Perce trapping protocol (Johnson 1998). Cougars will be captured and monitored following techniques of Murphy (1998). Cougars will be treed with hounds, immobilized, and fitted with radio collars and ear tags. Blood, hair, or fecal samples will be collected from cougars for serological, DNA, and food habits studies. Cougar captures will be performed from late November to April. Animal handling protocols will follow Kreeger (1997) and will be reviewed annually in the field by a veterinarian. Cougars and wolves will be radio-located weekly from aircraft or from the ground and monitored daily or hourly where cougars and wolves occur in the same area. Cougar and wolf kills will be documented opportunistically during routine field activities. Cougar and wolf predation rates on elk and mule

deer will be estimated by searching consecutive radio-location sites and snowtracking for periods of 15-40 days. Direct interactions between cougars and wolves during these periods will be documented using telemetry and snowtracking. All kill sites will be precisely located on a map for subsequent habitat analysis. Additionally, kill site location coordinates will be documented with Geographic Positioning Systems (GPS).

This study began November 15, 1998 and is proposed to end during 2002. Field work will occur from November through April for three years. The fourth year of the study will be used for data analysis and publication writing. Big Creek field activities will be conducted on foot, snowshoe, and horseback from the University of Idaho's Taylor Ranch Wilderness Research Station and wall tent camps. Panther Creek field activities will be conducted on foot, snowmobile, and by vehicle from Salmon, Idaho.

PROGRESS TO DATE

Field work on the project began in November 1998. After 5 1/2 months of work, project personnel had successfully captured and collared five cougars. These cougars were monitored weekly from both the ground and aircraft, and information was collected on their movements, activity patterns, and interactions with wolves.

Additionally, 33 known cougar or wolf kills were found and investigated. The species of the animal killed, and other information such as age, sex and general condition of the killed prey, were taken. Also, visits to the carcass by other predators were monitored through both radio telemetry, and through snow tracking. We are pleased to report that the first field season of this project was successful, and collection of scientific information is on track, as originally proposed.

ADMINISTRATION AND PERSONNEL

This project is a collaboration between the Hornocker Wildlife Institute, the University of Idaho, and the Nez Perce Tribe. Principal Investigator Howard Quigley will supervise the project. All research activities and findings will be provided to the Nez Perce Tribe and other management agencies. The Nez Perce Tribe has the responsibility for the management and monitoring of Idaho wolves. The Hornocker Wildlife Institute will employ wildlife biologists Jim and Holly Akenson to conduct field research on Big Creek, and Gary Power for Panther Creek. Jim has recently completed seven years of cougar and black bear research with the Oregon Department of Fish and Wildlife and Holly has worked as a wildlife biologist for 18 years. During the 1980s, the Akensons conducted wildlife studies in the rugged and remote Big Creek area. They are highly experienced at conducting field research under difficult wilderness conditions. Gary Power has many years of experience as a biologist with the Idaho Department of Fish and Game. In addition, Mr. Power has extensive experience with cougars in Idaho and his experience and contacts in the Panther Creek area make him ideally suited for the project. Two technicians will assist on each study area.

BUDGET 1999 - 2000, Big Creek Study Area

PERSONNEL	
Field Coordinators (2, 5 months @ $1500/mo)	$15,000
Technicians (2, 5 months @ $1000/mo)	10,000
Benefits @ 33%	8,250
TOTAL PERSONNEL	$33,250
EQUIPMENT	
Radio collars (5 BC, 2 PC @ $350)*	$2,450
Miscellaneous telemetry equipment	800
Capture/immobilization supplies	1,200
TOTAL EQUIPMENT	$4,450
TRAVEL	
Airfare (4 trips @ $190/hour)	1,600
Vehicle transport (1,200 miles @ .35/mile)	420
Lodging (6 nights @ $50/night)	300
Meals (6 days @ $30/day)	180
TOTAL TRAVEL	$2,500
OPERATING EXPENSES	
Aircraft rental for aerial telemetry (50 hours @ $150/hr)*	$7,500
Livestock and dog food	250
Field camp supplies	1,500
Office supplies	250
Telephone	500
Direct/Indirect/Management costs	5,836
TOTAL OPERATING EXPENSES	$15,836
TOTAL BUDGET 1999-2000	**$56,036**

*Expenses covered by the Nez Perce Tribe = $9,950
Funds committed from other sources = $15,000

Current Funding Needs = $31,086

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Big Creek Wolf-Cougar Predation Study

Progress Report 1. February 8, 1999.

Cooperators: Hornocker Wildlife Institute, Nez Perce Tribe, and University of Idaho.
Progress report for the period January 6 - February 4, 1999; by Jim and Holly Akenson.
Objectives: Radio collar up to 5 cougars. Document predation. Monitor wolf locations.
Crew: Jim Akenson, Holly Akenson, Wes Craddock and 4 hounds, Dan Adams.
Visitors: Kathy Quigley, DVM Hornocker Wildlife Institute, Greg Bjornstrom, Taylor Ranch temp. caretaker.

OVERVIEW

Capture efforts began on Jan. 7 to collar 5 cougars within the Big Creek big game winter range and the winter territory of the Chamberlain Basin Wolf Pack. Twenty days were spent afield. We operated from Taylor Ranch cabins (UI), Cabin Creek cabin camp (USFS), and Coxey Creek wall tent camp. We searched for cougar and wolf activity along a 22-mile segment of Big Creek between Acorn Creek and Goat Creek. We avoided hound and wolf conflicts by frequently checking for wolf radio telemetry signals when using hounds. We investigated all dead ungulates and other carcasses encountered to determine if death was caused from predation. We identified the predator that made the kill. At each kill site we completed a predation form describing the site, prey species, method of kill evidence, tracks observed, and other details.

CAPTURE

When we encountered cougar tracks that were fresh we pursued them with hounds until the cat treed. Once treed, the cougar was immobilized using the palmer dart system and the drug ketamine (3.5 mg per lb body weight). The immobilized cougar was then secured to a line by a climber and lowered from the tree to the ground. The cougar was fitted with a radio collar, measured, blood samples taken, and then monitored until recovered from anesthesia. Six cougars were immobilized; 5 of theses were instrumented with radio collars with the same frequency band as the wolves. Three additional male cougars were treed, but not radio collared since we wanted to target female cougars for monitoring.

Table 1. Cougar capture locations, sex, estimated age (years) and weight (lbs), and collar color-coding (on black collars).

Cougar ID	Location	Sex	Age	Weight	Collar Color
#1	Cabin Creek	Male	5	150	yellow/brown.
#2	Cliff Creek	Female	3	85	green.
#3	Cave Creek	Male	4	140	yellow/green.
#4	Coxey Creek	Male	3	125	Not Collared.
#5	Rush Creek	Female	2	70	blue.
#6	Cabin Creek	Female	2	70	purple/brown/silver

PREDATION

We examined 14 animal carcasses. Twelve were confirmed as predator kills by either observation of the predator, marks on the carcass, or track evidence in the snow. On 5 occasions cougars were observed on carcasses. When possible, femurs were collected to assess the prey species condition, and jaws were collected for aging.

Table 2. Predation documentation for carcasses found on Big Creek during January, 1999.

Prey	Cougar	Wolf	Coyote	NonPredation	Unknown
Elk	4	0	0	1	0
Mule deer	1	1	1	0	1
Bighorn	2	0	0	0	0
Coyote	1	1	0	0	0
Rabbit	0	0	1	0	0

TELEMETRY

Five telemetry flights were conducted during this period to locate wolves and cougars. General movement patterns were:

- Cougar #1: Cabin Cr. → Cabin Cr. → Goat Ridge → Goat Basin → Big Creek Gorge
- Cougar #2: Cliff Cr. → Rush Cr. → Spring Cr. → Spring Cr. → Cow Cr.
- Cougar #3: Cave Cr. → W. Fk. Rush Cr. → W.Fk. Rush → Rush Cr.
- Cougar #5: Rush Cr. → Rush Cr.
- Cougar #6: Cabin Cr.
- Chamberlain Basin Wolf Pack: Cabin Cr. → S. Fk.. Rush Cr. → Lime Cr. → Cabin Cr. → Monumental Cr.

COMPETITION

We documented 5 instances of multiple carnivores utilizing a kill. We also documented 2 coyotes being killed. One coyote was killed by a cougar near a cougar killed elk. Wolves killed the other coyote as the wolf pack traveled down Big Creek. A fresh cow elk carcass was found in Cabin Creek with no signs of predator tracks or feeding. We documented the following chronology of scavenger visits at the elk carcass over a 7 day period, using track evidence and visual observations:1) first by a bald eagle, then 2) by a wolf, then 3) by a bobcat, then 4) by a cougar, then 5) by a wolf, then 6) by a bobcat, and then 7) by a cougar which we saw, pursued, captured and radio instrumented. This cougar was the subadult female which became #6.

WOLF OBSERVATIONS

While conducting capture efforts on cougar we made these wolf observations:

- A lone wolf was observed on the Cliff Creek benches. We snow tracked this wolf over 4 miles and saw where it visited 3 cougar kills during 1 overnight period.
- On 6 occasions we observed fresh wolf tracks when we knew the Chamberlain pack was over 10 miles away. Once we observed fresh tracks of 3 wolves with no wolf signals in the area.
- During January, the Chamberlain pack, and single wolves have had a continuous presence on Big Creek. We observed recent wolf tracks on 10 of 12 field days while searching for cougars between Cabin Creek and Acorn Creek.

UPCOMING

We plan to follow radio-instrumented cougars and the Chamberlain Wolf Pack daily during the month of March to document kills. We will field test a predation sequence technique, following one cougar or the wolf pack every day to identify what and how often they kill. We plan to operate 2 crews of 2 people each. One crew will try to stay with the Chamberlain wolves, while the other crew monitors individual cougars. We would like to get radio collars on one or more of the lone wolves living in lower Big Creek, since compared to the Chamberlain Pack their movements appear to be more localized and their potential for interaction (scavenging) with other predators may be greater.

COUGAR AND WOLF PREDATION AND INTERACTIONS IN CENTRAL IDAHO

A Project Proposal from the Hornocker Wildlife Institute
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Project Cooperators: Hornocker Wildlife Institute, University of Idaho
University of Idaho, Moscow, Idaho
Nez Perce Tribe

PROJECT SUMMARY

Bringing the wolf back to the lower forty-eight states has been a goal of federal land management agencies for more than two decades. As government biologists planned for the process, they made a variety of predictions, numerical models, and volumes of paper about how the re-introduction would take place and what the world would be like with wolves back in place. Unfortunately, all of the predictions and models were based on information garnered from wolves in other places, such as Alaska, or the predictions and implications were simply "best guesses".

With the re-introduction of wolves into central Idaho in 1995 and 1996, an opportunity presented itself: an opportunity to follow the "sorting out" process as wolves re-establish. Real data—real information, can then be used to make solid predictions about new wolf populations in Idaho and throughout the West.

However, the agencies most likely to set about obtaining the information have been unable or unwilling to pursue the appropriate field work to answer the necessary questions. So, three of the main questions still remain:

- What will the impact be on prey populations (deer and elk),
- What will the impact be on other predators, and
- What will the impact be on domestic stock?

The central Idaho cougar/wolf project is designed to answer some of these questions with real information, from real situations, and provide insights to landowners, agencies, and the general public about what to expect in the future. For instance, what will elk herds do (go up or down or remain the same) with two top predators after them? The only way to truly find out is to look at the situation where it currently exists.

The central Idaho cougar/wolf project is established with two study areas: Panther Creek, in the southeastern part of the Idaho wilderness, and Big Creek, in the south-central part of the wilderness. Selection of these two study areas allows us to compare and contrast the cougar and wolf populations living in each area:

Panther Creek Study Area	**Big Creek Study Area**
Outside of wilderness	Within designated wilderness
Has domestic livestock allotments	No livestock allotments
Has greater access for recreation	Much more isolated from human access and use
Will allow study of predation on deer and elk, with a healthy, increasing elk herd	Will allow study of predation on deer and elk, with a decreasing, less-than-vital elk herd
	Site of extensive research on cougars in the early 1970s and the mid-1980s

With these differences between study areas, the project results will allow for much more broad-based conclusions. For instance, will prey selection within healthy elk herds by wolves be the same as in a declining elk herd? Will these predators turn to hunting domestic livestock when it's available? And what characteristics of livestock might make them more vulnerable to predation by wolves or cougars? The findings from this project will be useful in managing Idaho ecosystems, and will also be important to natural resource managers across the West, as wolves are re-introduced in more places.

The project began in January, 1999, and the first field season was successful with five cougars captured for radio-collaring in the Big Creek drainage. These cougars were monitored throughout the winter and spring, yielding important information about movements, activity, habitat use, and predation. Several wolves in the Chamberlain wolf pack were radio collared, allowing the activities of the pack to be monitored. This wolf pack used Big Creek drainage. Over 30 carcasses of deer and elk were investigated, as known cougar or wolf kills. Other predators were documented when they visited some of these kill sites. The age, sex, and condition of prey at the kill sites was recorded.

Field research is planned for the next two winters, with analysis of data and writing of reports and publications completed in 2002.

EFFECTS OF WOLF REINTRODUCTION ON A COUGAR POPULATION IN THE CENTRAL IDAHO WILDERNESS

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Abstract: Wolves (*Canis lupus*) were reintroduced in the central Idaho wilderness in 1995 and 1996 and rapidly established packs in areas previously occupied by cougars (*Puma concolor*). We spent four winters studying the relationship between sympatric wolves and cougars in the Idaho wilderness, beginning work the first year the two carnivores coexisted. We examined the potential for competition during winter between resident cougars and a newly established wolf pack for food, space, and habitats through radio telemetry tracking and examination of 192 carcasses. We found that wolf and cougar diets were almost identical. Winter home ranges of wolves and cougars overlapped, although the wolf pack home range size was 2-20 times the size of individual cougar home ranges. We observed wolf utilization of cougar-killed prey and evidence of wolf avoidance by cougars. Although no interspecific killing was documented between wolves and cougars, the effects of competition, a declining prey population, and heavy hunter harvest of cougars were expressed by low recruitment, decreased adults, and disrupted social structure in the cougar population. A large-scale wildfire provided a unique opportunity to compare wolf and cougar responses to catastrophic environmental change. Wolves, with large home ranges, were more adaptable to change than were cougars. For cougars, the combination of decreased prey numbers, low reproductive rate, high hunter harvest, and large-scale habitat alteration from fire appeared to amplify the effects of competition from the recently established wolf pack and increased intraspecific strife. The cougar population experienced a period of instability during this study, as cougars adapted to coexistence with another large carnivore in a dynamically changing environment.

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World Wolf Congress 2003

Bridging Science and Community

September 25 - 28, 2003
The Banff Centre
Banff, Alberta, Canada

hosted by

The Central Rockies Wolf Project

Sunday, September 28, 08:30, Max Bell Auditorium

Wolves & Cougars: Large carnivore competition in Idaho following wolf reintroduction

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In 1999 we initiated a 4-winter research project to evaluate the nature of the relationship between sympatric wolves and cougars in central Idaho. We examined the potential for competition between cougars and recently reintroduced wolves for food, space, and habitats through radio telemetry tracking and examination of 192 carcasses. We found that wolf and cougar diets were almost identical. Winter home ranges of wolves and cougars significantly overlapped, although the wolf pack home range size was more than 10 times the size of individual cougar home ranges. We observed interference competition at carcasses and evidence of wolf avoidance by cougars. Although no interspecific killing was documented between wolves and cougars, the effects of competition and a declining prey population were expressed in the cougar population dynamics: low recruitment and dispersal. A large-scale wildfire provided a unique opportunity to compare wolf and cougar responses to catastrophic environmental change. Wolves, with a large home range, were more adaptable than cougars. The combination of declining prey numbers, addition of wolf competitors, and large-scale habitat alteration amplified the competition between wolves and cougars. This high level of interspecific competition made it easier to recognize the initial mechanisms used by cougars to adjust to wolves joining the large mammal community. In future years predator:prey ratios will shift from the higher predator levels that occurred during this period of wolf establishment, toward a more "balanced" ratio of predators and prey. Cougar numbers and reproductive success will likely decline as a result of competition with wolves.

Wolf recolonization triggers trophic cascade in Banff National Park

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Wolves recolonized Banff National Park in 1986, and human activities lead to differential wolf densities across the Bow Valley. We used this serendipitous experiment to test the hypothesis that wolf recolonization initiated a trophic cascade in this Montane ecosystem. We investigated the effects of differential predation by wolves on 1) elk sub-population population growth rate, density, and survival; 2) willow regeneration, stem density, and height; 3) aspen regeneration, density and stand dynamics; 4) beaver density; and 5) songbird diversity and abundance during 1986 to 2000. We compared effects of recolonizing wolves across three spatial zones that differed in wolf use from low to high. Elk population growth rate was limited by predation by wolves and snow depth in areas with wolves, and was regulated by elk density in areas without wolves. In zones with and without wolf predation, annual survival was 0.68 and 0.86, respectively. Elk pellet group density was strongly negatively related to aspen regeneration, willow regeneration, willow stem density, and willow biomass. Threshold values for elk densities necessary to successfully regenerate aspen and willow were ~1 elk/km2 and ~5 elk/km2. Further, elk and active beaver lodge density were strongly negatively correlated. Finally, elk herbivory had a cascading negative effect on songbird diversity and abundance in areas without wolf predation. These alternating correlations between trophic levels support the trophic cascade hypothesis. Despite compelling evidence for a trophic cascade, management interpretation will differ across jurisdictions at the wolf population scale, and will require regional approaches to ecosystem management.

The Wildlife Society Northwest Section, February 12, 2003, Eugene, OR
Oral presentation

Interagency Wolf Conference, April 8-10, 2003, Pray, MT Oral presentation

CARNIVORES, UNGULATES, AND WILDFIRE

Holly A. Akenson*[1], James J. Akenson[2] and Howard B. Qiugley[3]. [1,2]Taylor Ranch Field Station, University of Idaho, Moscow, Idaho 83844; [3]Hornocker Wildlife Institute-Wildlife Conservation Society, Bozeman, Montana 59715

A massive forest fire swept across the Big Creek winter range in August of 2000, where we have been researching winter cougar and wolf predation behavior for 4 years, 1998-2002. The purpose of our work was to look at the relationships between the large carnivores and their prey and the interactions between carnivores. Following the fire that burned the majority of the ungulate winter range, we compared our data pre and post fire to evaluate changes in predator – prey and predator – predator relationships. We assessed ungulate displacement and nutritional condition of ungulate carcasses. We compared pre and post fire cougar and wolf winter home ranges and diets. We evaluated carnivore strife and mortality causes. We will discuss the different adaptive strategies used by carnivores and ungulates in response to fire.

Presentation at Seventh Mountain Lion Workshop. 2003. Jackson Wyoming

Four decades of cougar–ungulate relationships in the central Idaho wilderness.

Holly A. Akenson, James J. Akenson, Howard B. Quigley, and Maurice G. Hornocker

Abstract Research conducted on cougars (*Puma concolor*) in the Big Creek drainage in each of the last four decades has enhanced the understanding of the dynamic nature of cougar – ungulate relationships. In 1964, Maurice Hornocker initiated his benchmark research on this cougar population and assessed the role of cougar predation in regulating ungulate populations. Each study that followed has had different objectives, yet, combined these projects provide a rare continuum of ecological information on the dynamics of cougar – prey relationships. This cougar population has been influenced by significant environmental changes over the last 40 years. The ungulate prey base has fluctuated, but generally elk numbers have increased and deer have decreased. Total ungulate biomass was similar in the 1960's and 1980's, but was 12% lower in the study just completed. The dynamics of carnivore competition, both inter-specific and intra-specific, has changed since introduced wolves recolonized the drainage in the 1990s. A large-scale forest fire 2 years ago drastically altered winter and summer ranges and affected predator – prey relationships. We compared cougar population size, structure, reproduction, and mortality factors; prey selection during 3 time periods; and evaluated pre and post-fire data in the recent study. The estimated resident cougar population was 9 adults during the first 2 studies in the 1960's and early 1970's. The resident population grew to an estimated 13 adults in the mid-1980's, but dropped to 10 individuals by 2000, and down to 6 resident cougars by 2002. The population increase during the 1980's was in the adult female segment and it corresponded with an increasing elk population. The current low population is a result of a decreasing elk population, ungulate displacement from fire, increased hunter harvest of cougars, increased intraspecific strife, and competition with wolves for the same prey base. Cougars selected for elk rather than mule deer during the first study, but killed elk in proportion to their relative abundance during the study in the 1980's and recent study (2000). Historical perspectives from pioneer diaries indicate similar cougar population numbers. In 1888 a bounty hunter removed 12 cougars from the drainage, then ten years later a different cougar hunter noted trapping and poisoning 12 individuals on Big Creek. Archeological evidence, old newspaper articles and diaries, and early agency field notes are all integrated into this discussion of long-term predator - prey relationships. The lengthy record of information on predator and prey populations in the Big Creek drainage arguably makes this cougar population the best understood in North America.

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Presentation to Oregon Chapter of The Wildlife Society, February 2002

WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

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During the winters of 1999, 2000, and 2001 we investigated 137 large mammal carcasses on the Big Creek winter range. Deer and elk were killed in similar proportion to their abundance by wolves in 2 of 2 winters and by cougars in 2 of 3 winters. Elk calves were more vulnerable to predation than elk cows, although deer fawns were not selected for over adult deer. Incisor tooth aging of elk carcasses revealed that most elk that died during winter were very old-aged cows (up to19 years old); median age of cow elk carcasses was 13.5 years old. Despite the old age of cow elk, fecal progesterone levels indicated that over 95% of live cow elk sampled on the Big Creek winter range in the springs of 2000 and 2001 were pregnant. During August 2000 a large-scale forest fire burned more than half of the study area. Fire and winter severity have been identifiable factors influencing the effects of wolves and cougars on each other and their prey.

Presentation to 13th North American Interagency Wolf Conference.
April 2001, Chico, MT.

Presentation to The Wildlife Society Idaho Chapter.
February 2001, Boise, ID.

Jim Akenson and Holly Akenson, University of Idaho

WINTER PREDATION AND INTERACTIONS OF COUGARS AND WOLVES IN THE CENTRAL IDAHO WILDERNESS

The Hornocker Wildlife Institute, in cooperation with the University of Idaho, Nez Perce Tribe and Idaho Department of Fish and Game, is in the third winter of a 4-year predation study. The objectives are to determine the predation behavior of cougars and wolves, to document interactions between these two predators, and to evaluate the influence of these species on ungulates. The study area is the Big Creek drainage in the heart of the Frank Church River of No Return Wilderness. Access in this rugged and remote country is by hiking, snowshoeing, or on muleback. The effects of cougar and wolf predation on elk and deer populations and the effects of wolves and cougars on each other will be fully evaluated following completion of all field research.

During winters of 1999 and 2000 we have evaluated 86 carcasses on the Big Creek winter range. So far, deer were favored as prey by cougars, but deer and elk were killed in proportion to their abundance by wolves. Elk calves were more vulnerable to predation than elk cows, although deer fawns were not selected for over adult deer. Incisor tooth aging of 1999 elk carcasses revealed that most elk that died during winter were very old-aged cow elk (12-19 years old), although we found that over 95% of live cow elk sampled on the Big Creek winter range in spring 2000 were pregnant. A majority of the deer carcasses were located in lower Big Creek while most of the elk carcasses were found in upper Big Creek. We documented variation in individual cougar and wolf food habits. During winter 2000 we completed 3 predation sequences on cougars. We have not determined a predation rate for the wolf pack, since we were unable to obtain sequential wolf locations every day due to the short time the pack spent on kills and its wide ranging movements.

Several natural factors have influenced this research including winter weather severity, and large-scale fire. Winter 2000 was less severe than winter 1999, which allowed ungulates to utilize a larger winter range. In winter 2000, the Chamberlain wolf pack spent a significant amount of time on the upper elevation periphery of the Big Creek winter range, and only occasionally hunted the core winter range area that they used in winter 1999. Less overlap occurred between radio-collared wolves and cougars in winter 2000 than 1999. Preliminary observations indicate that the presence of wolves in a cougar's home range affects the movements of that cougar. During August 2000 a large-scale forest fire burned more than half of the study area. We are observing major changes in ungulate utilization of the winter range so far in 2001 as a result of the fires. The ecological effects of fire on cougar and wolf predation, and ungulate movements and population dynamics will be explored during the remainder of this study.

Presentation to 11th North American Interagency Wolf Recovery Conference. April 1999. Chico, MT

PREDATION AND INTERACTIONS OF WOLVES AND COUGARS ON BIG CREEK IN THE FRANK CHURCH RIVER OF NO RETURN WILDERNESS, CENTRAL IDAHO.

Jim Akenson and Holly Akenson
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Hornocker Wildlife Institute in cooperation with Nez Perce Tribe and University of Idaho

In January 1999 we began field research on a 4-year study of predation and interactions between wolves and cougars on the Big Creek winter range. Our objectives were: 1) to assess the cumulative effect of wolves and cougars on wintering populations of deer, elk, and bighorn sheep, and 2) to determine the relationship between wolves and cougars competing for winter food and space. During January and March we monitored 5 cougars that we radio instrumented in January and 3 wolves from the Chamberlain Pack that had been radio instrumented previously. We investigated 33 carcasses; 13 were known cougar kills and 12 were known wolf kills. We documented scavenger visits to carcasses by wolves (6 times), bobcats (4 times), coyotes (4 times), and cougars (2 times). We found 2 coyotes and a bobcat killed by cougars and wolves. The proportion of elk and mule deer carcasses found killed by wolves was similar to that of cougars. Both predators primarily killed older aged cow elk. We suspect the age structure of kills may reflect the elk population age structure. Arthritis, hoof and leg injuries, an abdominal hernia, and jaw necrosis were found in elk carcasses killed by wolves and cougars. Two wolf-killed elk were in poor condition and were not significantly consumed by wolves. We did not document direct interactions between wolves and cougars, but the radio-instrumented predators were often segregated on the winter range.