

May 1999

ENDANGERED SPECIES

Caribou Recovery Program Has Achieved Modest Gains



**Resources, Community, and
Economic Development Division**

B-282101

May 13, 1999

The Honorable Larry E. Craig
United State Senate

Dear Senator Craig:

Since the 1960s, the last remaining woodland caribou population in the contiguous United States has inhabited the southern Selkirk Mountains. The southern Selkirk Mountains are located in northeastern Washington, northern Idaho, and southeastern British Columbia. As recently as the 1950s, this population consisted of approximately 100 animals. However, by the early 1980s, it had dwindled to about 30. In 1983, the southern Selkirk Mountains population of woodland caribou was granted emergency protection under the Endangered Species Act. A final ruling of endangered status was published in February 1984. In 1985, the Department of the Interior's Fish and Wildlife Service, the agency primarily responsible for carrying out the act for land species, approved the first recovery plan for the southern Selkirk Mountains woodland caribou. Since then, federal and state agencies in the United States and ministries in British Columbia have participated in a cooperative program to recover the caribou. Figure 1 depicts a woodland caribou.

Figure 1: The Woodland Caribou



Source: U.S. Fish and Wildlife Service.

Concerned about the adequacy of the recovery program's funding and accomplishments, you asked us to provide you with information on (1) the amount and source of funds expended on the woodland caribou recovery program; (2) the results of the program, including the outcome of efforts to augment the population and the impact of the recovery efforts on land use; and (3) the future direction of the recovery program. In addition, you asked us for information on the number and type of research reports that

have been prepared on woodland caribou with Fish and Wildlife Service funding. Details on these reports are provided in appendix I of this report.

Results in Brief

The United States and British Columbia spent an estimated \$4.7 million on efforts to restore the woodland caribou population from 1984 through 1998. In the United States, the Fish and Wildlife Service provided the majority of these funds, spending about \$3.2 million. The largest portion of the Service's expenditures, about \$1.6 million, was in the form of grants to Idaho and Washington. These funds were used primarily for increasing the existing caribou population by transplanting other caribou (augmentation) to the southern Selkirk Mountains and conducting follow-up monitoring on the results of the augmentation effort. The Forest Service reported expenditures of about \$781,000 during this period for activities such as habitat surveys, augmentation efforts, and monitoring. In addition, Idaho and Washington reported spending about \$240,000 and \$419,000 respectively, for such activities as transplanting and monitoring caribou, providing law enforcement, and developing public information and education programs. British Columbia estimated that it spent about \$31,000 on caribou recovery efforts.

To date, the caribou recovery program has achieved modest gains. One of its most significant achievements has been the maintenance of a core population of woodland caribou centered in the southern Selkirk Mountains near British Columbia's Stagleap Provincial Park. In total, 103 caribou have been transplanted from separate populations in British Columbia to augment the southern Selkirk population. Most recovery program officials we contacted believe that without this augmentation, the southern Selkirk population would probably no longer exist. However, despite these efforts, the overall size of the southern Selkirk population has increased by only about 18 animals, to a total of about 48. The recovery program also has not achieved its goal of establishing two new self-sustaining herds, one in Idaho and another in Washington. This limited population increase is due to the high mortality among transplanted caribou and the deaths of some resident (nontransplanted) caribou. Although the cause of death is unknown for many caribou, researchers currently believe that predation (killing), mainly by cougars, is the most common cause. The recovery program has succeeded in mapping caribou habitat, developing caribou habitat management guidelines, completing research on various aspects of caribou ecology, developing information and education programs, providing law enforcement, and monitoring the caribou population. The impact on land use due specifically to caribou

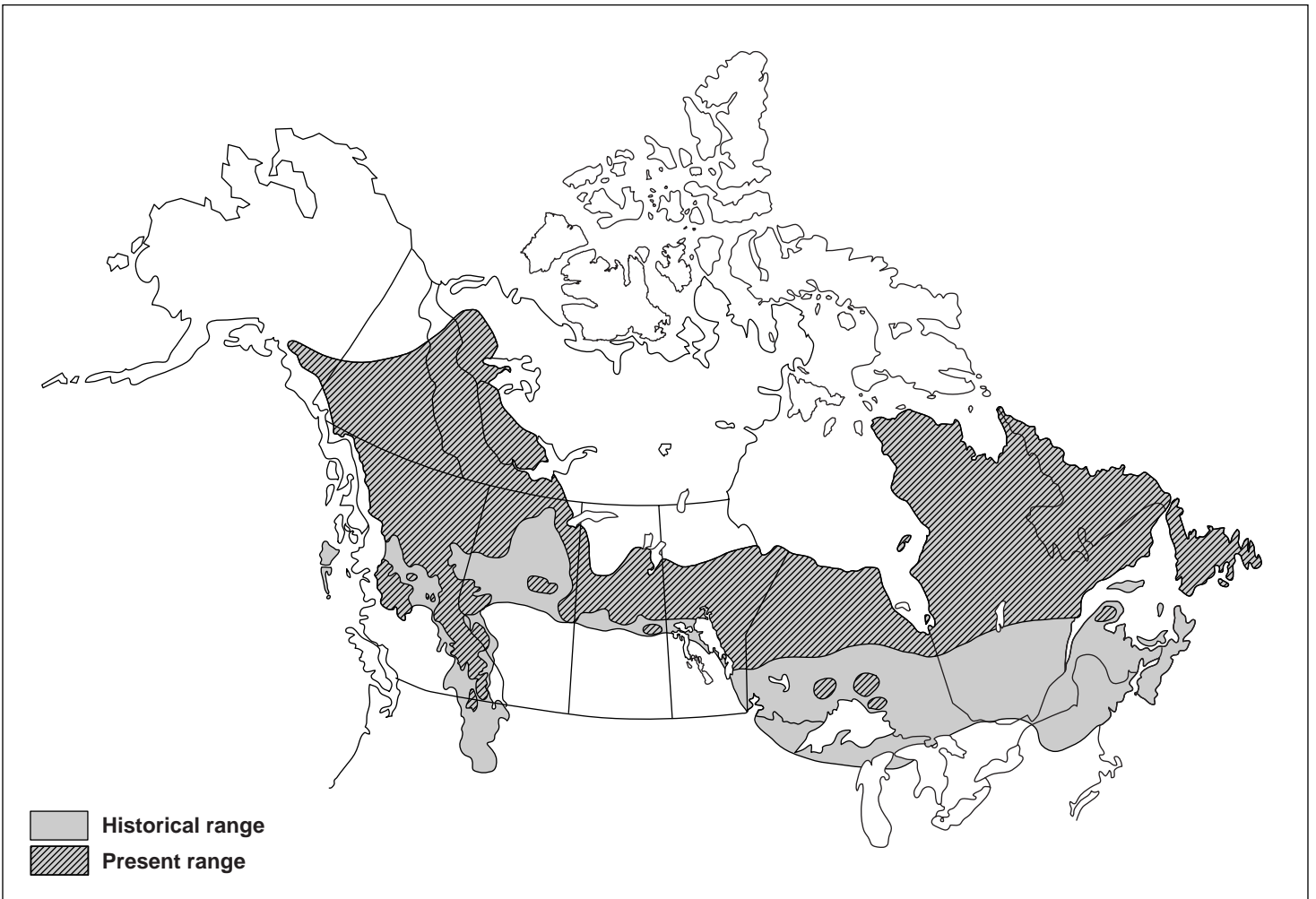
recovery efforts has been relatively minor. Specifically, according to the Forest Service, which manages most of the land within the U.S. portion of the caribou recovery zone, some restrictions have been placed on timber harvesting and a small portion of the caribou habitat has been closed to snowmobiling. Forest Service officials noted that even if the caribou recovery efforts were terminated, many land-use restrictions, such as road closures, would remain in effect to protect, among other things, old-growth forests; watersheds; and other species, such as grizzly bears.

Officials involved in planning future caribou recovery efforts agreed that, for the immediate future, the program's highest priority is to maintain the core population of caribou centered around Stagleap Provincial Park. The range of this population includes northeastern Washington and northern Idaho, as well as southeastern British Columbia. However, the availability of caribou for further augmenting the population is uncertain. For example, no woodland caribou are available from British Columbia in 1999. Another high-priority task will be to investigate the causes of and manage caribou mortality. Toward this end, the cooperating agencies recently initiated a study of cougar populations and their predation on caribou in the southern Selkirks. Other high-priority tasks include producing a consolidated map of caribou habitat, minimizing the impact of recreation on caribou in the recovery zone, and expanding information and education programs to obtain additional public support for caribou recovery. However, an overriding concern of officials involved in planning future recovery efforts is whether there will be adequate funding for the program. For example, in fiscal years 1997 and 1998, Washington and Idaho received only about 65 and 57 percent, respectively, of the grant funds they requested from the Fish and Wildlife Service.

Background

Historically, as figure 2 shows, woodland caribou were distributed throughout much of Canada and portions of the northern tier of the United States. There are two varieties, or ecotypes, of woodland caribou—mountain and northern. The two ecotypes are not genetically distinct and differ only in the use they make of their habitat and in their behavior. Currently, the only mountain caribou that regularly inhabit the contiguous United States is the population of the southern Selkirk Mountains. The range of these caribou is restricted to a relatively small area in southeastern British Columbia and extreme northeastern Washington and northern Idaho.

Figure 2: Present and Historical Range of Woodland Caribou in North America



Source: British Columbia Ministry of Environment, Lands and Parks.

While records suggest that caribou in this area were plentiful in the 19th century, the population had declined to about 100 animals by the 1950s. By the early 1980s, the population had further declined to about 30, and the woodland caribou had become one of the most critically endangered mammals in the United States.

In 1971, U.S. and Canadian resource management agencies signed a cooperative agreement to investigate and monitor the caribou. The agencies included the Forest Service, the Washington Department of Game, the Idaho Fish and Game Commission, the British Columbia Fish and Wildlife Branch, the British Columbia Forest Service, and the University of Idaho. The agreement resulted in the formation of the International Mountain Caribou Steering Committee and the International Mountain Caribou Technical Committee. The steering committee was established to approve study plans and funding and to help set direction for caribou recovery efforts and for the technical committee. The technical committee was tasked with coordinating caribou management and research studies and serving as a clearinghouse for information that promotes management activities designed to reverse the decline of the caribou population. The cooperative agreement produced a series of population and habitat studies in the 1970s and 1980s. Both committees are still active and are key participants in current caribou recovery efforts.

In 1977, the Idaho Fish and Game Commission designated the caribou as an endangered species in the state. The Washington Game Commission designated the caribou as endangered in 1982. In February 1984, the U.S. Fish and Wildlife Service (FWS) listed the southern Selkirk population of woodland caribou as endangered under the Endangered Species Act (ESA).

Under ESA, once a species is identified as threatened or endangered the responsible agency (in the case of the caribou, FWS) must generally develop and implement a recovery plan.¹ A recovery plan details the specific tasks that are considered necessary to recover a species. The plan can identify (but not obligate) other parties, such as federal, state and private entities, as cooperating agencies. Implementing a recovery plan is contingent upon appropriations, priorities, and other budgetary constraints affecting the participants. A recovery plan may also be modified to reflect changes in the status of a species, the completion of recovery tasks, and new findings that reflect the latest available scientific information.

In 1982, the International Mountain Caribou Technical Committee began preparing a management plan for the woodland caribou. FWS adopted a revised version of this document as the official recovery plan for the caribou in 1985. The recovery plan identified the following as cooperating agencies in the caribou recovery effort: FWS; the Fish and Wildlife Branch of the British Columbia Ministry of Environment (currently, the Wildlife

¹More information on the development of recovery plans is provided in app. II.

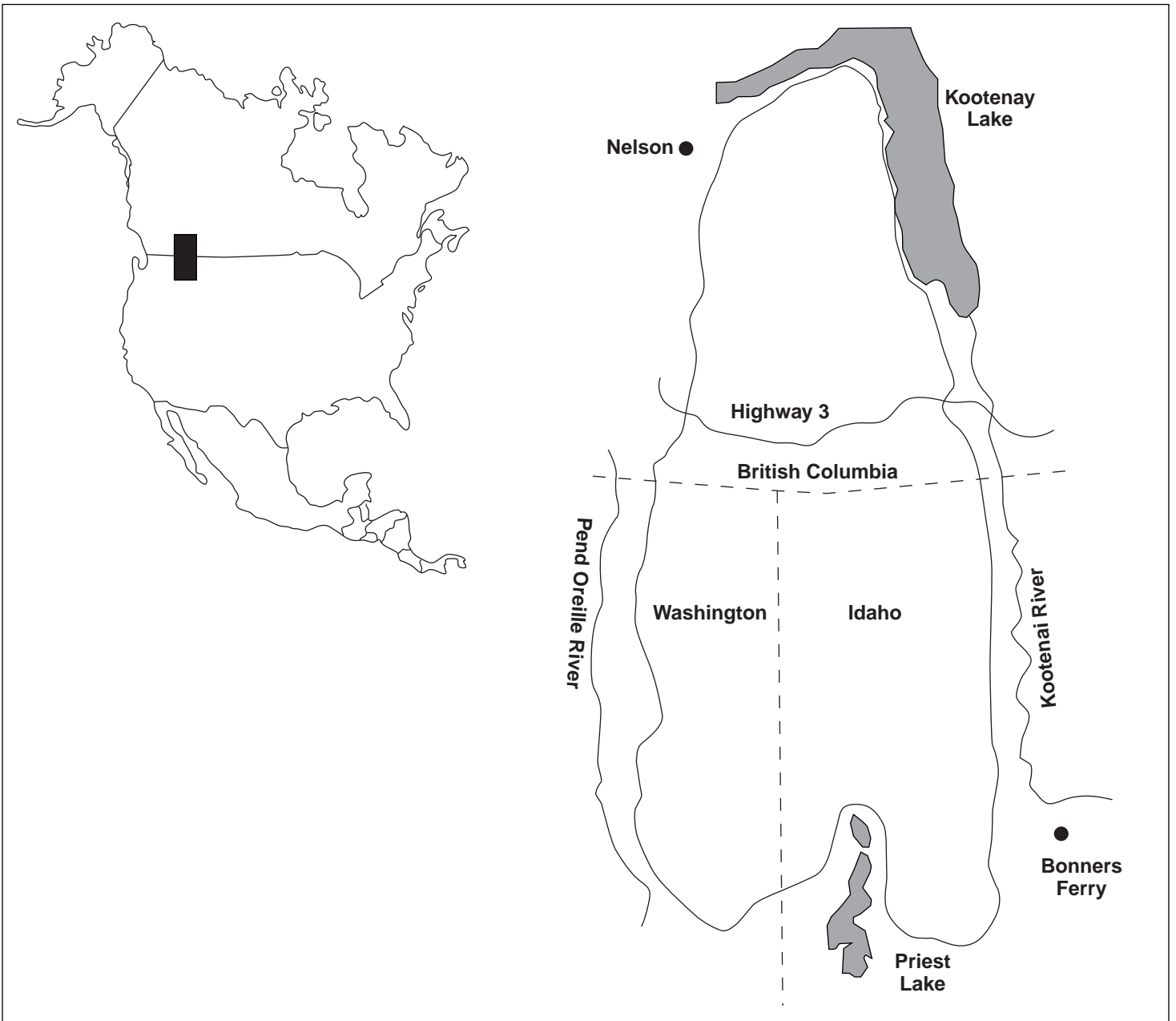
Branch of the Ministry of Environment, Lands and Parks); the British Columbia Forest Service (part of the Ministry of Forests); the Forest Service (Colville and Idaho Panhandle National Forests); the Idaho Department of Fish and Game; the Washington Department of Game (currently the Washington Department of Fish and Wildlife); and the University of Idaho.

In 1991, FWS appointed its own caribou recovery team to advise the agency on caribou recovery efforts. The recovery team completed a revised recovery plan in 1994. The revised plan identified all of the previously identified entities as cooperators in the new plan, as well as Washington State University and the Idaho Department of Lands. While these agencies agreed to cooperate in carrying out the recovery plans, the resources to implement the plans are controlled by congressional appropriations and the agencies' budgets and priorities.

FWS' recovery plans for the southern Selkirk woodland caribou identified a variety of management and research actions necessary for the species' recovery. These included collecting information on and managing caribou habitat, determining caribou population characteristics, maintaining the population through various efforts to reduce caribou mortality, and informing and involving the public and agency personnel about caribou and caribou management. The 1985 recovery plan also called for assessing the feasibility of augmenting the existing population by introducing caribou transplanted from other herds. The consensus of the biological community at the time was that augmentation was the only available method that could reasonably be expected to achieve the population's recovery.

As figure 3 shows, a recovery zone that includes the general area used by the caribou has been delineated. It covers about 2,200 square miles and includes national forest, state, private, and Canadian lands. The recovery zone encompasses the geographic area in the southern Selkirk Mountains where caribou management efforts are now focused.

Figure 3: The Southern Selkirk Woodland Caribou Recovery Zone



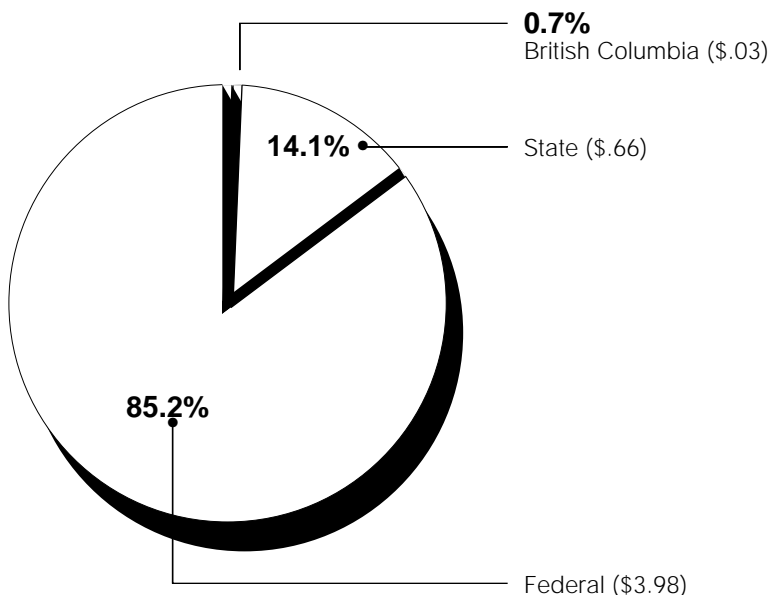
Source: Idaho Department of Fish and Game.

For more background on the history of woodland caribou in the southern Selkirk Mountains and the history of recovery efforts, see appendix II.

An Estimated \$4.7 Million Has Been Spent for Caribou Recovery

From 1984, when woodland caribou were listed as endangered under ESA, through 1998, federal and state agencies in the United States and British Columbia's Ministry of Environment, Lands and Parks spent an estimated \$4.7 million on efforts to recover the southern Selkirk population. Federal expenditures are estimated at about \$4 million and include primarily those of FWS and the Forest Service and, to a much lesser extent, those of the Department of the Interior's Bureau of Land Management and the Department of Agriculture's Animal and Plant Health Inspection Service. Idaho and Washington reported expenditures of about \$240,000 and \$419,000, respectively. Finally, British Columbia's Ministry of Environment, Lands and Parks reported estimated expenditures of about \$31,000. As figure 4 shows, most of the caribou recovery expenditures came from the U.S. government. However, it should be noted that the estimated expenditures for British Columbia include only the salary expenses of staff who participated in augmentation activities and costs related to a study of cougar predation on caribou. The British Columbia estimates do not include the direct and indirect value (expressed in monetary terms) of caribou that the province donated to the recovery effort and other recovery-related activities for which no expenditure records were available.

Figure 4: Sources of Funding for Caribou Recovery Efforts, 1984-98



Note: Percentages are rounded to the nearest tenth of a percent. Dollars are in millions rounded to two decimal places.

Source: GAO's analysis of reported data.

FWS' Expenditures

FWS estimated that its expenditures on the woodland caribou recovery program totaled about \$3.2 million. The largest category of FWS' expenditures, about \$1.6 million,² was the federal share of the ESA Section 6 grants provided to Idaho and Washington for recovery activities. States that have active programs for the conservation of species protected under ESA and cooperative agreements with FWS may receive Section 6 grants to fund their recovery efforts. The grants provided to Idaho and Washington specify a federal cost share of 90 percent and a state share of 10 percent. The Idaho Department of Fish and Game and the Washington Department of Fish and Wildlife performed the recovery work using the grants primarily to fund activities related to augmenting the existing southern Selkirk population, including monitoring the distribution, movement, and survival of the transplanted caribou. Other recovery activities funded by

²This figure represents the total federal share of Section 6 grant obligations from 1984 through the end of fiscal year 1998. The actual expenditures as of that date were about \$1.5 million. In addition, the amounts for five grants provided to Idaho were adjusted because they are multispecies ecosystem grants and only about 35 percent of the grant funds related to caribou recovery.

these grants include developing a census technique for counting the caribou and performing the census, conducted annually since 1991.

In addition to Section 6 grants, Idaho received grants administered by FWS under the Federal Aid in Wildlife Restoration Act, commonly referred to as the Pittman-Robertson Act. This act provides federal aid to states for the management and restoration of wildlife. The estimated federal funding for caribou under these grants, which specify a federal cost share of 75 percent and a state share of 25 percent, totaled about \$47,000.³ The work performed under these grants included research on caribou ecology and assistance in developing caribou management plans.

FWS also spent about \$924,000 for research on woodland caribou. Specifically, the National Ecology Research Center conducted a series of research projects over a 9-year period that focused primarily on the caribou's early winter habitat and diet but also included research on such topics as caribou genetics and late winter caribou foraging ecology.⁴ Additional information on this research is provided in appendix I, which contains a summary of reports that were based, in whole or in part, on this research.

Finally, FWS' remaining expenditures, approximately \$600,000, included general recovery funding and funding for law enforcement efforts. General recovery funding covers the salary, travel, and office expenses of FWS staff working on caribou recovery. For example, under this category, FWS funded the preparation of a revised recovery plan and of an augmentation plan, staff salaries associated with participation in augmentation efforts, and the costs of organizing and participating in caribou recovery team meetings.

We used estimated expenditure information in this report for a number of reasons. Specifically, FWS does not generally maintain complete records of its ESA expenditures on a species-by-species basis. Instead, FWS maintains its expenditure records by ESA funding categories, such as listing, recovery, consultation, and law enforcement. Accordingly, FWS'

³This figure represents the estimated federal expenditures under two Pittman-Robertson grants that fell within the time frame for our review. The period covered by these grants was from July 1983 through June 1985.

⁴This research was initiated at the Ecology Branch of FWS' Denver Wildlife Research Center in 1984. The Ecology Branch then joined FWS' Western Energy and Land Use Team, which later became part of the National Ecology Research Center. In 1993, the National Ecology Research Center and other organizations (or portions of organizations) joined to form the National Biological Survey. This organization was renamed the National Biological Service in 1995 and was merged into the U.S. Geological Survey in 1996. FWS has not funded caribou research since 1992.

expenditure information is based on the best available data but includes some estimated expenditures, and some data are missing. For example, for the period from 1984 through 1988, FWS' expenditure estimate is primarily limited to research and Section 6 grants. (FWS officials noted that records on additional expenditures were not required until the passage of the 1988 amendments to ESA). Therefore, the expenditure estimate for these years is conservative. In other years, the best available information on caribou-related expenditures, according to FWS, was a combined total that included some funding categories that are not specifically related to recovery efforts. However, FWS officials believe the reported expenditure information presents a reasonably accurate estimate of its expenditures on woodland caribou recovery efforts.

Forest Service's Expenditures

The Forest Service estimated that it spent about \$781,000 on caribou recovery efforts from 1984 through 1998. The largest identifiable expenditure the Forest Service reported, totaling about \$60,000, was for surveying and analyzing caribou habitat. However, some of this habitat work also related to the grizzly bear. Other Forest Service funds were spent for augmentation activities, mapping caribou habitat, monitoring the caribou population, purchasing radio collars for an investigation of cougar predation on caribou, funding graduate student research on caribou, and costs associated with attending caribou recovery team and technical committee meetings. The Forest Service's expenditure estimate also includes the indirect costs of implementing caribou-related tasks and of implementing threatened and endangered species program activities that benefited both the caribou and other species. Indirect costs include such items as the staff time spent designing timber sales to prevent adverse effects on caribou, considering the effects of other proposed land management activities on caribou, developing land and resource management plans to conserve caribou and their habitat, and coordinating with states or other agencies on caribou habitat management.

Like FWS, the Forest Service does not generally maintain complete expenditure records on a species-by-species basis. As a result, the Forest Service's expenditure data include estimates. Also, the Forest Service did not have complete records of its expenditures on caribou recovery efforts for the entire 15-year period covered by our review. For example, for 1984 through 1988, the only available information concerned those expenditures that could be identified by the Idaho Panhandle National Forest and did not include expenditures by the Colville National Forest or Forest Service regional offices. Accordingly, the estimates for this period

are conservative. According to the Forest Service, for 1989 through 1997, its expenditure estimates are more complete and include indirect costs as detailed in the preceding paragraph. For fiscal year 1998, the estimate includes only those expenditures that could be attributed directly to caribou recovery efforts by the Idaho Panhandle and Colville National Forests. As of February 1999, the Forest Service was compiling additional 1998 cost data; however, these data were not available when we completed our review. As a result, the cost estimate for fiscal year 1998 may be also conservative.

Other Federal Agencies' Expenditures

The Bureau of Land Management and the Department of Agriculture's Animal and Plant Health Inspection Service also reported expenditures for caribou recovery efforts. The Bureau of Land Management estimated that it spent about \$10,000 for monitoring the caribou population while the Animal and Plant Health Inspection Service estimated that it spent \$720 that was related to checking quarantined caribou for disease before they were transplanted to the United States.

Idaho's and Washington's Expenditures

Idaho and Washington estimated their expenditures for caribou recovery work at about \$240,000 and \$419,000, respectively. As noted, both of these states received Section 6 grants to fund the recovery work. In addition, Idaho received Pittman-Robertson grants. Accordingly, Idaho's and Washington's expenditure estimates include their contributions of funds required by these grants. Both states noted, however, that they have spent funds in excess of their contributions to these grants.

Idaho's expenditures supported law enforcement work; the supervision of staff working under Section 6 grants; and the administration of Section 6 grants, including the development of grant proposals, the development of public information and education programs, and the review of caribou-related reports. Washington's estimated expenditures went for such activities as preparing an augmentation plan; mapping caribou habitat features using Geographic Information System technology; providing law enforcement; providing information and education, including establishing a caribou-related Internet site; performing tasks related to transplanting and monitoring caribou; and attending various meetings on caribou.

There are some limitations to the expenditure estimates provided by the states. Specifically, the states did not have complete records of their

expenditures for all 15 years covered in our review. Accordingly, the estimates of the states' expenditures are based on the best available information. For example, during the period from 1986 through 1988, Idaho's estimated expenditures are limited to the state's share of the Section 6 grant in effect then and are, therefore, conservative.⁵ This limitation is due to a lack of historical program expenditure records. Additionally, the Washington Department of Fish and Wildlife's estimated expenditures for the period from 1984 through 1992 are limited mainly to the salary and travel costs incurred by the biologist with lead responsibility for the agency's caribou recovery efforts. Moreover, for 1998, Washington's expenditures are limited to the state's share of the Section 6 grant that was then in effect because a total expenditure estimate for the year was not available for our review. Accordingly, for these time periods, Washington's expenditure estimates are also conservative.

British Columbia's Expenditures

According to the Ministry of Environment, Lands and Parks, British Columbia's expenditures were primarily related to efforts to augment the southern Selkirk caribou population with caribou from other parts of British Columbia and to study cougar predation on caribou. The Ministry estimated these expenditures to be about \$31,000.⁶ The augmentation-related expenditures (about \$26,500) represent the salaries of staff who participated in planning and conducting the transplant operations, including preparing the plans and assisting in locating and capturing the caribou for transplant. The remaining expenditures were for the purchase of radio collars and associated costs for the study of cougar predation on caribou. The Ministry characterized its estimated expenditures as conservative because they do not cover such costs as the salaries and travel expenses for staff from the Ministry of Environment, Lands and Parks and the Ministry of Forests who attended recovery team, steering committee, or technical committee meetings. The estimate also does not include the salaries of staff from the ministries who were involved in planning timber harvests so as to protect caribou habitat. According to the Ministry of Environment, Lands and Parks, since the ministries do not keep records of such expenditures on a species-by-species basis, no information on these expenditures was available. The Ministry of Environment, Lands and Parks also noted that

⁵Idaho's expenditures for these years were reported by the state's fiscal year, which runs from July through June.

⁶This estimate is based on a Mar. 16, 1999, average exchange rate of 65.4 U.S. cents per Canadian dollar.

British Columbia would likely have incurred the costs for planning timber harvests even if there were no U.S. caribou recovery program, since British Columbia, including the Ministry of Forests and private industry, is taking actions to protect the habitat of the southern Selkirk caribou on its own behalf.

Recovery Program Has Achieved Modest Gains

FWS' recovery plans for the southern Selkirk Mountains caribou called for taking a variety of actions to assist the declining population. One of the most significant has been the transplanting of over 100 caribou from other parts of British Columbia to the southern Selkirk Mountains area. Most recovery program officials we spoke to believe that this action is probably responsible for the continued existence of a caribou population in the southern Selkirk Mountains. However, because many transplanted and some resident caribou have died, the net effect of the augmentation effort has been a relatively small increase in the overall population, from about 30 animals when the recovery effort started in 1984 to about 48 animals today. FWS noted that the mortality among the southern Selkirk transplants is in line with long-term recovery objectives established by the Canadian Wildlife Service for caribou in other areas. Furthermore, FWS believes that the information gained from the augmentation effort is essential in sustaining the recovery and is consistent with "adaptive management."⁷ The current population consists of both transplanted and resident caribou and moves freely across the borders of Washington, Idaho, and British Columbia.

Although the recovery program has not succeeded in establishing two new self-sustaining herds in the United States as planned, it has mapped caribou habitat in the recovery zone, developed habitat management guidelines, and completed research on certain aspects of caribou ecology. Furthermore, according to recovery program officials, restrictions on land use due specifically to the caribou have been relatively minor. Other restrictions, such as road closures on Forest Service lands to protect old-growth timber reserves, watersheds, and grizzly bear, would remain even if there were no recovery plan for the caribou.

Results of Augmentation Efforts

FWS' initial caribou recovery plan, approved in April 1985, called for an assessment of the use of augmentation as a possible method of increasing the southern Selkirk caribou population. At the time, the existing

⁷The concept of adaptive management is the basic premise for recovery plans and conservation strategies. It recognizes the need for flexibility and therefore allows FWS to modify the caribou recovery program if monitoring and/or research results indicate a need for change.

population occupied the international border area of extreme northeastern Washington, northern Idaho, and southeastern British Columbia. Later that year, the Forest Service issued a decision notice that called for augmenting the existing population in accordance with an augmentation plan that had been prepared by representatives of the cooperating agencies. The augmentation plan identified potential caribou capture locations in British Columbia and evaluated potential release sites in Idaho and Washington. Ball Creek in northern Idaho was selected as the release site because of such factors as the condition and availability of suitable habitat for a new caribou herd. In March 1987, 24 caribou were transplanted from British Columbia to Ball Creek. A nearly identical operation provided 24 additional caribou the following year. Caribou were not available for transplant in 1989, but 12 more caribou were transplanted to Ball Creek in March 1990. All transplanted animals were fitted with radio collars and have been monitored extensively to determine their distribution and movement, as well as their reproduction, mortality (including the causes when possible), and survival rates. Through these transplants, a second caribou herd was established in the southern Selkirk Mountains, although it has decreased in size over time and is therefore not currently self-sustaining.

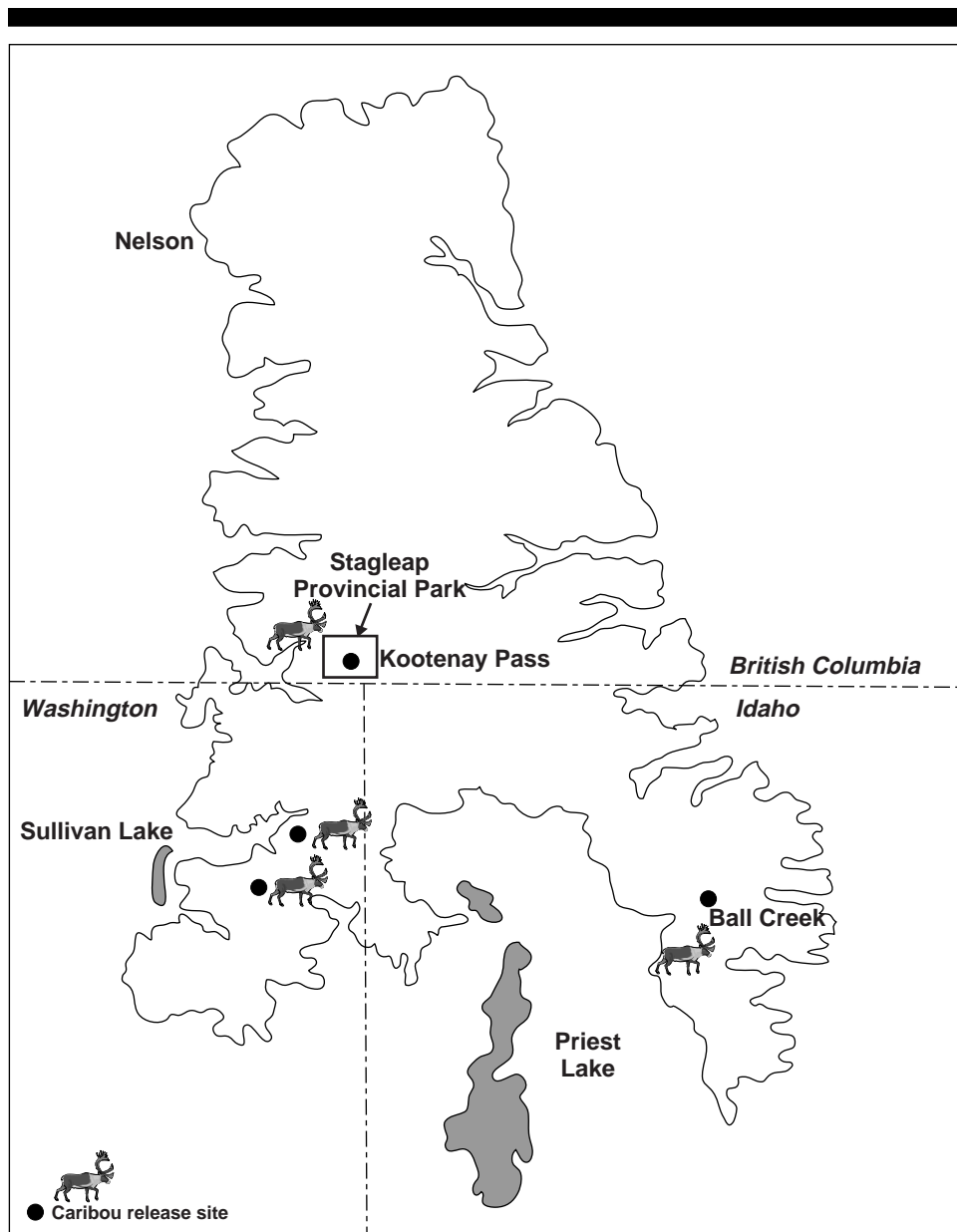
In March 1994, FWS issued a revised recovery plan. The revised plan called for, among other things, establishing a third self-sustaining herd of caribou, this time in Washington. Additional transplants were needed in Washington to reduce the risk of losing caribou to a catastrophic event such as a large fire, and to improve the distribution of caribou, increase the size of the population, and further enhance the probability of recovery. After a second augmentation plan was completed and approved, in April 1996, 19 caribou from British Columbia were released in the Sullivan Lake area of the Colville National Forest in Washington. An additional 13 caribou were transplanted to the same general area in March 1997. Finally, in March 1998, 11 more caribou were transplanted to the southern Selkirk Mountains. However, because previously transplanted animals moved back and forth between British Columbia and the United States, the 1998 transplants were released just north of the U.S.-Canadian border at Kootenay Pass in British Columbia.

According to the Washington Department of Fish and Wildlife, the Canadian release site had several advantages. Specifically, it decreased transport-driving time and thereby reduced stress on the caribou; it placed the caribou directly in a late winter feeding site; and it reduced the project's costs, since roads near the release site did not have to be plowed.

An official from British Columbia's Ministry of Environment, Lands and Parks noted that using the Kootenay Pass release site also eliminated the need for a costly and dangerous quarantine period and increased the likelihood of the transplants' encountering other caribou and taking up residence in that area rather than dispersing. Researchers had also noticed by this time that while the caribou transplanted during the 2 prior years exhibited considerable movement, they tended to congregate in the Stagleap Provincial Park area, just north of the Canadian border. The transplants released in British Columbia followed the same pattern. Within 2 weeks of their release near Kootenay Pass, all the animals were located within the Idaho portion of the recovery zone. These caribou continued to move and currently tend to congregate with the core population centered around the Stagleap Provincial Park area.

All of the Washington and British Columbia transplants were also fitted with radio collars, and the Washington Department of Fish and Wildlife has monitored their movements, survival, and causes of death. Figure 5 shows the locations of the four release sites in the recovery zone.

Figure 5: Caribou Release Sites in Idaho, Washington, and British Columbia



Source: Washington Department of Fish and Wildlife.

Through the augmentation efforts, 103 caribou were transplanted from British Columbia to the southern Selkirk Mountains—60 in Idaho, 32 in Washington, and 11 in British Columbia. As of October 1998, 59 of the 103 transplanted caribou had died (38 of the Idaho transplants and 21 of the Washington transplants). Of the remaining 44 transplanted caribou, 23 are alive (1 from Idaho and 22 from Washington/British Columbia) and the status of the 21 others is unknown, primarily because their radio collars are lost or have failed. Most recovery program officials we contacted believe that the augmentation efforts have probably been responsible for maintaining a core population of woodland caribou in the southern Selkirk Mountains. However, an official from the Idaho Department of Fish and Game said that he is not convinced that the caribou population would no longer exist without augmentation. He stated that a population of 25 to 30 animals around Stagleap Provincial Park has survived for some time and remains the core population. However, he added that the population probably would not have grown or expanded without intervention.

Because so many transplanted and some resident caribou have died, the increase in the overall size of the southern Selkirk population is relatively small. Specifically, when the population was listed under ESA, it was estimated to include about 30 caribou. In 1991, the year following the last of the Idaho transplants, the population numbered about 47 caribou. The population reached its highest level under the recovery effort in 1993, when it totaled about 51 individuals. However, it has declined since to about 48 individuals, even with the addition of the 43 caribou transplanted to Washington and British Columbia. FWS stated that it would be inappropriate to judge the success or failure of a reintroduction program on the basis of only 103 individuals transplanted over a 12-year period. According to FWS, mortality of 57 percent (59 confirmed deaths out of a total of 103 transplanted caribou) would not be considered excessive, especially for these types of animals. FWS noted that this mortality is in line with long-term recovery objectives established by the Canadian Wildlife Service in its recovery plan for a population of woodland caribou located within the boundaries of the Gaspésie Conservation Park in Canada. For example, the long-term goal of this plan was to maintain a survival rate of 50 percent for calves aged 6 months to 2 years. Furthermore, FWS stated that the information gained from the augmentation effort could be used to conduct studies, pinpoint problems, and make adjustments in recovery actions. According to FWS, “adaptive management” is an ongoing, essential effort in sustaining the recovery of the woodland caribou and of many other listed species and typifies why recovery is frequently a slow,

incremental process that is modified as monitoring and research indicate a need for change.

In commenting on our report, the British Columbia Ministry of Environment, Lands and Parks stated that, in general, the Ministry considers annual adult caribou mortality rates in excess of 15 percent to be high. The Ministry noted that recent estimates of adult mortality based on data from radio-collared caribou suggest that the annual mortality rate is even higher. This is of significant concern to the Ministry, which stated that identifying and addressing the cause of this high mortality remains very important for ensuring the long-term recovery of caribou in the southern Selkirk Mountains.

The cause of death is not known for many southern Selkirk caribou, primarily because by the time carcasses are located and examined, too little remains to make an accurate determination. However, predation, mainly by cougars, is the most common known cause of death. Natural causes, poaching or hunting, and accidental falls are other known causes. Some recovery program officials cautioned, however, that the primary cause of the decline in the southern Selkirk caribou population is currently unknown and it is important not to designate predation as the ultimate reason. For example, these officials noted that marginal habitat may be the major problem.

Augmentation efforts have not succeeded in establishing two additional self-sustaining herds in the United States as planned. Some of the Idaho transplants remained near the release site and established a small herd that is centered around Two Mouth Lakes, Idaho. However, the size of this herd has declined steadily over time—from about 26 caribou in 1991 to 5 caribou in 1999. The remaining Idaho transplants have died, left the southern Selkirk Mountains, or congregated with the core population centered around Stagleap Provincial Park. The Washington transplants have moved throughout the recovery zone but have also tended to congregate with the core population. In October 1998, the Washington Department of Fish and Wildlife issued a progress report on its augmentation efforts. The report stated that instead of transplanting 60 or more caribou during the first 3 years of the project as planned, the Department was able to transplant only 43 caribou. The primary reason for this shortfall was concern about straining the source populations in British Columbia. The report indicated that transplanting only a limited number of animals might have diminished the success of the augmentation effort.

Other Recovery Program Efforts

In addition to the augmentation efforts, FWS' recovery plans included a variety of other tasks. Generally, these tasks involved such activities as gathering information on and managing caribou habitat, conducting research on characteristics of the caribou population, endeavoring to reduce caribou mortality, and informing and involving the public and agency personnel about caribou and caribou management. Further information on other recovery program tasks and accomplishments appears in appendix III.

Program's Limited Impact on Land Use

According to recovery program officials, the impact on land use due specifically to caribou recovery efforts has been relatively minor. Specifically, some restrictions have been placed on timber harvesting within the recovery zone, and a small portion of the recovery zone has been closed to snowmobiling. Forest Service officials noted that even if the caribou recovery efforts were terminated, many land-use restrictions would remain in effect to protect, among other things, old-growth timber reserves; watersheds; and other species, such as grizzly bears.

When considering the southern Selkirk caribou for listing under ESA, FWS identified improperly designed timber harvesting as a threat to the population. For example, timber harvesting alters caribou habitat and creates additional human access to habitat, which can increase the potential for mortality. Timber cutting can eliminate escape cover, migration corridors, and the ability of the habitat to produce lichens—a major source of nutrition for the caribou. As a result of the caribou recovery effort, some types and methods of timber harvesting have been restricted or modified on lands administered by the Forest Service. According to Forest Service officials, while caribou habitat management guidelines do not prohibit timber harvesting in the recovery zone, they do affect the amount and type of timber that can be harvested within important caribou habitat. For example, to protect or promote the long-term improvement of caribou habitat, commercial operations to thin forests are designed from the outset to develop habitat with high canopy cover or higher levels of lichen production.

Besides imposing some restrictions on timber harvesting, the Forest Service has closed about 25 square miles of the 2,200-square-mile recovery zone to snowmobiling specifically to protect the caribou. Snowmobiling can harm caribou and their habitat either by directly harassing the animals or by disturbing the habitat to the extent that it becomes unacceptable. The closure was instituted in 1994, after the caribou herd was twice

displaced by snowmobiles. Forest Service officials also stated that no Forest Service roads have been closed specifically to protect the caribou. However, because the caribou recovery area overlaps with the Selkirk grizzly bear recovery area, the majority of the road-use restrictions have been put in place primarily to provide security and core habitat for bear. Forest Service officials noted that these road closures and restrictions also benefit caribou and other wildlife species.

Forest Service officials noted that even if the recovery efforts for caribou were terminated, many land-use restrictions would remain in the recovery area. These restrictions include land management objectives for the protection and management of other species, such as grizzly bear and their habitat, and of other areas, including the Salmo-Priest Wilderness area, the proposed Upper Priest Wild and Scenic River, roadless areas, and unsuitable timberland areas. The recovery area is also managed for the protection of old-growth timber reserves and for the preservation of watersheds and riparian areas. Finally, the recovery zone includes areas that contain typical or unique natural ecosystems and are reserved for scientific and educational purposes.

The Future of the Caribou Recovery Program

In January 1999, officials involved in caribou recovery efforts drafted an action plan that set priorities for the future of the program. Maintaining the core population of caribou currently residing in the southern Selkirk Mountains was identified as the highest-priority task. However, the availability of caribou for further augmenting the population, if needed, is uncertain. The draft action plan also identified the investigation and management of caribou mortality, including predation by cougar, as high-priority tasks. Other immediate needs include producing a consolidated habitat map for the recovery area, minimizing the impact of winter recreation on caribou, and expanding information and education efforts. However, an overriding concern of the officials involved in these planning efforts is whether adequate funding will be available from the cooperating agencies to accomplish these high-priority tasks. According to FWS, other long-term efforts needed to ensure the recovery of the caribou would be examined during FWS' status review of the recovery plan, which is due in 1999.

Immediate Needs of the Recovery Program

After the last augmentation effort was completed in March 1998, the caribou recovery team, the International Mountain Caribou Steering Committee and the International Mountain Caribou Technical Committee

began a series of meetings to plan the future of the recovery program. As a result of these meetings, they drafted an action plan that outlines efforts immediately needed to maintain the existing caribou population and its habitat. In March 1999, members of the steering committee agreed to name the action plan the “Emergency Caribou Recovery Action Plan.”

To accomplish the highest-priority need—maintenance of the core population, the draft action plan proposes to continue the annual census to determine the size of the remaining population and to augment the population when it reaches a level equal to or less than 50 animals. The draft action plan notes that 50 is considered to be the short-term critical threshold for augmentation. However, the plan also states that augmentation will occur if the annual population trend is decreasing and the 3-year recruitment rate (the percentage of calves that live to be a year old) is less than 15 percent or if British Columbia has additional animals available for transplant.

While the success of this strategy is likely to depend on future augmentation efforts, as of January 1999, the availability of caribou for such efforts was uncertain. For example, although the current population includes only about 48 animals, no caribou are available for transplant in 1999. In commenting on our report, British Columbia’s Ministry of Environment, Lands and Parks stated that the availability of caribou for transplant to the southern Selkirk population has, and continues to be, a major issue for British Columbia. The Ministry noted it is currently reviewing the population status of mountain caribou in British Columbia to determine whether potential source populations can sustain the loss of additional caribou for transplant.

The draft action plan also addresses the need to establish a goal for the total southern Selkirk caribou population. It was agreed, on the basis of the best professional judgment of those involved in the recovery effort, that the preliminary goal would be 200 animals. This figure could change with additional research. The group further agreed on the area near Stagleap Provincial Park as the preferred release site for future augmentation efforts.⁸ However, some U.S. agency representatives are concerned about the impression created by using U.S. funds to transplant caribou to the Canadian portion of the recovery zone. In response, other officials noted that the range of these animals still includes the United States. Furthermore, they stated that many different species of wildlife,

⁸The advantages of using the area near Stagleap Provincial Park are discussed in this report under the heading “Results of Augmentation Efforts.”

including grizzly bear and certain waterfowl, regularly move back and forth across the international border and managing all aspects of these ecosystems necessitates work across these boundaries. The draft action plan identified a number of other tasks, including investigating and managing caribou mortality. This task involves (1) monitoring radio-collared caribou to locate those that have died and attempt to determine the causes of death and (2) studying cougar predation on caribou. Currently, researchers in the United States and British Columbia believe that cougar predation may be the most important factor affecting the caribou's survival. Accordingly, a study of cougar predation has already been initiated. The study plan calls for radio collaring and monitoring 40 cougar (10 each in Idaho and Washington, and 20 in British Columbia). The objectives of the study include (1) assessing the extent and frequency of cougar predation on caribou, (2) determining whether predation is specific to individual cougar, and (3) determining whether cougar predation is based on opportunity or need. Using ESA Section 6 grant funding, the Washington Department of Fish and Wildlife has hired a doctoral candidate from Washington State University who will coordinate the analysis of the cougar monitoring data. As of March 22, 1999, 11 cougar had been collared—7 by Washington and 4 by British Columbia. The Idaho Department of Fish and Game had also begun its collaring effort. If cougar that kill caribou are identified, the agency with jurisdiction over where they are found will have responsibility for deciding how to deal with them.

Other tasks identified as immediate needs include producing a consolidated map of the entire recovery zone, using Geographic Information System data. The effort would focus initially on Forest Service land, but recovery officials hope to extend the map to include Idaho State and British Columbia lands as well. Another task is to minimize the impact of recreation on caribou. This effort will focus on winter recreation, particularly snowmobiling, and will identify areas of existing or anticipated high snowmobile use, determine where such use conflicts with caribou, and develop recommendations for reducing or eliminating conflicts. An immediate need to expand information and education efforts has also been identified. This effort will involve summarizing ongoing activities, improving the dissemination of existing information, and identifying alternative funding sources.

In commenting on our report, the British Columbia Ministry of Environment, Lands and Parks stated that it supports the following priorities for caribou recovery in the southern Selkirks: (1) ensure a commitment to maintain funding for future recovery tasks; (2) produce a

consolidated map of caribou habitat for British Columbia, Idaho, and Washington; (3) establish agreements for zoning and protecting critical winter habitats; (4) minimize recreational disturbance within those habitats; (5) proceed with a caribou/cougar morality study, including an action plan to deal with cougars identified as killing caribou; and (6) expand information and education programs to obtain public support for caribou recovery.

As of February 1999, officials planning the recovery effort were also developing an estimate of the costs to implement these high-priority needs. In addition, the draft action plan states that there are other longer-term tasks that need to be addressed to ensure the recovery of the caribou. According to FWS, these long-term efforts would be examined during FWS' status review of the recovery plan, which is due in 1999.

Funding Concerns

An overriding concern of officials planning future caribou recovery efforts is whether adequate funding will be available to implement the program's short-term and long-term needs. For example, in fiscal years 1997 and 1998, Washington and Idaho received only about 65 and 57 percent, respectively, of the Section 6 grant funding they requested. Specifically, in fiscal year 1997, Washington asked for \$225,000 and Idaho asked for \$189,000 for caribou recovery efforts. They received \$140,000 and \$96,000, respectively. Both states asked for the same amounts in fiscal year 1998; they received \$153,200 and \$120,200, respectively. For fiscal year 1999, Washington was allocated about \$97,000 of the \$202,500 it requested and Idaho was allocated \$120,000 of the \$189,000 it requested. Idaho's Section 6 funding requests for these years covered the Selkirk ecosystem, including grizzly bear recovery projects. Only about 35 percent of the funds were used for caribou recovery projects. FWS acknowledged that it has not been able to fund caribou recovery work at requested levels but noted that it receives a limited appropriation for Section 6 grants that must be divided among 50 states. FWS stated that these funds, which are allocated to FWS regions on the basis of the number of species listed, are not sufficient to fund all state-proposed recovery projects.

The funding concern was reiterated in a January 1999 letter from the chairman of the steering committee to the director of FWS' Region 1 in Portland, Oregon. The chairman noted that the partial funding of recovery efforts financed through Section 6 grants has compromised the success of these efforts over the past few years. For example, because of funding constraints, the Washington Department of Fish and Wildlife has had to

reduce the number of flights it makes to monitor radio-collared caribou. This, in turn, has made it difficult to determine the causes of some caribou deaths. Furthermore, there is also concern about whether enough funding will be available to conduct a complete predator study that will yield valid data.

The steering committee has also asked for an additional commitment of FWS staff to the recovery program. According to the chairman, caribou recovery is a multiagency, international program that cannot succeed without the commitment of FWS staff to coordinate the effort. Currently, according to FWS, its representative to the caribou recovery team can spend only a relatively small portion of her time on caribou recovery efforts because of a heavy workload pertaining to other ESA issues and activities.

British Columbia officials have also expressed concern about the commitment of adequate U.S. resources to the recovery effort. For example, at a December 1998 steering committee meeting, the Kootenay regional director for the Ministry of Environment, Lands and Parks (the region that encompasses the Canadian portion of the recovery zone) indicated that unless British Columbia gets a clear signal of definite resolve from the United States to recover the southern Selkirk caribou population, further augmentation of the population will not be a high priority for British Columbia.

Finally, the chairman of the steering committee stated that reversing the negative trend for the remaining caribou population would require a strong commitment of staff and funding from all of the participating agencies. He noted that while the other agencies have provided, and are continuing to provide, financial support, caribou recovery ultimately depends on a strong financial commitment from FWS. Officials involved in planning future recovery efforts recognize that all cooperating agencies need to determine whether caribou recovery is a high priority, since funding from these agencies is controlled by the priorities they set. Accordingly, as of January 1999, recovery officials had focused their efforts on obtaining a commitment for funding future recovery tasks from their own agencies and from outside sources, such as conservation groups.

Agency Comments

We provided copies of a draft of this report to the Department of the Interior and its Fish and Wildlife Service; the Department of Agriculture's

Forest Service; the British Columbia Ministry of Environment, Lands and Parks; and the states of Idaho and Washington for their review and comment. We received letters commenting on the report from the Department of the Interior; the Forest Service; the British Columbia Ministry of Environment, Lands and Parks; and the Washington Department of Fish and Wildlife. We also received comments from the Idaho Department of Fish and Game.

Interior's letter stated that the Department was in general agreement with our findings and offered a technical clarification that we incorporated in the report. Interior's letter and our response are included in appendix IV. The Forest Service's letter stated that the agency concurred with the report as written (see app. V).

According to the letter from the British Columbia Ministry of Environment, Lands and Parks, the report provides a good overview of the recovery program. The Ministry noted, however, that it was discouraged by the slow progress of the caribou recovery program. Furthermore, the Ministry expressed significant concern about the recent high mortality among radio-collared caribou and stated that identifying and addressing the cause of this high mortality remains a very important issue for ensuring the long-term recovery of the southern Selkirk herd. In addition, the Ministry identified the actions or priorities that it supports for caribou recovery in the Selkirks. Finally, the Ministry noted that the availability of caribou for transplant to the southern Selkirk population has, and continues to be, a major issue for British Columbia. The Ministry stated it is currently reviewing the population status of mountain caribou in British Columbia to determine if any of these populations could sustain a loss for transplants. The Ministry noted, however, that any future transplants from British Columbia would also depend upon a clear signal of definite resolve from the United States to recover the southern Selkirk caribou population. We included this information in the report. The Ministry's letter and our responses are included in appendix VI.

Washington's Department of Fish and Wildlife noted that the report is a good summary of caribou recovery efforts and accurately reflects Washington's expenditures on this effort. The Department also provided some technical clarifications that we incorporated into the report. The Department's letter and our responses are included in appendix VII.

The Idaho Department of Fish and Game provided us with updated information on the size of the caribou population, the number of caribou

remaining in the Idaho (Two Mouth Lakes) herd, and the location of the Idaho release site. We revised the report accordingly.

Scope and Methodology

To determine the amount and source of funds expended on the woodland caribou recovery program, we collected documentation and interviewed officials from the U.S. Fish and Wildlife Service's headquarters office in Washington, D.C.; Region 1 office in Portland, Oregon; and Upper Columbia River Basin field office in Spokane, Washington. We also collected information on expenditures for research by FWS' National Ecology Research Center from 1984 through 1992. Additionally, we collected documentation and interviewed officials from the Forest Service's headquarters office in Washington, D.C., and Idaho Panhandle and Colville National Forests; the Bureau of Land Management; the Animal and Plant Health Inspection Service; the Idaho Department of Fish and Game; the Washington Department of Fish and Wildlife; and the British Columbia Ministry of Environment, Lands and Parks. We did not independently verify the accuracy of this expenditure information. We also reviewed ESA and additional information on funding sources for recovery efforts.

Much of the expenditure information we obtained from the agencies consisted of estimates of expenses for caribou recovery efforts. Moreover, while we generally collected expenditure data for fiscal years 1984-98, in some cases, the agencies did not have complete records of their expenditures for this period. Accordingly, in these cases, the expenditures reported here are limited to the information that was available from the agencies and, in some instances, are likely to be conservative estimates of expenditures for the caribou recovery program. In addition, in some cases, we relied on expenditure information that the state and federal agencies provided for inclusion in FWS' annual report to the Congress entitled Federal and State Endangered Species Expenditures. As with other expenditure data we collected, we did not independently verify the accuracy of this information. With respect to FWS and the Forest Service, the annual expenditure data provided in this report differed, in most cases, from expenditure information that we collected independently. However, FWS' Assistant Director for Planning and Budget and the Forest Service's Deputy Chief for Business Operations stated that, for certain years covered in our review, the estimates provided for the congressional report for their agencies are the most accurate available. The Forest Service noted, for example, that the data it provided for the congressional report included a more complete array of reasonably identified expenditures,

including various indirect costs, such as those for the staff time spent designing timber sales that would not adversely affect caribou and considering the effects of other proposed land management activities on caribou.

To report expenditures by the Bureau of Land Management and the Animal and Plant Health Inspection Service, we generally relied on data provided in FWS' annual reports to the Congress. This report was first issued for fiscal year 1989. Accordingly, the first year for which we collected expenditure data for these agencies was fiscal year 1989. In addition, at the completion of our review, fiscal year 1995 was the most recent year for which FWS had completed its report. The Bureau of Land Management, however, provided us with some additional expenditure data that were not included in FWS' reports. We included these data in our report.

To determine the results of the recovery program, including the outcome of augmentation efforts and the impact of recovery efforts on land use, we interviewed officials from agencies participating in caribou recovery efforts. We also collected and reviewed relevant documentation, such as ESA, proposed and final rules leading to the caribou's listing under ESA, the initial and revised caribou recovery plans, augmentation plans, and reports of research performed and/or funded by FWS. We also reviewed reports from the Idaho Department of Fish and Game and the Washington Department of Fish and Wildlife that summarize the results of completed caribou augmentation efforts and other recovery activities.

To determine the future direction of the recovery program, we interviewed officials and obtained documentation from the participating agencies. We also collected and reviewed the minutes of meetings held by the caribou recovery team, the International Mountain Caribou Steering Committee, and the International Mountain Caribou Technical Committee. Finally, we reviewed their draft action plan identifying high-priority tasks for future recovery efforts.

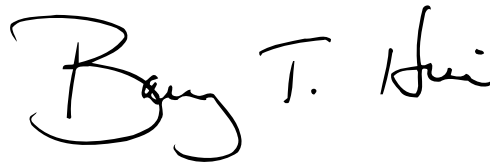
We conducted our review from July 1998 through April 1999 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Honorable Bruce Babbitt, Secretary of the Interior; the Honorable Jamie Rappaport Clark, Director, U.S. Fish and Wildlife Service; the Honorable Daniel J. Glickman,

Secretary of Agriculture; the Honorable Mike Dombeck, Chief, U.S. Forest Service; and the Honorable Jacob Lew, Director, Office of Management and Budget. We will also make copies available to others upon request.

If you have any questions or need additional information, please contact me at (202) 512-3841. Major contributors to this report are listed in appendix VIII.

Sincerely yours,

A handwritten signature in black ink that reads "Barry T. Hill". The signature is written in a cursive style with a large, looping initial "B".

Barry T. Hill
Associate Director, Energy,
Resources, and Science Issues

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Abbreviations

ESA	Endangered Species Act
FWS	U.S. Fish and Wildlife Service

Summary of Reports Resulting From Woodland Caribou Research Performed or Funded by the U.S. Fish and Wildlife Service's National Ecology Research Center

The following reports, summarized in chronological order, were based on woodland caribou studies performed or funded by the U.S. Fish and Wildlife Service. This research was initiated at the Ecology Branch of FWS' Denver Wildlife Research Center in 1984. The Ecology Branch then joined FWS' Western Energy and Land Use Team, which later became part of the National Ecology Research Center. In 1993, the National Ecology Research Center and other organizations (or portions of organizations) were merged to form the National Biological Survey. This organization was renamed the National Biological Service in 1995 and was subsequently merged into the U.S. Geological Survey in 1996. Although FWS has not provided funding for caribou research since fiscal year 1992, the results of funded studies have continued to be published, most recently in 1998.

For each report we identified, we included an abstract describing its findings. In most cases, the researchers that wrote the reports prepared these abstracts. However, GAO prepared abstracts for 10 of the reports. The GAO-prepared abstracts were subsequently reviewed and approved by the primary researcher who prepared the reports.

Chronological Listing of Reports

Rominger, E.M., and J.L. Oldemeyer. 1986. Forest and Snow Components of Selkirk Mountain Caribou Early Winter Habitat. Unpublished Report, U.S. Fish and Wildlife Service, Fort Collins, Colorado. 45 pp.

Abstract

The Selkirk Mountain caribou population of northern Idaho, northeastern Washington, and southeast British Columbia was listed as an endangered species in 1983 under the Endangered Species Act of 1973. This isolated remnant caribou population resides primarily in British Columbia, with a few individuals as part-time residents in the United States (Scott and Servheen 1985). Although woodland caribou originally occurred in all Canadian border states (Hall 1981) and 350 miles south of their present range in Idaho (Johnson 1967), the Selkirk population of 25-30 woodland caribou is considered the last remaining herd in the 48 contiguous states.

Selkirk caribou select seasonal habitats within their home range and movements include the classic double migration described by Edwards and Ritcey (1959) for woodland caribou in Wells Gray Provincial Park, British Columbia. Ecological and socioeconomic factors combine to make early winter habitat the most critical seasonal habitat. Early winter habitat

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is located in the old-growth cedar/hemlock forest types and between this type and the higher-elevation spruce/fir forest type. Most early winter habitat occurs between 1375 and 1675 meters, generally on northerly slopes (Scott and Servheen 1985). Old-growth cedar/hemlock is economically important to the timber industry because of the efficiency of harvest and consequently has been extensively logged in both Canadian and U.S. caribou habitat.

Caribou begin a major shift in diet selection during the onset of early winter as plant aging and early snows decrease the availability and efficiency of harvest of vascular plants. Soft deep snows physically inhibit caribou from using the arboreal lichen component of the spruce/fir community until snow packs settle and harden. Therefore, caribou must adapt a foraging strategy intermediate to open fall grazing and late winter foraging on arboreal lichens. Weather conditions make early winter the most difficult time to monitor woodland caribou. Lack of information during early winter for Selkirk caribou and studies of woodland caribou (Edwards and Ritcey 1959, Stardom 1975, Bloomfield 1980, Antifeau 1985) and the need to better understand caribou use of early winter habitat in relation to forestry practices was the impetus for this research.

Rominger, E.M., and J.L. Oldemeyer. 1987. Habitat Component Mapping of Selkirk Mountain Caribou Early Winter Habitat in Southeastern British Columbia, Canada. Unpublished Report, U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, Colorado. 56 pp.

Abstract

The Selkirk Mountain caribou population of northern Idaho, northeast Washington, and southeast British Columbia was listed as endangered in 1983 in accordance with the Endangered Species Act of 1973. This isolated remnant caribou population resides primarily in British Columbia, with a few individuals as part-time residents in the United States (Scott and Servheen 1985).

Preliminary research during 1983-84, by the Idaho Department of Fish and Game, delineated population status, home range and seasonal habitat use (Scott and Servheen 1985). This research determined early winter habitat to be the most critical seasonal habitat because of the substantial use of the economically important old-growth western red cedar/western hemlock community and because snow reduced the availability of forage and initiated the transition from summer forage comprised primarily of

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vascular forage, to the late winter diet of almost exclusively arboreal lichens. These concerns were the impetus for the initiation of an in-depth study by the U.S. Fish and Wildlife Service to map habitat components in critical drainages used by caribou during early winter and monitor habitat components at actual early winter caribou use sites during early winter (Rominger and Oldemeyer 1986).

The objective of this report is to describe the physical and silvicultural components of the Waldie and Curtis Creek drainages and their tributaries. These two drainages are in British Columbia on the west side of the Selkirk Range, where a majority of early winter sightings of caribou during 1983-84 occurred. This report includes maps and site descriptions of the area mapped into habitat components during the summer of 1985 and site descriptions of caribou early winter sightings from 1983-86 (Scott and Servheen 1985, Rominger and Oldemeyer 1986). This report will enable resource managers to evaluate future impacts of logging, mining, and recreation on this portion of Selkirk caribou early winter habitat. These data can also be compared with data from caribou use sites and proportions of these drainages that provide optimal habitat. Comparisons of these habitats with historical range in the United States will enable biologists to better manage reintroduced caribou. Climate, geology, caribou use of early winter habitat, and other aspects of Selkirk caribou ecology are addressed in separate reports (Crawford and Scott 1985, Scott and Servheen 1985, Rominger and Oldemeyer 1986).

Rominger, E.M. 1987. "Lichen-Bearing Windthrown Trees Are Important to Selkirk Caribou Early-Winter Habitat." U.S. Fish and Wildlife Service, Research Information Bulletin No. 87:124.

Abstract

The native woodland caribou population that inhabits northern Idaho, northeastern Washington, and southeastern British Columbia is currently composed of 25-30 animals, with most seasonal ranges occurring in Canada. In March 1987, 24 additional woodland caribou were transplanted into northern Idaho from two populations in British Columbia. The National Ecology Research Center began investigating early winter habitat of the native population in 1985. Early winter in the Selkirk Mountains is defined as the period from first snowfall until snow depths and other conditions enable caribou to ascend to late-winter habitats in higher-elevation Engelmann spruce/subalpine fir forests. This seasonal habitat has been determined to be the most critical for caribou survival.

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Rominger, E.M., and J.L. Oldemeyer. 1988. "Quantification of Woodland Caribou Early Winter Habitat, Selkirk Mountains, British Columbia." Proceedings of the 3rd North American Caribou Workshop. Alaska Department of Fish and Game, Wildlife Technical Bulletin No. 8:161-162.

Abstract

In winter 1986-87, there were 25-30 woodland caribou in the endangered population inhabiting the Selkirk Mountains in the Pacific Northwest. These caribou ranged primarily in southeastern British Columbia but also frequented northern Idaho and northeastern Washington. In March 1987, 24 woodland caribou from two British Columbia populations were transplanted to northern Idaho to improve the Selkirk population's chances of long-term survival.

In 1985, the National Ecology Center, U.S. Fish and Wildlife Service, began studying early winter habitat of the Selkirk population, specifically during the period from first snowfall until snow conditions permit/cause caribou to move upslope to forest communities at 1,500 meters to 1,800 meters elevation. Early winter use occurs primarily in mature/old-growth stands of economically important timber in both the Engelmann spruce/subalpine fir and the western red cedar/western hemlock communities; the area between the two communities is also used extensively. The lower-elevation, more densely canopied cedar/hemlock community is particularly important because snow is shallower there, which reduces energy costs to caribou and extends the availability of green vascular forage. In the higher-elevation, more open-canopied spruce/fir community, the increased costs of locomotion through deeper snow are apparently offset by increased availability of highly digestible arboreal lichens.

Compared with randomly selected locations, actual caribou use sites had significantly ($P < 0.05$) more lichen-bearing, recently windthrown trees; were at higher elevation; and had lower slope angles, canopy cover, and tree basal area. Arboreal lichen on windthrown trees was apparently important forage because vascular plants were buried by snow.

Because Selkirk caribou use spruce/fir and cedar/hemlock communities extensively during early winter, we recommend that mature old-growth stands for both forest types be maintained. Special considerations should be given to stands on less steep slopes where available arboreal lichen biomass is relatively high and is replenished by trees which are commonly blown down.

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Rominger, E.M., and J.L. Oldemeyer. 1989. "Early-Winter Habitat of Woodland Caribou, Selkirk Mountains, British Columbia." *Journal of Wildlife Management* 53(1):238-243.

Abstract

We monitored early-winter habitat use by woodland caribou in the southern Selkirk Mountains, British Columbia, during November and December 1985-86. We compared biological and physical attributes of random locations within known early-winter caribou range to actual caribou use sites. Univariate and descriptive discriminant analysis indicated significant ($P < 0.05$) separation of several habitat variables between random sites and sites used by caribou. We observed caribou in old-growth stands with moderate slopes (< 30 degrees); greater density of recently windthrown, lichen-bearing trees; higher elevations; and less canopy cover and total tree basal area than measured at random plots. Because the Selkirk caribou use Engelmann spruce-subalpine fir and western red cedar/western hemlock communities, we recommend maintenance of old-growth timber in these habitat types.

Rominger, E.M. 1990. Caribou Diets and Arboreal Lichen Availability. *Proceedings of the Caribou Workshop*, Ministry of Environment, British Columbia. 4 pp.

Abstract

Mr. Rominger looked at the lichen biomass estimates of standing trees, blowdown/litterfall, and effects of landform on tree density. He also deals with forage intake rates, primarily for barren ground caribou and reindeer. He suggests 2 kg/day rather than 5 kg/day may be a more reasonable estimate. This is a more reasonable estimate when compared with the dry forage and intake of other species. He cites Detrick (1984) as the most complete work, using the destructive technique of cutting branches, collecting all the lichen, and weighing it. The literature available usually refers to subalpine fir and Engelmann spruce.

Factors to be considered in regard to the lichen intake rate of woodland caribou are the nutritional values, energy variation in foraging strategy, body size and winter severity. There is up to twice the protein in arboreal lichen as compared with terrestrial lichen. Foraging on arboreal lichen is probably more energy efficient than cratering of barren ground caribou. Milder (maritime) climates where caribou were not subjected to

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temperature extremes should also be considered. However, the larger body size of woodland caribou may cause an increase in intake rate compared with barren ground caribou.

Rominger, E.M. 1990. "Research Continues on Augmentation of the Southern Selkirk Mountain Caribou Herd." *Endangered Species Technical Bulletin*, Vol. XV(8):6.

Abstract

Woodland caribou once occurred widely in forested regions from southeastern Alaska, through much of Canada, to the northern conterminous United States. Due to extensive habitat alteration and unrestrictive shooting, however, only one population still naturally occurs in the conterminous United States. In 1983, this remnant herd, which occurs in the Selkirk Mountains of northern Idaho, northeastern Washington, and southeastern British Columbia, was estimated at 25-30 individuals. The animals in this herd were rarely seen in the United States because most of their seasonal habitats were in Canada. The potential threats to the survival of the southern Selkirk Mountain caribou herd while in the United States, including poaching, habitat loss, collisions with motor vehicles, and genetic problems from inbreeding, led the Fish and Wildlife Service to list the population as endangered in February 1984 (see *BULLETIN* Vol. IX, No. 3).

Rominger, E.M., and J.L. Oldemeyer. 1990. "Early-Winter Diet of Woodland Caribou in Relation to Snow Accumulation, Selkirk Mountains, British Columbia, Canada." *Canadian Journal of Zoology*, Vol. 68(12): 2691-2694.

Abstract

Woodland caribou in the southern Selkirk Mountains of British Columbia shift from a diet of primarily vascular plants during snow-free months to an arboreal lichen-conifer diet during late winter. We present evidence that caribou diets, during the early-winter transition period, are influenced by snow accumulation rates. Caribou shift to an arboreal lichen-conifer diet earlier during winters of rapid snow accumulation and forage extensively on myrtle boxwood, an evergreen shrub, and other vascular plants during years of slower snow accumulation. The role of coniferous forage in early-winter food habits is examined. Forest management

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strategies can be developed to provide habitat that will enable caribou to forage in response to varying snow accumulation rates.

Rominger, E.M., J.L. Oldemeyer, R.W.T. Detrick, and D.R. Johnson. 1990. Arboreal Lichen Biomass on Live and Dead Subalpine Fir, Northern Idaho. Unpublished Report, U.S. Fish and Wildlife Service, Fort Collins, Colorado. 35 pp.

Abstract

Two estimates of arboreal lichen biomass on subalpine fir were summed separately and combined to estimate the availability of this forage for woodland caribou in high-snowpack ecosystems of Southwest British Columbia and northwestern United States. We estimated lichen biomass between two and six meters on standing trees to determine availability at various snow depths during late winter. This estimate was combined with a biomass value between six meters and treetop to estimate lichen availability on whole trees made available to caribou via windthrow. We sampled arboreal lichen from more than 1,050 branches on 266 trees and snags between two and six meters and more than 1,100 branches on 111 trees and snags between six meters and treetop. Total biomass estimates for three diameter-size classes ranged from 444 to 1,170 grams for dead trees and from 716 to 3,075 grams for live trees. Despite the universally large variances concomitant with estimating mean arboreal lichen biomass, the averages of several other studies on arboreal lichen biomass are similar to our estimate for two to six meters on whole trees. These estimates of arboreal lichen biomass will enable us to better understand the winter ecology of woodland caribou.

Warren, C.D. 1990. Ecotypic Response and Habitat Use of Woodland Caribou Translocated to the Southern Selkirk Mountains, Northern Idaho. M.S. Thesis, University of Idaho, Moscow. 194 pp.

Abstract

Between April 1987 and March 1990 the ecotypic response and habitat use of translocated woodland caribou were studied in northern Idaho and southern British Columbia. Two populations, each representing an ecotype of woodland caribou, were used as sources for the reintroduction effort. Anahim Lake caribou (woodland ecotype) were captured in west-central British Columbia. Revelstoke caribou (mountain type) were captured in southeastern British Columbia. Over the first two years, 48

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radio-collared caribou were released into the southern Selkirk Mountains, including 26 Anahim and 22 Revelstoke animals. A total of 962 relocations were recorded, 443 of which were sampled for habitat characteristics. Significantly more Revelstoke caribou emigrated from the release area and joined resident caribou herds in southern British Columbia, while Anahim caribou incurred significantly greater mortality. These differences were most apparent during the first year after release. Habitat use patterns revealed important interactions between the two translocated populations and the nearest resident (Stagleap, mountain ecotype) caribou herd. The two most important influences affecting the response of the caribou appeared to be their traditional habitat use patterns acquired from their native herds and the habitat use patterns learned, or assimilated, from other caribou after release. The late winter period showed the greatest difference between the caribou ecotypes. Anahim caribou used mature, densely forested areas on south-facing slopes, while the late winter habitat use of Revelstoke and Stagleap-area caribou showed no distinct pattern. There were also differences specific to the caribou populations during the other seasons. Summer habitat use patterns suggest that differences exist between the release area in northern Idaho and the area occupied by the resident Stagleap herd. Differences in habitat use between years of study indicated that some “random” searching behavior occurred for several months following release and that the translocated caribou could adjust certain habitat use patterns in response to being placed in unfamiliar territory. All seasons revealed some similarities in habitat use between the caribou populations, indicating universal habitat needs of the woodland subspecies. The taxonomic and evolutionary status of mountain caribou are discussed. Finally, the implications of this studies’ findings for translocation efforts conducted on other species and recommendations for the continued management of the Selkirk Mountains caribou are presented.

Rominger, E.M., and J.L. Oldemeyer. 1991. “Arboreal Lichen on Windthrown Trees: A Seasonal Forage Resource for Woodland Caribou, Selkirk Mountains, British Columbia.” Proceedings of the 4th North American Caribou Workshop, Newfoundland and Labrador Wildlife Division: 475-480.

Abstract

Arboreal lichen, particularly fruticose beard lichens, are important early-winter forages in the high snowpack ecosystems of western North America. As snow depth increase in the Selkirk Mountains of northern

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Idaho and southeastern British Columbia, woodland caribou feed extensively on recently windthrown lichen-bearing trees and snags. One-hectare areas around caribou early-winter locations had significantly ($P < 0.001$) greater amounts of recently windthrown trees compared with randomly placed 1-hectare plots within caribou early-winter habitat. This study estimates the potential contribution of windthrow to the woodland caribou forage base in Selkirk Mountains. Subalpine fir trees and snags dominated (85 percent) the windthrow component at both caribou and random locations. We sampled arboreal lichen on subalpine fir trees and snags felled at logging operations in northern Idaho. Subalpine fir trees and snags were stratified by 3 size classes and sampled in proportion to their occurrence in the windthrow measured at caribou and random locations. The estimates of arboreal lichen biomass made available via windthrow are compared with biomass available in standing trees up to 3 meters.

Rominger, E.M., J.L. Oldemeyer, and C.T. Robbins. 1991. "Foraging Dynamics and Woodland Caribou: A Winter Management Conundrum," Proceedings of the Fifth North American Caribou Workshop, Rangifer, Special Issue No. 7(123).

Abstract

Research, primarily on the endangered Selkirk woodland caribou population, has enabled biologists to answer many of the basic ecology questions pertaining to caribou in high snowpack ecosystems. Data have been collected on habitat selection (Freddy 1974; Scott and Servheen 1985; Simpson et al. 1985; Rominger and Oldemeyer 1989; Warren 1990), food habits (Freddy 1974; Scott and Servheen 1985; Simpson et al. 1985; Rominger and Oldemeyer 1990), arboreal lichen biomass (Stevenson 1979; Detrick 1984; Rominger et al. submitted), tree density in subalpine forests (Rominger and Oldemeyer submitted), and arboreal lichen nutritional quality (Antifeau 1987; Robbins 1987). Specific knowledge that is lacking for caribou winter nutritional ecology includes forage intake rates during winter and the constraints upon this process. The interrelationship of snow depth, aspect, lichen biomass within vertical strata of trees, daily intake, constraints upon this intake, and tree density in relation to both forage dynamics and potential predator detection combine to make this process very complex. The nearly monophagous late-winter diet reported for woodland caribou in these high snowpack ecosystems affords a unique opportunity in wild ungulate ecology to recreate an accurate facsimile of diet choices in a laboratory setting. We propose a dissertation research

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project to test specific hypotheses related to late-winter foraging ecology using pen-raised woodland caribou at Washington State University.

Rominger, E.M., and J.L. Oldemeyer. 1991. Comparison of Fixed-Plot and Variable-Plot Sampling to Estimate Tree Density in Selkirk Woodland Caribou Subalpine Forest Habitat. Unpublished Report, U.S. Fish and Wildlife Service, Fort Collins, Colorado. 20 pp.

Abstract

An accurate estimate of tree composition and density is important to the management of woodland caribou because of their relationship to the biomass of arboreal lichens. The fruticose arboreal lichens within these trees are the principal winter forage of woodland caribou in high snowpack ecosystems. We tested four density estimation techniques in timber stands with known densities. A fixed subplot (400 square meters) was determined to be the most accurate technique, and point-centered quarter was the least accurate. Mean stem density of live and dead standing trees greater than or equal to 13 centimeters' diameter at breast height in homogeneous stands of mature to old-growth subalpine fir/Engelmann spruce was 395 plus or minus 37.7 stems per hectare (mean and 95-percent confidence interval).

Rominger, E.M. 1992. Early-Winter Habitat of the Selkirk Woodland Caribou. U.S. Fish and Wildlife Service, National Ecology Research Center, Fort Collins, Colorado. 19 pp.

Abstract

Early winter is bounded by the abiotic constraint of snowfall and snow condition rather than by a temporal frame. The first persistent snowfall initiates early winter, and crusted deep snow that enables caribou to ascend into late-winter habitat terminates this season. This period may overlap with rut activities in October or may not occur until January or February. The bioenergetic costs of travel in deep soft snow and the relatively minor vertical lift afforded by early-winter snow conditions are among the parameters that constrict Selkirk caribou below high elevation late-winter habitat. The potential for caribou to use lower elevation, often snow-free habitats exists. However, during early winter, caribou are primarily found in mature/old-growth subalpine fir/Engelmann spruce and western hemlock/western red cedar forests and the area between these two forest types on moderate slopes between 1500 and 1900 meters. The

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conclusions presented in this chapter on early-winter ecology of Selkirk caribou are based on data collected on the extant population in British Columbia during early winters 1985-86 (Rominger and Oldemeyer 1989a,b; 1990) and earlier research (Freddy 1974, Scott and Servheen 1985).

Rominger, E.M. 1992. Revision for the Early-Winter Habitat Chapter, Selkirk Woodland Caribou Recovery Plan. National Ecology Research Center, Fort Collins, Colorado. 26 pp.

Abstract

Early winter is bounded by the abiotic constraint of snowfall and snow condition rather than a temporal frame. The first persistent snowfall initiates early winter, and crusted deep snow that enables caribou to ascend into late-winter habitat terminates this season. This period may overlap with rut activities in October or may not occur until January or February. The bioenergetic costs of travel in deep, soft snow and the relatively minor vertical lift afforded by early-winter snow conditions are among the parameters that constrict Selkirk caribou below high-elevation late-winter habitat. The potential for caribou to use lower elevation, often snow-free habitats exists. However, during early winter, caribou are primarily found in mature/old-growth subalpine fir/Engelmann spruce and western hemlock/western red cedar forests and in the area between these two forest types on moderate slopes between 1500 and 1900 meters. The conclusions presented in this chapter on the early-winter ecology of Selkirk caribou are based on data collected on the extant population in British Columbia during early winters 1985-86 (Rominger and Oldemeyer 1989a,b, 1990) and earlier research (Freddy 1974, Scott and Servheen 1985). Habitat parameters of caribou use sites were compared with random locations within predicted caribou early-winter habitat during 1985 and 1986.

Rominger, E.M., L. Allen-Johnson, and J.L. Oldemeyer. 1994. "Arboreal Lichen in Uncut and Partially Cut Subalpine Fir Stands in Woodland Caribou Habitat, Northern Idaho and Southeastern British Columbia." *Forest Ecology and Management* 70:195-202.

Abstract

To better understand the effects of partial cutting on arboreal lichen biomass production within woodland caribou habitat, lichen was hand picked from 1228 branches on 307 subalpine fir trees in Idaho and in

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British Columbia. Lichen biomass from partially cut stands was compared with biomass on trees from adjacent uncut stands at each site. Arboreal lichen biomass did not differ significantly between uncut and partially cut stands. The total number of branches per tree did not differ significantly between uncut and partially cut stands. Live branches had more lichen than dead branches. Species composition of arboreal lichen changed in partially cut stands compared with adjacent uncut stands. The ratio of live to dead branches was substantially different within the British Columbia partial cut.

Rominger, E.M. 1995. Late Winter Foraging Ecology of Woodland Caribou. Ph.D. Dissertation, Washington State University, Pullman. 68 pp.

Abstract

To better understand the late winter foraging ecology of woodland caribou in the arboreal lichen feeding niche, bottle-raised caribou were used in laboratory and field trials. Variables with the greatest influence on intake rate differed between laboratory and field trials. Bite size was the most important variable in laboratory trials; bite rate was the most important in field trials. During late winter field trials, caribou foraged on lichen primarily on standing subalpine fir and dead trees. Bite size, bite rate, intake rate, tree resident time, and amount of lichen eaten per tree were included in a general linear model with tree species, tree size class, and tree lichen class as the independent variables. All variables except bite size increased significantly with an increase in tree lichen class. Compared with theoretical maximums, intake rate was low on all lichen class trees (range 1.4 to 2.1 g/min). Caribou would have to forage 14 to 21 hours to meet predicted daily requirements. Tree resident time and time between trees varied inversely with tree density. In cafeteria style preference trials using the two primary arboreal lichen genera, caribou strongly preferred *Bryoria* spp. (92 percent) compared to *Alectoria Sarmentosa* (8 percent). Apparent dry matter digestibility of this diet was 82 percent. Data from late winter field trials were used to test recent functional response models relative to optimality and mechanisms. Observed patch resident time, amount of lichen eaten per patch, lichen intake rate, and bite rate of caribou were significantly lower than model predictions. I conclude that short temporal frame foraging trials with fasted ungulates do not accurately reflect foraging ecology under field conditions, that caribou do not forage “optimally” as defined by current models, and that multiple tests of models will be required to integrate foraging theory and management.

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Rominger, E.M., C.T. Robbins, and M.A. Evans. 1996. "Winter Foraging Ecology of Woodland Caribou in Northeastern Washington." *Journal of Wildlife Management* 60(4): 719-728.

Abstract

To better understand the late winter foraging ecology of woodland caribou feeding on arboreal lichens, we used bottle-raised caribou in experimental arena trials with artificial trees, and in field trials within historical late-winter habitat. Factors with the greatest influence on intake rate differed between experimental arena and field trials. Bite size was the most important variable in experimental arena trials; bite rate was the most important in field trials. During late winter field trials, caribou foraged on lichen primarily on standing subalpine fir and dead trees. Bite size, bite rate, intake rate, tree resident time, and amount of lichen eaten per tree were included in a general linear model with tree species, tree size class, and tree lichen class (<average, average, and >average) as the independent variables. Tree lichen class was the most important variable in the model, and 76 percent of all bites occurred on >average lichen class trees. Compared with theoretical maximums, intake rate was low on all lichen class trees (range = 1.4-2.1 g/min). At these intake rates caribou would have to forage 14-21 hours to meet predicted daily requirements. Tree resident time and time between trees varied inversely with tree density. In cafeteria style preference trials with the 2 primary arboreal lichen genera, caribou strongly preferred Bryoria (92 percent) compared to Alectoria Sarmentosa (8 percent). Apparent dry matter digestibility of this diet was 82 percent. Timber stands must be substantially older than traditional harvest rotation lengths to provide the high lichen biomass found on >average lichen class trees. Caribou remained in habitats where Bryoria was the predominant genus of arboreal lichen and would not forage in Alectoria Sarmentosa dominated valley bottom habitat.

Warren, C.D., J.M. Peek, G.L. Servheen, and P. Zager. 1996. "Habitat Use and Movements of Two Ecotypes of Translocated Caribou in Idaho and British Columbia." *Conservation Biology* 10(2): 547-553.

Abstract

Two woodland caribou ecotypes, mountain and northern, were translocated to the southern Selkirk Mountains in northern Idaho to augment a remnant subpopulation. The translocation resulted in an additional subpopulation that used the general area of the release site. The

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mountain ecotype stock exhibited patterns of movement and habitat use similar to those of the resident subpopulation. The northern ecotype stock exhibited more variable habitat use, especially in the first year after translocation. Dispersal of the northern stock was not as extensive as that of the mountain stock. Fourteen of 22 caribou from the northern stock and 6 of 18 caribou from the mountain stock died during the 3-year period after the release. Our results suggest that when donor subpopulations must be used that do not closely compare with resident subpopulations extinct or extant, larger numbers of individuals may be needed to establish a self-sustaining population.

Rominger, E.M., and C.T. Robbins. 1996. "Winter Foraging Dynamics of Woodland Caribou in an Artificial Landscape." Proceedings of the Sixth North American Caribou Workshop. Rangifer, Special Issue No. 9:235-236.

Abstract

Woodland caribou subsist on a nearly monophagous diet of alectoroid arboreal lichens during winter in the high snowpack ecosystems of western North America. This phenomenon provided an opportunity to mimic an entire seasonal diet in a laboratory situation using bottle-raised woodland caribou. Arboreal lichen biomass is reported to vary significantly among tree species (i.e., more lichen on subalpine fir than on Engelmann spruce), among topographical sites (i.e., more lichen on valley bottom trees than on mid-slope trees) and along the vertical axis of trees (i.e., more lichen on branches between 4 and 5 meters than between 2 and 3 meters; Detrick, 1984). The objective of this experiment was to quantify arboreal lichen intake rates of woodland caribou foraging on natural branches collected from two land types, and two foraging heights within trees. We report the results of foraging trials using 8 woodland caribou (3, 2.5-year-old steers; 1, 1.5-year-old female; and 4 steer calves) conducted in an artificial forest during the autumn of 1992.

Rominger, E.M., and C.T. Robbins. 1996. "Generic Preference and In-Vivo Digestibility of Alectoroid Arboreal Lichens by Woodland Caribou." Proceedings of the Sixth North American Caribou Workshop. Rangifer, Special Issue No. 9:379-380.

Abstract

Lichens are eaten by most ungulate species in North America (Bergerud, 1972; Steveson, 1978; Jenkins & Wright, 1987; Fox & Smith, 1988; Klein &

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Bay, 1990). However, none of these species are more obligate lichen feeders than woodland caribou in ecosystems of western North America where deep snowpacks preclude cratering. The digestibility of lichens is reported to vary substantially (21 percent to 85 percent; Hanley & McKendrick, 1983; Robbins, 1987) depending on technique and, in the case of in-vitro analyses, inoculum source (Person et al., 1980; Thomas et al., 1984; Antifeau, 1987). The objective of this experiment was to determine the in-vivo digestibility of and generic preference for the 2 primary arboreal lichens found in late-winter woodland caribou habitat in southeastern British Columbia, northern Idaho, and northeastern Washington.

Rominger, E.M. 1998. "Autumn Foraging Dynamics of Woodland Caribou in Experimentally Manipulated Habitat." Proceedings of the Seventh North American Caribou Conference. Rangifer, Special Issue No. 10:261.

Abstract

Unlike other North American cervids, woodland caribou in the Selkirk ecosystem do not forage or browse. Therefore, during autumn, as forbs become senescent and deciduous shrubs defoliate, caribou foraging decisions are narrowed. Shallow snow depths preclude a diet shift to arboreal lichen in standing trees, as is observed in late winter. The objective of this research was to determine the importance of the two principal forage items previously reported in autumn diets: (1) arboreal lichen on windthrown trees and (2) the evergreen shrub myrtle boxwood. Foraging trails were conducted with three tame woodland caribou in six 5000 square meter pens experimentally manipulated to either remove all windthrown trees and myrtle boxwood or retain extant myrtle boxwood and add "windthrown" trees by felling trees. Additionally, the pen design was such that half was in an old-growth stand of western red cedar/western hemlock and half was in an adjacent clear-cut.

Arboreal lichen, as a result of a large bite size, had the greatest influence on intake rate. Caribou in pens with lichen bearing windthrown trees had significantly higher intake rates ($P < 0.006$) and significantly lower ($P < 0.01$) eating bite rates (exclusive of search time between plants). Foraging bite rate (inclusive of search time between plants) did not differ ($P < 0.20$) due to treatment. Intake rates ($P < 0.005$) and foraging bite rates ($P < 0.03$) of caribou were significantly greater in timbered portions of pens. Search time was significantly greater ($P < 0.005$) in clear-cut portions of pens. In the timbered portion of treatment pens, lichen comprised

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34 percent of the total bites and 67 percent of the dry matter intake and arboreal lichen from windthrown trees comprised 27 percent of the total bites and 52 percent of the dry matter intake. These data suggest that arboreal lichen is an important dietary component earlier in autumn than previously reported and extends the period that woodland caribou subsist primarily or solely on arboreal lichen 30 to 60 days in the high snowpack ecosystems of western North America.

Tame caribou autumn diets comprised less than one-percent myrtle boxwood, in apparent conflict with observations of wild caribou in timbered habitats with myrtle boxwood. However, in these trials, more than 95 percent of the myrtle boxwood occurred in the clear-cut portion of trial pens, and forages in clear-cuts have been reported to have significantly higher levels of secondary plant compounds. Total phenolics in myrtle boxwood samples collected from the clear-cut portion of trial pens and from clear-cuts in British Columbia were 3 times greater than levels in myrtle boxwood samples collected from old-growth stands in British Columbia. In addition, snow depths underneath the forest canopy never covered the primary forage plants. I hypothesize that these woodland caribou forage very little on myrtle boxwood because of (1) the availability of other forage species, and (2) the high level of phenolics present in myrtle boxwood during these trials.

Woodland Caribou in the Southern Selkirk Mountains

Woodland caribou are one of seven remaining subspecies of caribou in North America.⁹ There are two varieties, or ecotypes, of woodland caribou—mountain and northern. The two ecotypes are not genetically distinct and differ only in the use they make of their habitat and in their behavior. For example, mountain caribou do not congregate in large herds, as do northern caribou. Mountain caribou also live in areas of high snowfall where they feed largely on tree-borne lichen in the winter, whereas northern caribou inhabit less mountainous terrain and dig in the snow for low-growing lichens and other plants.

Mountain caribou in the southern Selkirk Mountains use different types of habitat, at varying elevations, depending on the season. For example, they spend the early winter at elevations of 3,000 to 6,200 feet, where they feed on tree-borne lichens that have blown to the ground and on remaining green forage. As snow hardens later in the winter, they move to elevations generally above 6,000 feet, where they feed primarily on lichens hanging from trees. In the spring, mountain caribou move down to areas where new green forage is available. Although mountain caribou exhibit seasonal movements, they depend on mature to old-growth forests for habitat and food for much of the year.

The mountain ecotype of woodland caribou is found mainly in central and southeastern British Columbia. The northern ecotype ranges over much of the remainder of Canada. Historically, woodland caribou were distributed throughout much of Canada and portions of the northern tier of the United States.

Currently, the only caribou population that regularly inhabits the contiguous United States is the mountain caribou population of the southern Selkirk Mountains. Its range is restricted to a relatively small area in southeastern British Columbia, extreme northeastern Washington, and northern Idaho. While records suggest that caribou in the area were plentiful in the 19th century, the population had declined to about 100 individuals by the 1950s. By the early 1980s, the population had further declined to about 30, and the caribou had become one of the most critically endangered mammals in the United States.

Interest in managing the woodland caribou in the southern Selkirks increased as the population decreased. In 1971, U.S. and Canadian resource management agencies signed a cooperative agreement to

⁹The caribou that inhabit portions of Alaska are a separate subspecies that tend to gather and migrate in larger herds.

investigate and monitor the caribou. The agencies included the Forest Service, the Washington Department of Game, the Idaho Fish and Game Commission, the British Columbia Fish and Wildlife Branch, the British Columbia Forest Service, and the University of Idaho. The agreement resulted in the formation of the International Mountain Caribou Steering Committee and the International Mountain Caribou Technical Committee. The steering committee was established to approve plans for studies and funding and to help set direction for caribou recovery efforts and for the technical committee. The steering committee's members include management-level representatives of the participating agencies. The technical committee was tasked with coordinating caribou management and research studies and with serving as a clearinghouse for information that promotes management activities designed to reverse the decline of the caribou population. Membership in the technical committee is open and includes wildlife biologists from the participating agencies; individuals working on caribou research; and other interested parties, such as private citizens, timber companies, and environmental groups. The cooperative agreement produced a series of population and habitat studies in the 1970s and 1980s. Both committees are still active and are key participants in current caribou recovery efforts.

In 1977, the Idaho Fish and Game Commission designated the caribou as an endangered species in the state. The Washington Game Commission designated the caribou as endangered in 1982. In 1980, the Idaho Department of Fish and Game and a private citizen petitioned the U.S. Fish and Wildlife Service (FWS) to list the southern Selkirk population of woodland caribou under the Endangered Species Act (ESA). FWS issued an emergency rule designating the population as endangered in January 1983. The emergency rule was extended in October 1983, and a final rule listing the species as endangered was issued in February 1984.

Under ESA, once a species is identified as threatened or endangered, the responsible agency (in the case of the caribou, FWS) must develop and implement a recovery plan unless such a plan would not contribute to the conservation of the species. For example, some species have not been recently sighted and may be extinct. For those species, the preparation of a recovery plan is deferred until individuals are found in the wild. In addition, state management plans are used in place of recovery plans for some species, and some species do not have individual recovery plans because they are covered by multispecies plans.

A recovery plan details the specific tasks that are considered necessary to recover a species. The plan can identify (but not obligate) other parties, such as federal, state and private entities, as cooperating agencies. Implementing a recovery plan is contingent upon appropriations, priorities, and other budgetary constraints affecting the participants. A recovery plan may also be modified to reflect changes in the status of a species, the completion of recovery tasks, and new findings that reflect the latest available scientific information.

In 1982, the International Mountain Caribou Technical Committee began preparing a management plan for the woodland caribou. FWS adopted a revised version of this document as the official recovery plan for the caribou in 1985. The recovery plan identified the following as cooperating agencies in the caribou recovery effort: FWS; the Fish and Wildlife Branch of the British Columbia Ministry of Environment (currently, the Wildlife Branch of the Ministry of Environment, Lands and Parks); the British Columbia Forest Service (part of the Ministry of Forests); the Forest Service (the Colville and Idaho Panhandle National Forests); the Idaho Department of Fish and Game; the Washington Department of Game (currently, the Washington Department of Fish and Wildlife); and the University of Idaho.

In 1991, FWS appointed its own caribou recovery team to advise the agency on caribou recovery efforts. The recovery team completed a revised recovery plan in 1994. The revised plan identified all of the entities identified by the initial plan as cooperators in the new plan, as well as Washington State University and the Idaho Department of Lands. While these agencies agreed to cooperate in carrying out the recovery plans, resources to implement the plans are controlled by congressional appropriations and the agencies' budgets and priorities.

FWS' recovery plans for the southern Selkirk Mountains woodland caribou identified a variety of management and research actions necessary for the species' recovery. These included collecting information on and managing caribou habitat, determining caribou population characteristics, maintaining the population through various efforts to reduce caribou mortality, and informing the public and agency personnel about caribou and involving them in caribou management. The 1985 recovery plan also called for assessing the feasibility of augmenting the existing population by introducing caribou transplanted from other herds. The consensus of the biological community at the time was that augmentation was the only available method that could reasonably be expected to achieve the

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population's recovery. The 1994 revised recovery plan added the need to establish a third self-sustaining herd in the state of Washington to reduce the risk of losing caribou through a catastrophic event, such as a large fire, and to better distribute the caribou, increase their number, and further enhance the probability of the species' recovery.

A recovery zone that includes the general area used by the caribou as habitat was delineated in the initial recovery plan. It covers about 2,200 square miles and includes national forest, state, private and Canadian lands. The recovery zone encompasses the geographic area in the southern Selkirk Mountains where caribou management efforts are now focused.

Examples of the Recovery Program's Tasks and Accomplishments

In addition to augmentation efforts, FWS' recovery plans included a variety of other tasks. Generally, these tasks involved such activities as gathering information on managing caribou habitat, conducting research on the characteristics of the caribou population, endeavoring to reduce caribou mortality, and developing public information and education programs. The following illustrate some of the recovery program's tasks and other accomplishments.

Habitat Mapping: The recovery plans called for the agencies to inventory existing caribou habitat. Accordingly, the agencies have mapped most of the caribou habitat in the recovery zone. They are now focusing on consolidating the mapping efforts completed to date so that they can produce a single uniform map of the recovery zone.

Caribou Management Units: Forest Service land, which provides the majority of the habitat for caribou in the United States, has been further divided into caribou management units. These units include all seasonally important habitat and provide more localized information on the distribution of caribou habitat within the recovery zone. FWS is attempting to get individual management plans developed for each caribou management unit to assist in long-term planning for protecting and improving these habitat.

Habitat Management Guidelines: The cooperating agencies have developed caribou habitat management guidelines, and the Forest Service is using them to design timber sales in caribou habitat. These guidelines attempt to minimize the effects of logging on caribou and can also be used to develop silvicultural standards that may enhance the caribou habitat over the long term. Although the development of these guidelines began in the 1970s, they have been revised over time and were used to develop the most recent forest plans for the two national forests located within the recovery zone (the Colville and the Idaho Panhandle National Forests). The cooperating agencies have recognized the need to update the guidelines again to take into account the results of more recent research (see our discussion of the habitat suitability index model below).

Efforts to Protect Habitats in British Columbia: The Ministry of Environment, Lands and Parks and the Ministry of Forests have undertaken efforts to protect caribou habitat in the British Columbia portion of the recovery zone. These efforts include planning timber harvests to minimize their impact on caribou habitat, establishing a land-use planning process that resulted in guidelines for the retention of

Appendix III
Examples of the Recovery Program's Tasks
and Accomplishments

an old-growth forest in a high-priority caribou habitat, and protecting additional caribou habitat in a recently established provincial park and wildlife management area. The Ministry of Environment, Lands and Parks is also developing a comprehensive mountain caribou management strategy for British Columbia. This strategy will address the viability of, threats to, and habitat conditions needed for maintaining all populations of caribou in British Columbia, including the southern Selkirk population.

Research: A substantial amount of research has been completed on various aspects of woodland caribou ecology. According to FWS, the results of this research have helped tailor recovery efforts to the specific needs of the species. For example, the National Ecology Research Center conducted a series of research projects that focused primarily on issues related to the mountain caribou's early winter habitat and diet. Early winter habitat is believed to be the most critical seasonal habitat for caribou because they begin a major shift in their diet during the onset of early winter, as plants age and early snows decrease the availability and ease of harvesting plants. The National Ecology Research Center effort also included research on caribou genetics, late winter caribou foraging ecology, and the ecotype response and habitat use of transplanted caribou. These projects included field studies and resulted in the publication of numerous peer-reviewed reports and articles. The reports that resulted from this research effort are summarized in appendix I. Other completed research on caribou has addressed the population characteristics, seasonal habitat use and food habitat of the resident southern Selkirk caribou population, as well as the seasonal habitat use of transplanted caribou. British Columbia has also invested extensively in research on the characteristics of other mountain caribou herds in the province.

Habitat Suitability Index Model: Information gained from tracking transplanted and resident caribou, as well as research on their use of seasonal habitat, has been used to draft a habitat suitability index model. This model can be used to rate the suitability of caribou habitat during a given season by taking into account such variables as elevation, slope, type of tree cover, percentage of forest canopy closure, and the age of the uppermost canopy of the forest. According to FWS, the model will be used to revise the agency's habitat management guidelines and will allow for more accurate and predictable timber management in the recovery zone.

Caribou Census Technique: The Idaho Department of Fish and Game has developed a technique that is used to estimate the number of caribou in the southern Selkirk Mountains, even though some caribou are not fitted

Appendix III
Examples of the Recovery Program's Tasks
and Accomplishments

with radio collars. The census has two phases. In the first phase, a fixed-wing aircraft survey is performed to determine the distribution of caribou from tracks made in the snow or animal sightings. In the second phase, a helicopter census is taken to count and classify the caribou. The census, which has been performed since 1991, provides the most accurate available accounting of the overall caribou population. The census is conducted in the winter (Feb.-Apr.) when caribou are at higher elevations and in open-canopy forests.

Information and Education: To better inform the public about the endangered southern Selkirk Mountains caribou and gain support for recovery efforts, the recovery plans called for various information and education efforts. For example, the Idaho Department of Fish and Game sponsored an "Adopt-a-Caribou" program that allowed school children to name and monitor the location of transplanted caribou. The Washington Department of Fish and Wildlife has also developed an Internet Web site that provides general information on the southern Selkirk caribou and the progress of Washington's augmentation efforts. It also includes a "Track-a-Caribou" feature that provides middle and high school students with opportunities to monitor the movements of transplanted caribou and the success of the recovery program. Other informational and educational efforts include a slide series and video describing caribou ecology and management, newspaper and magazine articles, and presentations in local communities to children and adults. The International Mountain Caribou Technical Committee also serves as a forum for disseminating information on the caribou.

Law Enforcement: Law enforcement efforts conducted by U.S., state, and Canadian agencies have included the distribution of identification cards and pamphlets to hunters so that they will be better able to identify and not accidentally kill caribou. Other efforts have included discussing caribou identification, natural history, and management with hunters, as well as placing signs in caribou habitat warning hunters that caribou may be present. In addition, patrols to enforce a ban on the use of snowmobiles in caribou habitat have been instituted to protect caribou. Enforcement efforts focusing on illegal caribou mortality have also led to the successful prosecution of some offenders.

Comments From the Department of the Interior

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D.C. 20240
April 14, 1999

Mr. Barry T. Hill
Associate Director, Energy, Resources,
And Science Issues
U.S. General Accounting Office
441 G Street, N.W.
Washington, D.C. 20548

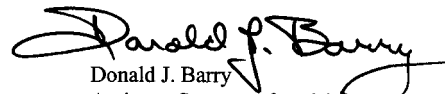
Dear Mr. Hill:

The Department of the Interior has received and reviewed the U.S. General Accounting Office draft report entitled, "ENDANGERED SPECIES: Caribou Recovery Program Has Achieved Modest Gains," GAO/RCED-99-102. We are pleased to note that many of the comments and changes offered previously for your consideration were included in the report, and we are in general agreement with your findings.

We have one specific editorial comment to offer affecting pages (e.g., pages 10 and 30) referencing the National Biological Service. A number of organizations (or portions of organizations) were merged to form the National Biological *Survey* in 1993. This organization was renamed the National Biological *Service* in 1995 and was subsequently merged into the U.S. Geological Survey in 1996.

Thank you for the opportunity to review and comment on the draft report.

Sincerely,


Donald J. Barry
Assistant Secretary for Fish
And Wildlife and Parks

Now on pp. 11 and 34.
See comment 1.

GAO Comments

The following are GAO's comments on the Department of the Interior's letter dated April 14, 1999.

1. We revised the report as suggested.

Comments From the Department of Agriculture's Forest Service



United States
Department of
Agriculture

Forest
Service

Washington
Office

14th & Independence SW
P. O. Box 96090
Washington, DC 20090-6090

File Code: 1440

Date: APR 12 1999

Barry T. Hill, Associate Director
Resource, Community, and Economic Development Division
General Accounting Office
Washington, D. C. 20548

Dear Mr. Hill:

We have completed our review of the General Accounting Office (GAO) Official Draft Audit Report entitled "*Endangered Species Caribou Recovery Program Has Achieved Modest Gains*," Report No. GAO/RCED-99-102, issued March 1999. We concur with the audit report as written.

If you have additional questions or concerns, please contact Linda Washington, External Audit Liaison on (202) 205-1784.

VINCETTE L. GOERL
Chief Financial Officer
Deputy Chief, Office of Finance

Comments From the British Columbia Ministry of Environment, Lands and Parks

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



April 8, 1999

Barry T. Hill
Associate Director, Energy, Resources, and Science Issues
United States General Accounting Office
Washington, DC 20548
USA

Dear Barry Hill:

Thank-you for the copy of the draft report entitled "Endangered Species: Caribou Recovery Program Has Achieved Modest Gains" for review and comment by the BC Ministry of Environment, Lands and Parks.

The report is a good overview of the South Selkirk caribou recovery program, and generally we do not have any significant concerns with the content of the report. However it is discouraging that the report indicates \$4.7 million has been spent on caribou recovery in the South Selkirks, with only modest gains. It is also disturbing that the recovery program has resulted in relatively minor land-use restrictions for protecting caribou, although as noted in the report, some restrictions have been placed on timber harvesting and a small portion of the caribou habitat has been closed to snowmobiling.



Our only significant concern with the report relates to the statement (p. 17, second para.) "According to FWS, a mortality rate of 57 percent would not be considered excessive, especially for these types of animals." It is not clear how to interpret this mortality rate. In general, we consider annual adult mortality rates in excess of 15% as being high. Recent estimates of adult mortality (from radio-collared animals) suggest that the annual mortality rate is much higher than this. Identifying and addressing the cause of this high mortality remains a very important issue for ensuring long-term recovery of the South Selkirk caribou herd.

The BC Ministry of Environment, Lands and Parks supports the following priorities for caribou recovery in the South Selkirks:

1. ensure commitment to maintain funding for future recovery tasks;
2. produce a consolidated map of caribou habitat (for BC, Idaho and Washington);
3. establish agreements for zoning and protection of critical winter habitats;
4. minimize recreational disturbance within those habitats;
5. proceed with caribou/cougar mortality study, including an action plan to deal with identified cougars killing caribou;
6. expand I&E programs to obtain public support for caribou recovery.

.../2

Ministry of
Environment,
Lands and Parks

Wildlife Branch

Mailing Address:
PO Box 9374 Stn Prov Govt
Victoria BC V8W 9M4

Location:
2975 Jutland Road
Victoria, B.C.

See comment 1.

Now on p. 19.
See comment 2.

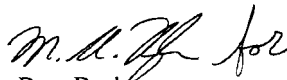
See comment 3.

Appendix VI
Comments From the British Columbia
Ministry of Environment, Lands and Parks

See comment 4.

A major issue for BC has and continues to be the availability of caribou for transplant to the South Selkirk caribou population. A recent caribou survey conducted in the North Cariboo Mountains and Hart Ranges indicated low calf recruitment and lower than desired numbers of caribou. This area has provided most of the recent transplant animals to the South Selkirks. We are currently reviewing the population status of other mountain caribou sub-populations in BC to determine if any of these could sustain a loss of caribou for transplants. Any future transplants from BC will also depend upon a clear signal on definite resolve from the United States to recover the southern Selkirks caribou population.

Yours truly,



Doug Dryden
Director

GAO Comments

The following are GAO's comments on the Ministry of Environment, Lands and Parks' letter dated April 8, 1999.

1. We included the Ministry of Environment, Lands and Parks' concerns about the modest gains of the caribou recovery program in the Agency Comments section of the report.
2. Our reference to 57-percent caribou mortality refers to the percentage of caribou transplanted to the southern Selkirks (59 of 103) that are known to have died. We added the Ministry's view that annual adult mortality rates in excess of 15 percent are high, its statement that recent estimates of adult mortality suggest that the annual mortality rate is higher than this, and its concern about the need to identify and address the cause of this high mortality.
3. We added the Ministry's priorities for caribou recovery in the southern Selkirk Mountains to the report.
4. We included the issues that the Ministry raised about the availability of caribou for transplant to the United States in the report.

Comments From the Washington Department of Fish and Wildlife

Note: GAO comments supplementing those in the report text appear at the end of this appendix.



State of Washington
DEPARTMENT OF FISH AND WILDLIFE

Mailing Address: 600 Capitol Way N • Olympia, WA 98501-1091 • (360) 902-2200, TDD (360) 902-2207
Main Office Location: Natural Resources Building • 1111 Washington Street SE • Olympia, WA

Mr. Barry T. Hill
Associate Director
Energy, Resources, and Science Issues
General Accounting Office
Washington, D.C. 20548

Dear Mr. Hill:

Thank you for the opportunity to provide additional review of the draft report entitled *Endangered Species: Caribou Recovery Program Has Achieved Modest Gains (GAO/RCED-99-102)*.

The report is a good summary of the caribou recovery efforts to date and accurately reflects Washington's expenditures for caribou recovery. We have a few comments that we feel would improve the report:

1. **Page 4** - The first paragraph is confusing in the jump in the discussion from woodland caribou to mountain caribou. Between the first and second sentence, we recommend adding a sentence or two from page 48 of the appendix which clarifies the distinction between the mountain and northern ecotypes.

2. **Page 16** - The map of the caribou release sites is confusing and difficult to read and does not show the locations of the release sites. If the source of the map is from the October 1998 Washington Department of Fish and Wildlife report *Mountain Caribou Recovery in the Southern Selkirk Mountains of Washington, Idaho, and British Columbia* (p.37), it is missing the three numbered release sites shown in the report. It would also need the addition of the Idaho release site. This may already be taken care of if you are planning on using the maps we produced for the report at Will Garber's request.

3. **Page 21** - The reference to the "action plan" in the first paragraph may need to be changed to "emergency action plan". This should be confirmed by the Caribou Steering Committee.

Thank you for the opportunity to comment.

Sincerely,

Handwritten signature of Steve Pozzanghera in black ink.

Steve Pozzanghera
Assistant Director
Wildlife Management Program

SP:hc

See comment 1.

Now on p. 18.
See comment 2.

Now on p. 23.
See comment 3.

GAO Comments

The following are GAO's comments on Washington Department of Fish and Wildlife's letter received April 7, 1999.

1. We revised the report to include information on the two ecotypes of woodland caribou.
2. The map of caribou release sites has been revised and now includes all four release sites.
3. We revised the report to note the title of the action plan.

Major Contributors to This Report

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