Date May 14, 1999

TO: Regional Director, R-6, USFWS

FROM: Grizzly Bear Recovery Coordinator

RE: Finding on the 5 issues from the Grizzly Bear Recovery Plan remanded by the court for further consideration

Judge Paul Friedman of the United States District Court for the District of Columbia remanded 5 issues to the Fish and Wildlife Service (Service) for further consideration on September 25, 1995. This office reconsidered these 5 issues in a document released for public comment in late 1997. Public comments were sought on this reconsideration (called the Further Information document attached and incorporated) by mailing it to interested parties and by placing a notice of availability in the Federal Register. Seven written comments were received on the Further Information document. This office has reviewed these comments and in this memo responds to the concerns raised in these comments and provides a finding and conclusion on these 5 remanded issues.

I. Summary of the Court Decision and the Further Information Document

In September 1993 the Fish and Wildlife Service approved a revision of the Grizzly Bear Recovery Plan. The Plan was originally approved in January 1982. In May 1994 The Fund For Animals and 22 other organizations and individuals filed suit in the U.S. District Court for the District of Columbia over the adequacy of the Plan. Later in May 1994 the National Audubon Society and 19 other organizations and individuals also filed suit in the same court. The two cases were eventually consolidated. In September 1995 the court issued an opinion. The motions for summary judgment of both the plaintiffs and the defendants were granted in part and denied in part. The court ordered the Service to reconsider certain portions of the Plan and to provide supplemental information. The court made the following statements it its decision regarding issues that should be further considered by the Service;

1. The FWS has not explained how minimum bear population and grizzly distribution goals consider how much habitat and of what quality is necessary for recovery or how the answers to these questions can be derived from the females with cubs and occupancy criteria. (Court decision at p. 24.)
Defendants have not met their burden to develop objective measurable criteria by which to assess present or threatened destruction, modification, or curtailment of the grizzly bear s habitat or range. (Court decision at p. 25.)
2. By wholly failing to consider whether there is a need or an appropriate means of monitoring whether disease is a threat to the grizzly bear, the FWS has failed to meet its obligation under the ESA. (Court decision at p. 25.)
3. Defendants have not explained, however, how the human-caused mortality criterion addresses the threat caused by grizzly predation on livestock (Court decision at p. 26.)

4. ...the FWS has failed to meet its obligation under the ESA to incorporate into the GBRP objective, measurable criteria addressing genetic isolation. (Court decision at p. 27.)
5. Accordingly, the FWS must reconsider the available evidence and its decision to adopt the population monitoring methodology that it has incorporated into the GBRP. (Court decision at p. 29.)
6. Therefor, the FWS must explain whether reliance on the existence of Canadian bears influenced its population targets and why such reliance is reasonable. (Court decision at p. 31.)

In response to these findings by the Court, the following resulted (referenced by the numbers of the court findings listed above):

1. In response to the habitat criteria necessary for a recovered population, as part of the settlement agreement between the parties of the GBRP lawsuit on November 15, 1996, the Service agreed to:

a.) Hold a workshop on habitat for grizzly bear recovery to allow non-IGBC scientists to present their views and ideas on the grizzly bear s habitat-based recovery needs. This workshop was held on June 17, 1997.

b.) Consider comments received at the habitat workshop and received during the public comment period on the habitat criteria before the habitat criteria are finalized, and to address in writing significant comments received when the criteria are finalized.

c.) Prior to publishing any proposed rule to delist any grizzly bear population, the Service will establish habitat-based recovery criteria for that ecosystem in accordance with the processes outlined in items a. and b. (above). In any such rulemaking to change status, the Service will address the 5 factors in Section 4(a)(1) of the ESA, and prior to publishing any rulemaking, the Service will assess whether any threat is posed to that population by any of the 5 factors in Section 4(a)(1).

2. - 6. In response to statements 2. through 6. (above), the Service agreed to provide further information on the issues of disease, mortalities relating to livestock interactions, genetic isolation effects monitoring, population monitoring methods, and reliance on Canada. This information was provided by the Service in the Further Information document released for public comment on August 29, 1997.

II. Summary of the Further Information document released for comment by the Service on August 29, 1997.

The Further Information document included the supplemental information that the

Service was to provide and the results of its reconsideration. The issues covered in the further information document and a summary of each are as follows:

Disease and parasites - There was detailed monitoring ongoing relating to disease by having all dead bears examined in the Wildlife Laboratories of either Montana Fish, Wildlife and Parks Department in Bozeman or the Wyoming Game and Fish Department in Laramie. Furthermore, there was no evidence of any chronic or widespread disease found in any of the bear examined to date, nor was disease a factor in the original listing of the grizzly bear in 1975.

Livestock interactions and mortality - All grizzly bears that die as a result of conflicts with livestock are counted as human caused mortalities and become part of the human caused mortality limit. Grizzly bear mortality or removal related to livestock conflicts has always been counted as a human-caused mortality and calculated in the recovery criteria.

The affects of genetic isolation - Since the Grizzly Bear Recovery Plan was finalized in 1993, new methods and information have become available due to the rapidly evolving scientific work on bear genetics. Given this new information it seems appropriate to incorporate that new scientific information into the recovery plan. This approach will be a proactive strategy for assuring that there is no significant loss of genetic diversity in the isolated grizzly bear populations in the conterminous United States, and continued baseline monitoring of all populations and those contiguous populations in Canada. Isolation of the Yellowstone population makes this the population of most concern because it is the only isolated population, other than the North Cascades (where no data are currently available). Given that the data on population fitness indicates that current levels of genetic diversity are adequate, but concern that an ongoing loss below current levels could lead to detrimental conditions, maintenance of the existing levels of diversity is desirable. A new section on monitoring of genetic diversity change over time was proposed for the Recovery Plan with a specific protocol for monitoring genetic diversity change and for responding with management action if there is a significant loss of diversity.

Population monitoring methods - The 1993 Grizzly Bear Recovery Plan proposed the use of three parameters to assess the status of a grizzly population. These three parameters were unduplicated counts of females with cubs of the year, the number of human-caused bear mortalities, both the total number and the number of those killed by humans that were females, and the distribution of family groups of grizzly bears. These three parameters were chosen in lieu of any other applicable methods available at the time the recovery plan was written in the late 1980s and early 1990s.

One of the methods identified in the 1993 Recovery Plan, sightings of a minimum number of animals sighted each year, was suggested by McCullough (1983) after a review of the best ways to assess the status of the Yellowstone grizzly population. Knight and Eberhardt (1985) built on McCullough s suggestion and used sightings of females to project population status in the Yellowstone grizzly population. These studies were fundamental to the development of monitoring an minimum number of females with cubs in the Recovery Plan by using unduplicated sightings of only the most easily

recognized and differentiated age cohort (Knight, et al. 1995), females with cubs of the year. The methods in the Recovery Plan were the best methods available to assess population status at that time and were in fact based on the recommended method proposed by McCullough (1983).

The target of occupancy by females with young is designed to demonstrate adequate distribution of the reproductive cohort within the recovery zone. Adequate distribution of family groups indicates future occupancy of these areas because grizzly bear offspring, especially female offspring, tend to occupy habitat within or near the home range of their mother after weaning. The distribution parameter is important to assure that the bears are distributed across the recovery zone. Without this parameter, the target of females with cubs could be met in a small area of the recovery zone in an area of food concentration with no bears living in other areas inside the zone.

Human-caused mortality is the third parameter monitored according to the 1993 Recovery Plan. Human-caused mortality must be monitored so it can be managed within sustainable levels. The goal of the Recovery Plan is zero human-caused mortalities, while the limit on human-caused mortalities is 4% of the minimum population size as calculated using the number of unduplicated females with cubs. The limit of 4% human-caused mortality in the 1993 Recovery Plan is based on the work of Harris (1986) who demonstrated that a 6% human-caused mortality rate resulted in a stable population. The 4% known mortality rate was used to account for an unknown, unreported rate of 33% (for every 2 bears we know are killed there is one bear that is killed that is unknown).

The Further Information document detailed newer population monitoring methods that have been refined since the Recovery Plan was published. Methods to monitor grizzly bear populations have increased in variety and approach since the Recovery Plan was written in the late 1980s and revised in the early 1990s. Using the Yellowstone ecosystem as an example, the Further Information document compared the application of newer methods to the results from the monitoring parameters and target values for these monitoring parameters used in the Recovery Plan. The Recovery Plan monitoring parameters have been met or are very close to being met in Yellowstone since 1992. The newer monitoring methods show that during the same period the Yellowstone population was increasing. The use of these newer methods confirms that the Recovery Plan monitoring methods are conservative and provide an accurate and sound way to monitor the status of a grizzly bear population.

Thus, after reconsideration of the population monitoring and recovery criteria in the Recovery Plan, the Further Information document concluded that these criteria are adequate objective and measurable criteria, and that the selection of the population monitoring and recovery criteria in the Recovery Plan were based on logical interpretations of data and published information. These methods were the best available at the time the Plan was written, and their use was reasonable and biologically sound.

Reliance on Canada - Four grizzly bear populations span the international border with Canada. The Northern Continental Divide, Cabinet-Yaak, and Selkirk ecosystems are

extensions of contiguous grizzly bear populations in British Columbia. The North Cascades recovery area may be isolated from other grizzly bear populations in British Columbia. Population targets for the Selkirk and Cabinet-Yaak ecosystems relied on the fact that these populations were adjacent to Canadian grizzly bear populations. These targets were based on: (1) the maximum density of grizzly bears that could live in the available habitat each ecosystem on the US side of the contiguous population; and (2) the fact that the US side of the border was only a subset of a larger, contiguous population that ranged far to the north in Canada. The presence of contiguous US-Canada grizzly bear populations is the foundation of pursuit of recovery of the species in the Selkirk and Cabinet-Yaak ecosystems. The US portion of these contiguous populations is not sufficient in area or extent to maintain a viable population in and of itself. Recovery of the species in these ecosystems in isolation from Canada would likely not be possible given limited available habitat. If there were no grizzly bears and/or no assurance of continued contiguous populations with Canada in the Selkirk and Cabinet-Yaak ecosystems, the population targets for these ecosystems would have been different and, in fact, the very idea of recovery in these areas might have been questioned due to the limited habitat on the US side. However, grizzly bears do exist as contiguous populations in both ecosystems and ongoing efforts in both countries help to assure the existence of these contiguous populations. The Service determined that, given the history of positive cooperation and increasing coordination with British Columbia and Alberta, sufficient evidence exists to justify as biologically sound the reliance on Canada grizzly bear populations and management programs in setting the population targets for the Selkirk and Cabinet-Yaak ecosystems.

III. Comments received on the grizzly bear further information document and the Service response to the issues raised by the commentors.

Seven written comments were received from the public on the Further Information document. The main concerns raised in relation to each of the five issues for further consideration or information are listed below along with the Service response to each comment.

_____

DISEASE AND PARASITES

ISSUE: Concerns about the effect of disease and parasites on grizzly bears -

Comment: Only one comment addressed this section by stating In addition to actually having a disease, a species may be threatened by a disease that affects an important element of its ecosystem . The specific example addressed was that of whitebark pine and the blister rust that has been affecting the species. Whitebark pine nuts are an important food source for grizzly bears in the Yellowstone recovery zone. The comment further suggested that the recovery plan be amended to take account of this threat to

an important food source for Yellowstone s grizzlies .

Response: Bears utilize whitebark pine nuts as a significant food source in several areas including Yellowstone. The Conservation Strategy that is developed for each recovery zone will identify major food sources and monitoring techniques of those food sources. In the Yellowstone example these major food groups will include whitebark pine, ungulates, and cutthroat trout. Major food items identified for monitoring in other recovery zones may be different. By monitoring these significant food items FWS can determine the extent to which disease may ultimately affect bear populations that depend on these foods.

RELIANCE ON CANADA

Four major issues relating to Reliance on Canada were identified through analysis of the comments received. These were: size of grizzly bear populations along the international border and contiguity of these populations with Canada, grizzly bear habitat protection along the international border, legal protection of bears in Canada, and sustainability of Canadian hunting quotas.

U.S. Population connection to Canada.

Comment: Three comments stated that there was little evidence of population contiguity across the international border, especially with regard to the Selkirk and Cabinet-Yaak recovery zones and therefore small, isolated populations require special management.

Population Size along the International Border

Available estimates of grizzly bear populations along the Canadian border with U.S. grizzly bear recovery zones come largely from the British Columbia Grizzly Bear Conservation Strategy (BCMELP 1995). Populations were estimated on the basis management units. Two management units adjoin each of the Selkirk and Cabinet-Yaak recovery zones. Population estimates for these management units total about 50 bears north of the Selkirks and 25 bears north of the Cabinet-Yaak. Four population management units border the Northern Continental Divide recovery zone. Two occur in British Columbia and two occur in Alberta. British Columbia estimates there are 155 grizzly bears directly north of the Northern Continental Divide and Alberta estimates there are 45 individuals in their management units (Nagy and Gunson 1990, Simpson et al. 1995). These management units are bordered on the north by additional management units populated by grizzly bears that extend north through British Columbia into the Yukon and Alaska. These estimates were based on habitat capability and are the only large scale estimates (management unit) available. Grizzly bear

populations in the North Cascades of central Washington extend into British Columbia approximately 75 miles. Populations north of the border may be in the range of 15-20 animals (Gyug 1997). Populations south of the border are unknown, but are likely less than 20 individuals.

Smaller study area density estimates have been made for a few areas adjoining U.S. populations. Research results from the Selkirk recovery zone report population densities of 1 bear per 16.6 square miles north of the international border and 1 bear per 27.4 square miles south of the border (Wielgus et al. 1994). No research density estimates are available for the Canadian area north of the Cabinet-Yaak. Research results from the North Fork of the Flathead River in Canada report population densities of at least 1 bear per 8.5 square miles (McLellan 1989). Minimum population estimation through methods involving DNA collection is underway at several locations in Canada, but results from those studies are not yet available.

Contiguity with Canadian Grizzly Bear Populations

Capture and radio collaring of bears in the area of the international border within the Northern Continental Divide grizzly bear recovery zone has been ongoing since the late 1970's. Many of these studies have been based in the North Fork of the Flathead River west of Glacier National Park in the U.S. and Canada. Jonkel (1982) reported home ranges of 8 male and 6 female grizzly bears collared and monitored in the North Fork of the Flathead River from 1976 to 1979. Eight had home ranges solely within the U.S., 3 had home ranges solely in British Columbia, and 2 had home ranges that overlapped the international boundary. McLellan (pers. comm. 1999) monitored 110 grizzly bears in the North Fork of the Flathead River from 1978 to 1998. At least 71 of these animals were monitored crossing the international border. Thirty-five animals were not known to cross the international border and 4 were not monitored for sufficient time to determine any home ranges.

Ten of 20 bears (50%) captured south of the international boundary in the Yaak study area of northwest Montana and northern Idaho were monitored crossing into Canada between 1987 and 1998 (Kasworm and Servheen 1995, Wakkinen and Kasworm 1999) No bears were captured during limited trapping efforts in British Columbia. Four of these animals were adult males that spent portions of spring breeding season in Canada during various years between 1987 and 1998. One of these males was observed courting an adult female whose home range occurs largely in Canada, but was captured in the U.S. Another adult female whose home range occurs largely in the U.S. was observed in association with 2 different adult males in Canada and subsequently produced a litter of cubs. Furthermore, 2 adult males (tag 134 and 128) originally captured in the U.S. were monitored up to 20 miles north of the border and north of the Moyie River in the Purcell Mountains during breeding season of 1987 and 1992 (10% of all captured bears).

Forty-four grizzly bears were captured and collared from 1983 to 1998 in both the Canadian and U.S. portion of the Selkirk recovery zone (Wakkinen and Johnson 1997, Wakkinen and Kasworm 1999). Eighteen of those 44 bears (41%) had portions of their home ranges in both the U.S. and Canada. Four marked bears (9%) have made significant moves outside the recovery zone. Two of these bears moved west of the recovery zone. One was an adult male (tag 1049) that denned west of the Salmo River in British Columbia during 1989. In 1995 a subadult male (tag 1023) moved west of the Pend Oreille River in Washington. Three of these bears have moved east of the recovery zone into the Canadian Purcell Mountains just north of the Cabinet-Yaak recovery zone. In 1994 an adult male (tag 13) was captured at a livestock depredation site in the Canadian portion of the Selkirk recovery zone and relocated about 20 miles north within the recovery zone. Later in 1994 the same bear was killed east of Kootenay Lake in the Purcell Mountains. In 1996 a subadult male (tag 1022) that was originally captured in the U.S. portion of the recovery zone was killed east of Kootenay Lake in the Purcell Mountains. In 1998 another subadult male (tag 1023) that was captured in the U.S. portion of the Selkirk recovery zone was killed on the east side of the Purcell Mountains. This was the same animal that moved west of the recovery zone in 1995. All of these animals were identified by ear tags remaining from original captures inside the recovery zone.

Monitoring of grizzly bears in the Selkirk and Cabinet-Yaak recovery zones has shown movement and mingling of approximately 7-10% of marked animals from each recovery zone in the Purcell Mountains of southern British Columbia east of Kootenay Lake and northwest of the Moyie River. This area is about 20-50 miles north of the juncture of the state boundaries of Idaho and Montana and the international border with Canada. Movements were documented on repeated occasions even with small sample sizes. These percentages of marked animals must be viewed as minimum numbers. Knowledge of these movements was obtained because the ear-tags were recovered at the time of death. Other bears originally tagged in the Selkirk or Yaak study areas may be present in the southern Purcell Mountains, but have not been detected. They must be captured or killed and reported to determine presence of ear tags. Research and associated marking of animals has occurred within the recovery zones and can therefore document movements out of the recovery zones. Documenting movements from the Purcell Mountains into either recovery zone could only be accomplished by marking animals in the former area. However, the fact that movements have been observed out of recovery zones, where bear population densities are likely lower, suggests that movements into the recovery zones are likely. These monitoring results and observations support population connectivity among the Selkirk and Cabinet-Yaak recovery zones and Canadian populations north and west of the Moyie River and east of Kootenay Lake. Habitat in the Purcell Mountains is continuous north from the international boundary for at least 150 miles before reaching the Trans-Canada Highway near Revelstoke, British Columbia. The Purcell Mountains are bounded on the west by Kootenay Lake and the community of Nelson and to the east by the Kootenay

and Columbia River valleys with the communities of Cranbrook and Kimberly. The west side is also bounded by highways 95 and 93 and associated developments from the international boundary 150 miles north to the junction with Trans-Canada Highway 1 near Golden. British Columbia population estimates for this area range from 446 to 577, depending upon the amount of area included northwest of Kootenay Lake (Simpson et al. 1995).

Evidence of bears moving across the international border in the North Cascades is not currently available. No native grizzly bears have been collared and monitored to determine movements, but genetic research in British Columbia is ongoing. Grizzly bear populations in the North Cascades of central Washington extend into British Columbia approximately 75 miles but appear isolated from other grizzly bear populations by at least 50 miles because of human habitation and development (Gyug 1997). Much of the international border is protected by North Cascades National Park and the Pasayten Wilderness in the U.S. and Manning and Cathedral Parks in Canada, which will protect opportunities for bears to cross the international border in this area for the future when populations are larger.

Though movement data does not necessarily indicate population connectivity through interbreeding, FWS believes it is a good indication of such activity. Mitochondrial DNA analysis of grizzly bears in the U.S. and Canada placed bears in the same interbreeding group or clade from the Yellowstone, Northern Continental Divide, Cabinet-Yaak, Selkirk, West Slope of the Canadian Rockies and East Slope of the Canadian Rockies study areas (Waits et al. 1998). This research indicates population connectivity in the recent past. Genetic monitoring will allow further assessment of this issue in the future (see proposed supplement to the recovery plan regarding genetic monitoring).

Grizzly Bear Habitat Protection in Canada along the international border.

Comment: One comment stated that grizzly bear habitat along the international border was being destroyed.

Response: Forestry, mining, recreation, and road building also affect grizzly bear habitat in British Columbia. In 1995 the British Columbia provincial government developed a grizzly bear conservation strategy (BCMELP 1995). The strategy's mandate is to ensure the continued existence of grizzly bears and their habitats for future generations. The strategy has four goals:

1. To maintain in perpetuity the heterozygosity and abundance of grizzly bears and the ecosystems.
2. To improve the management of grizzly bears and their interactions with humans.
3. To increase public knowledge of grizzly bears and their management.

4. To increase international cooperation in management and research of grizzly bears.

A major goal of the British Columbia Grizzly Bear Conservation Strategy is to ensure effective, enhanced protection and management of habitat through land use planning processes, new protected areas, and the Forest Practices Code. Many of these processes are ongoing, and have not had the opportunity to achieve the stated goals of grizzly bear habitat protection.

Canadian coordination and cooperation has been strengthened through participation in the (US) Interagency Grizzly Bear Committee composed of state and federal branches of government with jurisdiction over management of grizzly bears and their habitat. The Service has a scientific representative on the British Columbia Grizzly Bear Scientific Advisory Committee, which will make recommendations directly to the Minister of Environment concerning grizzly bear policy and management. This committee is composed of government and independent grizzly bear scientists from Canada and a scientific representative from the United States (USFWS Grizzly Bear Recovery Coordinator) who review all aspects of grizzly bear management and research policy in British Columbia. The committee was recently critical of the government of British Columbia regarding commitment and timely implementation of the Grizzly Bear Conservation Strategy (BCGBSAC 1998). In the 1998 report card issued by the committee, 18 grades were given: 1 A, 2 Bs, 5 Cs, 4 Ds, and 6 Fs. Grades of A and B were for international liaison, bear viewing, and education. Most habitat protection grades were Fs and the key area of funding was an F. Two major criticisms were that no Grizzly Bear Management Areas have been established to ensure benchmark, linkage and core areas are delineated and that the Identified Wildlife Management Strategy has not been implemented to protect critical habitats of grizzly bear under the Forest Practices Code . The provincial ministry has responded to these criticisms and has recently released the Identified Wildlife Management Strategy as part of the Forest Practices Code (BCMELP 1998a).

The Forest Practices Code was recently updated with specific prescriptions for grizzly bear habitat under the Identified Wildlife Management Strategy (FPC 1999). It should be noted that these prescriptions have not yet been applied because they are new (February 1999) and will require monitoring to determine their effectiveness in protecting grizzly bear habitat on crown lands. However it is useful to examine what is proposed to be protected under this body of regulation. Wildlife habitat areas (WHA) will be established based on grizzly bear population and habitat objectives consistent with the Grizzly Bear Conservation Strategy. These WHAs will fall into two categories: security and foraging. Security WHAs are intended to maintain ecological integrity of critical habitat patches and to insure security of the bears using these patches. Foraging WHAs attempt to compensate for habitat alienation, degradation, or loss of important areas in landscape units by maintaining habitat values in other areas. They may also be established to maintain security, thermal cover, or linkage among important habitats. Priority for WHA establishment will be in districts adjoining U.S. grizzly bear

habitat along the international boundary. These are areas where the British Columbia government has identified the conservation status of these populations as threatened. This designation should not be confused with the U.S. designation as threatened under the Endangered Species Act, rather it is a provincial method for identifying populations that may be threatened with decline. Specific objectives for security WHAs include no road or trail building and no forestry practices unless they are designed to restore or enhance degraded habitat. Specific objectives for foraging WHAs include timber harvest without roading, deactivation of non-permanent roads after harvest, practices other than clearcutting to maintain cover, and practices that stimulate regrowth of forage species for bears.

Other recent additions to the Forest Practices Code include recommendations for higher level planning at the level of grizzly bear population units which are currently being delineated (FPC 1999). These recommendations are not mandatory and may be modified based on: the capability of the land to support grizzly bears, current condition or effectiveness of the habitat, status of the grizzly bear population, and other resource objectives. Some recommendations made include: minimize open road densities to 0.6 kilometer per square kilometer of habitat, deactivate and revegetate temporary roads, consider closing access in sub-basins of important grizzly bear valleys for 50 years after timber management, and scheduling forestry activities to avoid displacing bears from preferred habitat during periods of seasonal use. If these recommendations are implemented, they could represent a step toward significant habitat protection measures for grizzly bears in British Columbia.

The Protected Area Strategy seeks to enlarge the area of the province set aside in parks and protected areas from 7 percent to 12 percent by the year 2000. Protected areas include national parks, provincial parks, and other designations that are quite similar to the U.S. designation wilderness. British Columbia has increased the amount of area in protected areas from 6.8 percent of the province in 1990 to 10.6 percent of the province in 1997 and appears to be in reach of their goal of 12 percent by the year 2000 (BCMELP 1998b). The goal of 12 percent protected areas has been applied to the entire province and there are some regions within the province that may have more or less than the goal. The province was divided into 11 ecoprovinces and 112 subunits known as ecosections. The ecoprovince just north of the Selkirk, Cabinet-Yaak, and Northern Continental Divide recovery zones is referenced as the Southern Interior Mountains. The percentage of protected areas in this region has increased from 11.3 percent in 1990 to 16.1 percent in 1997.

Habitat protection in British Columbia is not controlled by the U.S. Endangered Species Act and Canada has no similar legislation. The British Columbia Grizzly Bear Conservation Strategy is an important step toward grizzly bear conservation. The U.S. recovery effort will continue to monitor and make recommendations regarding grizzly bear conservation strategies within British Columbia. However, until proposed habitat protection strategies are implemented, the Service has no means of evaluating their effectiveness.

Legal protection of grizzly bears in Canada.

Comment: One comment was received that stated that bear populations in Canada have little legal protection .

Response: Grizzly bear populations in Canada are estimated to be near 25,000 individuals with 10,000 to 13,000 occurring in British Columbia (BCMELP 1995). Canada does not have an endangered species act as occurs in the U.S., but has made population status reviews for grizzly bears by categories of risk (Banci et al. 1994). This designation is composed of 6 categories listed with increasing risk: not at risk, vulnerable, threatened, endangered, extirpated, and extinct. Grizzly bears in the border area north of the Northern Continental Divide are not at risk while populations north of the Selkirks, Cabinet-Yaak, and North Cascades are currently considered threatened. Threatened is defined as: Any indigenous species that is likely to become endangered in Canada if the factors affecting its vulnerability are not reversed. Furthermore, endangered is defined as: Any indigenous species that is threatened with imminent extinction or extirpation throughout all or a significant portion of its range in Canada, owing to human action.

At the provincial level, British Columbia has designated grizzly bears as a blue listed species. The blue list includes vulnerable taxa that are of special concern because of characteristics that make them particularly sensitive to human activities or natural events. It also includes species that are generally suspected of being vulnerable, but for which information is too limited to allow designation in another category.

Grizzly bears are hunted in portions of British Columbia and Alberta. Hunting has occurred in the British Columbia portion of several recovery zones in the past. British Columbia closed the hunting season in the Selkirk grizzly bear recovery area in 1995, thereby reducing the potential for human-caused mortalities. There has not been a hunting season for grizzly bears directly north of the Cabinet-Yaak or North Cascades recovery zones since the 1970s. Hunting north of the Northern Continental Divide recovery zone is a regulated permit hunt in both British Columbia and Alberta. Both provinces set hunting quotas to harvest no more than 4 percent of the estimated population (Nagy and Gunson 1990, Simpson et al. 1995). Hunting regulation and policy include: Cubs, females with cubs, and yearlings (up to two years of age) are protected; Baiting is not permitted; Hunting is prohibited in all national parks, ecological reserves, and some provincial parks; All grizzly bears killed by hunters or in conflict situations must be inspected by a wildlife official within 10 days to determine sex, size, and age. Two British Columbia residents were recently fined a record $13,500 each for grizzly bear hunting out of season.

The trade in bear parts, particularly gall bladders and paws has seriously impacted

Asian bear populations and parts cannot easily be distinguished from parts of bears killed in North America. Because of this, and increasing evidence of poaching for parts, British Columbia banned possession, trafficking, importation, and export of bear gall bladders and genitalia separated from the carcass or hide. Other Canadian provinces have joined in this ban including Alberta, Manitoba, Ontario, and Yukon. A first offense under the Wildlife Act regulation carries a maximum penalty of $5,000 and/or six months in jail, per infraction. The fine increases to $10,000 for subsequent offenses.

Sustainability of Alberta and British Columbia hunting quotas.

Comment: One comment was received that questions Alberta s grizzly bear management plan goals which emphasizes reduction of total man caused mortality to no more than 6 percent and still increasing the provincial grizzly bear population by 25 percent. The commentor indicated that 6 percent was still excessive and that unreported mortality would push actual mortality rates to an unsustainable level.

Response: The Alberta grizzly bear management plan (Nagy and Gunson 1990) states that provincial populations will be increased to 1000 individuals and that harvest will be restricted to 2 percent of bear management unit populations to allow this growth. Once goals are attained, harvest rate could be 4 percent, but all human caused mortality must be accounted such that total mortality does not exceed 6 percent in a specific bear management unit. By doing so, this management plan recognizes the need to allow for nonhunting and unreported mortality in establishing hunter harvest. Furthermore the plan calls for population and habitat inventory as priorities for bear management units in southern Alberta near the international boundary.

Hunting mortality management in British Columbia and Alberta has been based upon allowable percentages of the population that can be removed without causing a decline. Various population modeling techniques have been used to estimate this percent. Harris (1985) recommended a total man-caused mortality rate of 6.5 percent in modeling the Northern Continental Divide population with the U.S. Miller (1990) estimated that a grizzly bear population could sustain a hunting mortality rate of 5.7 percent. Both of these modeling exercises partitioned and accounted for natural mortality before making estimates of remaining human caused mortality that the population could withstand. Hunting is only one component of human caused mortality. Vehicle collisions, defense of life or property, poaching, and management removals are examples of other sources of human caused mortality. These mortalities are not always documented, but have been estimated. Nagy and Gunson (1990) reported non-hunting unreported losses at about 32 percent of the annual hunter harvest in Alberta from 1972-1987. More recently an analysis radio telemetry information from 13 study areas Alberta, British Columbia, Montana, Idaho, and Washington between 1975 and 1997 reported that in jurisdictions where hunting was allowed, managers were aware of 67-83

percent of the human caused mortalities or that unreported mortality represented 20-49 percent of known human caused mortality (McLellan et al., 1999). This research indicates that for ten known man-caused mortality there would be and additional two to five unreported mortalities. The British Columbia grizzly bear conservation strategy states that the maximum harvest level should be 4 percent of the total population, including kills from all sources. The unreported kill is assumed to be 50 percent of the legal kill unless documentation indicates other wise. The strategy also states that hunting seasons are not permitted in management units that support 25 or fewer grizzly bears.

_____

_____

ISSUE: Monitoring the numbers of grizzly bears killed in interactions with domestic livestock -

None of the comments received addressed this issue.

_____

ISSUE: The need to monitor changes in genetic diversity within and between populations -

Two commentors raised concerns about the monitoring of genetic diversity. These comments are paraphrased as follows:

Comment: One commentor raised questions on the contiguous nature of the Selkirk, Cabinet/Yaak and NCDE populations with Canadian populations, with resulting genetic interchange between US and Canadian populations.
Response: Refer to the contiguousness with Canada section for a response.

Comment: One commentor raised concerns about the statement in the Further Information document that it may be possible for a population to loose as much as 30% of its genetic variability before a loss can be statistically proven.
Response: The proposed supplement to the Grizzly Bear Recovery plan on genetic monitoring requires simulations of genetic heterozygosity changes per generation using data from ongoing sampling. If such simulations indicate that the 16 loci being examined are not sufficiently sensitive to simulated genetic changes, then the number of loci and the number of samples examined will be increased thereby increasing the power of the monitoring effort and decreasing the variance in the results.

Comment: One commentor was concerned that genetic monitoring would not continue after delisting the Yellowstone population.

Response: The Yellowstone Conservation Strategy, which is the management plan to be followed by all agencies after delisting, if it does occur, requires continued monitoring of genetic diversity using the same methods in the genetic monitoring section that will be added to the recovery plan.

Comment: One commentor raised the issue that the monitoring of genetic diversity does not set a specific recovery level for genetic diversity.
Response: The Further Information document details why it is not scientifically possible to set a level of genetic diversity that is related to a recovered or healthy population. The wide range of genetic diversity that exists in wild grizzly bear populations, many of which are healthy such as that on Kodiak Island, show there is no set level of diversity that is necessary for a healthy population. Instead, the Service proposes a system that will not allow reduction of genetic diversity below existing levels. There is no evidence that the current level of diversity is detrimental to any grizzly population and the commentor provided none.

Comment: One commentor was concerned that any augmentation of any population is evidence of a population that is not recovered. The commentor also made the statement that the Further Response assumes it would be legitimate under the law to de-list a species that requires the introduction of outside animals in order to survive .
Response: There are examples of augmentation of wild large mammal populations such as bighorn sheep and game bird populations for genetic diversity enhancement as well as demographic benefits. These animals were not listed under the Endangered Species Act (ESA) when such augmentation was done. The maintenance of genetic diversity through regular interchange of wild animals between isolated populations is a consideration of wildlife management agencies when they manage for healthy populations. Thus, the possibility of augmentation to maintain genetic diversity for the Yellowstone grizzly bears does not make this population unrecoverable under the ESA any more than augmentation of a bighorn sheep population makes that sheep population endangered or threatened under the ESA. There is nothing in the available scientific evidence that indicates that augmentation would be necessary for grizzly population to survive , the term used by the commentor. Augmentation would only be used if a significant measurable decline in genetic diversity was documented. This is a proactive management effort to maintain diversity at or above existing levels and would be done to prevent any detrimental effects should such effects exist. There is no evidence that a decline in diversity would have any effect that would cause the population not to survive . Such augmentation is a realistic and proactive management technique used on many wildlife populations to minimize possible declines in genetic diversity and as such is a benefit to populations not a detriment.

Comment: One commentor brought up the issue that the existing populations are all limited in size and that effects of genetic diversity loss could be exacerbated by small population size.

Response: The Service agrees and that is why the Service has supported the completion of a Population Viability Analysis (PVA) on grizzly bear populations with emphasis on the Yellowstone population (Boyce 1995, Boyce et al. 1999a) so as to better understand the demographic and genetic issues relating to the probability of survival of grizzly bears south of Canada. This PVA analysis showed that existing populations south of Canada have greater than a 95% probability of persistence to a 500 year time horizon given what we know about demographic parameters. The existing genetic data on the effects of the present level of genetic variability or the possible rates of change in such variability over time do not permit us to predict how genetics will influence these predicted probabilities of persistence. However, given that the proposed genetic variability monitoring system will allow us to see if there is a decline in genetic variability over time and will also allow us to proactively respond to any such changes. This will allow us to be responsive to any genetic influences on persistence so as to minimize or eliminate detrimental effects.

Comment: One commentor thought that although DNA based measurements are a useful tool for gaining understanding about genetic diversity, that other measures such as morphometrics, cub mortality, litter size, etc, should also be used to serve as further information on genetic variation.
Response: We agree and in fact all these factors are reported and quantified by ongoing research and monitoring on grizzly bears, and they will be compared with the ongoing and simultaneous genetic diversity monitoring via the 16 loci.

Comment: One commentor thought that the allozymes work done in the 1980s should be continued and compared to judge changes in diversity over time.
Response: The allozyme work done in the 1980s was never published that we are aware of. There is little genetic diversity reflected in allozyme data in comparison to microsatellite DNA data. Given the small samples available in the 1980s, allozyme data and the minimal diversity reflected in such samples, we believe there would be minimal gain in pursuing such and analysis, but we will consider it as a side possibility when the microsatellite DNA monitoring program gets underway as well as any other new applicable genetic techniques.

Issue: The Use of the Population Monitoring Methodologies in the Recovery Plan to Estimate Population Status

Three commentors raised concerns about the use of the monitoring methods in the Recovery plan and the possible use of other monitoring methods as discussed in the Further Information document. These comments were grouped into the concerns addressed below.

Comment: One commentor thought that the number of females with cubs of the year sightings have been too small, and uncertainty about detectability too large for the past decade of data to provide evidence that there has been an increase in the number of females with cubs.
Response: The commentor presented no analysis supporting his assertion that sample size was too small or that detectability was uncertain so it is difficult to respond in detail to this statement. In fact, the recovery plan makes no statement about the proportion of females with cubs seen and the minimum population estimate derived from the Recovery Plan method does not rely on such knowledge. The Recovery Plan relies on a minimum population estimate based on unduplicated sightings of females with cubs and a rigorous elimination of any and all possible duplicate sightings as per Knight et al. (1995). The Recovery Plan makes the implicit statement on p. 20 that the minimum counts of females with cubs cannot be used to estimate a rate of change or increase or decrease in the number of females with cubs. The Recovery Plan method does not try to do what the commentor says it cannot do, so in that regard, we agree.

Comment: One commentor raised concerns about the unknown unreported mortality rate and that the 2:1 ratio of known:unknown human-caused mortality in the Recovery Plan was not accurate.
Response: Increases in the sample size of radio-collared grizzly bears since 1993 now allow an analysis of this issue. This analysis can be done because sample sizes of radio-collared bears are now available to more accurately estimate this ratio. In light of these new data, the Service will be recalculating the known:unknown human-caused mortality ratio using these new data and revising the Recovery Plan if this new calculation is different from the 2:1 ratio used in the Plan. If the known:unknown ratio is different from the 2:1 ratio in the Plan in any ecosystem, this will also require a revision of the mortality limit calculations for that ecosystem which are tiered to this known:unknown ratio.

Comment: One commentor raised concerns that some females may be counted twice in the development of the unduplicated count of females with cubs, thus overestimating the number of females in the population.
Response: While it could be possible to count one female twice, it is unlikely due to the rigorous review of each sighing that is done by the agency personnel involved in each yearly count. Any two females that are thought to be the same are only counted once. For example, if there are two sightings of females both with two cubs in the same general area (usually within 10 miles of each other) and there is no way to be sure they were not two animals (i.e. one of the two females was a radio-collared bears) then only one of the sightings is counted. The objective of this method is to have a minimum unduplicated count by being rigorous in excluding any possible duplicate sightings. We agree with the commentor that it is not always possible to distinguish all females with cubs when they are unmarked. The only way to sure that all females are distinguishable is to capture and radio-collar all adult females in the ecosystems. This

is an intrusive and disruptive method and one that caries risk of mortality and disturbance to the adult female population. Capturing all the adult females in all the ecosystem would also cost several million dollars, far beyond the means of the agencies. The unduplicated count method is a non-intrusive method that yields a minimum number and the Service makes every effort to minimize duplication and is confident that the population number resulting from this method is indeed a minimum. Since the commentor proposes no alternative method to the method used by the Service in the Recovery Plan, and since with the above-mentioned protocols the Service believes the method is sound, we will not change this method.

Comment: One commentor raised concerns that increased effort will yield more sightings, and that this could be used to mistakenly infer that the population has increased.
Response: The Service specifically states that the use of unduplicated sightings of females with cubs should not be used to indicate trends in the population and that any attempt to use this parameter to indicate trends or precise population size would be an invalid us of these data Recovery Plan p. 20. We agree with the commentor that such inferences about population trend should not be made with unduplicated sightings of females with cubs.

Comment: One commentor was concerned that the potential use of mark-resight methods depending on sightings of radio-collared bears from aircraft could not be easily applied throughout an entire ecosystem other than Yellowstone because the necessary assumption that these other ecosystems are closed systems.
Response: We agree that the assumption about a closed system cannot be met in ecosystems other than Yellowstone and would not propose to use mark-resight systems using radio-collared bears and aircraft sightings in areas other than Yellowstone.

Comment: One commentor raised concerns about the maximum likelihood estimator (MLE) relating to what percentage of the population needs to be seen for it to reliable stating that it is not possible to see 75% of the population by looking for females with cubs.
Response: The comment is irrelevant because the commentor wrongly believes that the population referred to in the 75% statement is the total population. It is the adult female population with cubs that requires sighting, not the total population.
Comment: One commentor took issue with the interpretation by Eberhardt (1995) that the use of bears trapped only in research efforts was truly representative of the population status and trend. The result according to the commentor, was an overly optimistic and biased estimate of population growth.
Response: The commentor infers that use of only research trapped bears leaves out s significant number of bears. This is not true. Eberhardt's research-trapped bears includes most of the bears. Only those bears that were first captured as management bears are eliminated from the sample, and this is a small proportion of the total

population. Indeed, we have estimated this to be between 2 and 3%, therefore any possible bias will be very small. It is not true that Eberhardt ignored those bears "lost" to the management-trapped segment of the population. If a bear was first caught as a research bear, it was retained for survival analysis even if it later became a management bear. Again, the bias is very small, not substantial as this commentor claims and this small number of bears does not significantly change in the population trend calculated by Eberhardt.

Comment: One commentor took issue with the analysis of population trend by Boyce (1995) for the same reason as stated above- the use of only bears initially trapped in research actions.
Response: Boyce explicitly uses only those bears that we initially radio collared as research bears, but many of those bears eventually become management bears and they are retained in the analysis. The bias is substantially less than 2% of the sample and this is why both Boyce (1995) and Eberhardt (1995) were comfortable ignoring such an effect.

Comment: One commentor raised concerns about the changes in population growth rate that occur when different time periods are used for the calculation, and that it is potentially ,misleading to present λ calculated only for 1986-1996.
Response: It is true that growth rates change when calculated over different time periods. It is also true that growth rates change in response to management actions that limit human-caused mortality and increase bears survival and resulting number so cubs born by females that live to adulthood. Given that management efforts change over time as agencies become more responsive to bear-human conflicts and resulting bear mortality, the population change in the most recent time period is most indicative of how the population is responding to current management efforts, and that historic trajectories have little relevance to the current situation for any population. We agree that presenting growth rates is most indicative of population status when averaged over the most recent interval. The approach the Service is taking in the Yellowstone Conservation Strategy is to calculate population growth using the most recent 10 years of data and to continually update estimate of population trajectory using such annual updates.

Comment: One commentor raised concerns about the use of the MLE estimator because of the heterogeneity of sightings of females with cubs among years is too high and that the consideration of heterogeneity was minimized. The commentor also states This (MLE method) does not allow for major intervening effects due to differences among years in search effort by humans or sightability of females with cubs of the year.
Response: This commentor does not understand the reason that the cumulative counts method is so powerful. It is powerful because the detectability among years can vary without any consequence to the population estimates. The Boyce et al. (1999b) paper the commentor refers to that was summarized in the 1997 Further Information

document has since been revised extensively with particular emphasis on the heterogeneity issue. This paper has been submitted for publication and the revision addresses the concerns raised by this commentor. The commentor is incorrect in the statement that "This does not allow for major intervening effects due to differences among years in search effort by humans or sightability of females with COY." This is exactly why the cumulative counts method was developed - because it eliminates these effects.

Comment: One commentor raised the possibility that a new paper submitted for publication by Craig Pease and David Mattson contains information which could be used to calculate the level of heterogeneity in sightings of females with cubs based on the types of habitats where bears could be expected to be sighted.
Response: The Service believes that the heterogeneity issue and its relevance to interpretations of estimates using the MLE method is being resolved through scientific peer review on the new Boyce et al. (1999b) manuscript, and that this will address concerns about the calculation of sighting probabilities for application of the MLE method. In an effort to better understand sighting probability based on habitat use, the Service has contracted for a statistical analysis modeling of the probability of sighting various age and sex classes of bears. This analysis will be used to further evaluate the application of mark-resight methods to estimate population size. The Pease and Mattson paper does not reveal the high levels of heterogeneity suggested by the commentor.

Comment: One commentor raised concerns about the variations in sightability between years due to different habitat use and was concerned that these differences in sightability may influence the outcome of the MLE method. In an effort to make his point about changes in habitat use and sightability between years, the same commentor said: In 1986, no females with cubs were first seen on moths sites, whereas by 1992 fully 2/3 (66%) of all unique sightings of females with cubs were seen on moth sites.
Response: The revised Boyce et al. (1999b) manuscript addresses the heterogeneity of sighting between years and demonstrates that this variation does not invalidate the estimates obtained with MLE. The Service is satisfied that the issue of variation in sightings due to variations in detectability related to changes in habitat use between years will be addressed through the scientific peer review process on the revised Boyce et al. (1999b) manuscript. The commentor is wrong in his statements about numbers of females with cubs first seen on moth sites. In point of fact, in 1986, 1 of 25 (4%) sightings was on a moth site while in 1992, 5 of 25 (20%) were initially seen on moth sites (IGBST 1998). This is not even close to what was claimed by this commentor and the origins of his numbers are unknown.

Comment: Two commentors were concerned about the uncertainty of the results in the MLE when used to estimate population size. The concerns were most due to the heterogeneity in sightings and its effect on the MLE outcome. There was also concern

about the mortality level and that a 4% known mortality rate was unsustainable due to his belief that the known:unknown mortality ratio of 2:1 for all recovery areas is arbitrary . One commentor stated that the best current information suggests that less than of all mortality is known.

Response: The range of variation in sighting probabilities and the effects of this range on the outcome of the MLE estimator is dealt with in detail in the revised MLE manuscript of Boyce et al. (1999b) The Service believes this minimizes uncertainty in the MLE results and therefor the risk in applying the method.

In response to the issue about uncertainty about the known:unknown mortality ratio, we repeat the following that was previously presented concerning this issue: Increases in the sample size of radio-collared grizzly bears since 1993 now allow an analysis of this issue. This analysis can be done because sample sizes of radio-collared bears are now available to more accurately estimate this ratio. In light of these new data, the Service will be recalculating the known:unknown human-caused mortality ratio using these new data and revising the Recovery Plan if this new calculation is different from the 2:1 ratio used in the Plan. If the known:unknown ratio is different from the 2:1 ratio in the Plan in any ecosystem, this will also require a revision of the mortality limit calculations for that ecosystem which are tiered to this known:unknown ratio.

Comment: One commentor suggested that there needs to be a link between the population parameters in the recovery plan and the probability that the population will exist for some specified time into the future. This commentor also said that the estimates of probability of extinction and population trend presented by Boyce (19950) were biased high and should not be used in this link.

Response: The Service supported and facilitated the population viability analysis (PVA) of Dr. Mark Boyce (Boyce 1995, Boyce et al. 1999a). A PVA entails an evaluation of the likelihood of long-term persistence by a population (Boyce 1995, p. 5). Beyond this PVA, the Service has engaged Dr. Boyce in efforts to link habitats to demographics in a habitat-based PVA effort. This effort is currently ongoing and the results should be available in late 1999. The results of Boyce s 1995 PVA show that the probability of persistence for the Yellowstone population is greater than 95% even out to a 500 year time period (Boyce 1995, p. 25). This analysis was based on demographic data not linked implicitly to the Recovery Plan parameters. The Recovery plan parameters, a minimum number of females with cubs seen, family groups well-distributed throughout the ecosystem, and limits on the number of total and female human-caused mortalities, are indices of population health. Adherence to these parameters has yielded the population that we have today in Yellowstone that is increasing (Eberhardt 1995, Boyce 1995) and has a long-term probability of existence (Boyce 1995, Boyce et al.1999a). The service is commented to continually update PVA estimates and to apply the best available information to estimate probabilities of persistence.

Comment: One commentor was concerned about the use of the von Bertalanffy method to treat sightings of females with cubs, and pointed out several problem associated with

this method.
Response: The Service agrees that this method has too many problems to be used and consideration of the von Bertalanffy method has been eliminated in favor of the MLE method as detailed in Boyce et al. (1999b).

Comment: One commentor was concerned that as the density of females with cubs per unit area increases, it may become increasingly difficult to eliminate duplicate sightings.
Response: If that was the case, it would probably result in the elimination of more actual females due to possible overlaps between two family groups. This would result in an even more conservative estimate as many real females with cubs would not be counted because of possible duplications. In general, there has not been such an increase in density of females with cubs per unit area to cause such a problem in any ecosystem, so this is a possible problem for consideration some time in the future when the grizzly population increased enough to cause such a density problem.

Comment: One commentor was concerned that changes in the way sightings of females with cubs were classified over time would create bias in the results.
Response: We agree. This is why it is so important to continue to be rigorous in reporting and evaluating all sightings and why sightings should only be taken from select and qualified observers. Knight et al. (1995) provide a valuable protocol to continue a high level of rigorous sighting reporting.

Comment: One commentor was concerned that even if the number of females with cubs has increased, this would not necessarily indicate comparable increases in total cubs, in total adult females, or in population size, much less in demographic vigor or population viability. This commentor also stated: Without data on rates of maturation and survival for litters, one could not reliably predict even whether the correlation between number of females with cubs vs population size rate [sic] or viability would be positive or negative, much less strength and steepness of slope for the correlation.
Response: The use of females with cubs is not intended to be used as an estimator of increases in numbers of total adult females nor of total population size as stated by the commentor (see Recovery Plan p. 20 wherein this point is stated). The use of unduplicated sightings of females with cubs is used to estimate the minimum population size, unless a more sophisticated resighting effort is done as per the MLE method, which would yield an estimate of total population size. Neither method is suitable for estimating population trajectory or trend and it is not used this way as per the Recovery Plan.

It could be theoretically possible that many females could loose their litters each year thereby decreasing interbirth interval and increasing the number of females seen with cubs. This could lead to in inference that the minimum population was higher than it actually was. If this happened, the females that repeatedly lost their cubs and bred again would not contribute to population recruitment and this could dampen the rate of population growth or even result in negative growth. If this happened frequently to

numerous adult females, it would increase both the number and proportion of females having cubs seen each year. However, this could only happen for a short time and then the number of females with COY litters would begin to decline because the adult female cohort would not be replenished. Such a situation could not perpetuate for long without a decline in the overall number of females in the population and resulting decline in numbers sighted with cubs. If this scenario were correct, then the survivorship data for cubs should be very low. In fact, Yellowstone cub survivorship is, however, among the highest that has been documented in North American grizzly and brown bear studies. Thus, it seems unlikely that the theoretical possibility conceived of by the commentor is actually happening.

The commentor stresses the importance of demographic data such as rates of maturation and survival for cubs in order to correlate numbers of females with cubs to population size and rates of population growth. In fact, such demographic data are available and have been used by Boyce (1995) and Boyce et al. (1999a) and other to document population trend in relation to numbers of females seen with cubs.

Comment: One commentor stated: USFWS.....appears to interpret alleged changes in the number of females with cubs (i.e. litters) as an indication that reproduction is increasing in the Yellowstone population..... .
Response: The Service does not infer that a change in the number of females with cubs seen is a change in the rate of population growth or an increase in the rate of reproduction. As the Recovery Plan states on p. 20, the numbers of females with cubs seen is indicative of the minimum population size in the area of interest, and it should not be used to estimate population trend or rate changes. Changes in detectability, sightability, and effort can change the number seen independent of population or reproduction rate changes. The Service does not use sightings of females with cubs to infer or indicate that the Yellowstone population is increasing. Awareness of the increase in the Yellowstone population is based on the calculation of population trend or λ using reproductive rate and survivorship data from radio-collared adult females in Yellowstone as reported in Eberhardt (1995), Boyce (1995), and Boyce et al. (1999a).

IV. Finding of the Fish and Wildlife Service (Service) on the 5 issues remanded for further consideration.

After reviewing in detail the points and issues raised by the 7 commentors on the Further Information Document, and upon consideration of appropriate new information available since the Recovery Plan was published in 1993, the Service makes the following conclusions on each of the 5 issues remanded for further consideration by the court:

1. Concerns about the effect of disease and parasites on grizzly bears -
The Service finds that there are currently sufficient and detailed monitoring of disease in

grizzly bears through examination of all dead bears at the Montana Wildlife Laboratory and at the Wyoming Wildlife Laboratory. There is also in place a system to monitor white-pine blister rust occurrence and impact on the whitebark pine community in the Yellowstone ecosystem. If changes in the incidence of white pine blister rust are impacting the production of pine nuts used by bears, this monitoring protocol and annual reporting system would allow the agencies to be aware of it and respond accordingly.

2. The basis and rationale for reliance upon Canada for the health and maintenance of grizzly bear population along the US-Canada border -
The Service finds that there is convincing evidence that reliance on Canada and Canadian management system is sound and reasonable for those populations that exist along the US-Canada border. Canadian management systems are in place and continue to improve in addressing limiting and monitoring human-caused mortality north of the US border. However, recent additions to the Forest Practices Code designed to protect grizzly bear habitat have not been in place for sufficient time to judge their effectiveness. The Service will monitor these habitat protection measures as they are applied. There has been considerable improvement of habitat and population management in Canada as management concerns are responded to by both the Alberta and British Columbia governments. While there is not a law equivalent to the Endangered Species Act in Canada, there has been considerable interest and commitment on the part of the provincial governments to improve management so as to reduce human-caused mortality and improve habitat security. These provinces have demonstrated a commitment to work cooperatively with US management authorities by forming joint US-Canada committees to implement the British Columbia Grizzly Bear Strategy and the Rocky Mountain Grizzly Bear Coordinating Committee. These are evolving efforts and both continue to improve the management of populations and habitats and to coordinate management efforts for grizzlies across the border. The Service will continue to work cooperatively with Canada to assure improvements in management for grizzly bears along both sides of this international border.

3. Monitoring the numbers of grizzly bears killed in interactions with domestic livestock -
The Service has always monitored and reported the numbers of bears killed in interactions with domestic livestock and will continue to do so.

4. Monitoring changes in genetic diversity within and between populations -
The Service finds that new methods to monitor genetic diversity changes have come into existence since the completion of the 1993 Grizzly Bear Recovery Plan. It is useful to apply these methods, as detailed in the Further Information Document, and the Service will append these new methods to the Recovery Plan. This will assure continued monitoring of genetic diversity changes over time and will assure a timely management response to minimize detrimental impacts of decreases in diversity over time.

5. The Use of the Population Monitoring Methodologies in the Recovery Plan to Estimate Population Status -

In the Further Information document, using the Yellowstone ecosystem as an example, the Service compared the application of newer population monitoring methods to monitor population size and trend to the achievement of the target values for the monitoring parameters used in the Recovery Plan. The Recovery Plan monitoring parameters have been met or are very close to being met in Yellowstone since 1992. The newer monitoring methods show that during the same time period, the Yellowstone grizzly bear population has been increasing (Eberhardt and Knight 1996, Eberhardt 1995, Boyce 1995). The Service stated in the Further Information document that newer methods show an increasing population in Yellowstone confirm that the Recovery Plan monitoring methods and targets provide an accurate and sound way to monitor the status of a grizzly bear population and that monitoring of females with cubs can be an indicator of an increasing population if the targets in the Recovery Plan for unduplicated females with cubs and limits on human-caused mortality were met.

Upon reconsidering the available evidence, the Service finds that the fundamental issue regarding the use of the population monitoring methodology in the Grizzly Bear Recovery Plan is not the methods themselves but rather how the data, particularly the data on females with cubs, are gathered and treated.

The Service finds that the way the data on the population monitoring methods in the Recovery Plan are gathered and treated in the Yellowstone Ecosystem is suitable, well organized, and reliable and that due to the organized collection system these data provide a valuable and credible documentation of the status of this population, particularly when combined with new available methods to estimate population trend and total population size. However, the Service also finds that current population data gathering and handling efforts in the NCDE and the Selkrik-Cabinet/Yaak ecosystems are not acceptable and do not provide the level of confidence in these populations as exists for the Yellowstone population.

In the Further Information document, the Service correlated data from the population methods in the Recovery Plan to newer methods estimating population trend and total size. The Service now finds that correlating the positive results from the new monitoring methods to the monitoring parameters and target values used in the Recovery Plan is reasonable for the Yellowstone Ecosystem, but that such a correlation cannot be reasonably made for ecosystems other than the Yellowstone ecosystem. The reason that such a correlation cannot be made in areas outside the Yellowstone ecosystem is that the data on females with cubs are collected in a different manner in Yellowstone than in any other ecosystem. In Yellowstone, there is an existing USGS Interagency Grizzly Bear Study Team (Study Team) which carries out ecosystemwide monitoring of the Recovery Plan parameters as well as applying the newer monitoring methods. This Study Team completes annual observation flights for females with cubs and intensive radio tracking of marked bears and spends approximately $60,000 per year on such aircraft observation and monitoring flights. Between 40 and 50 radio-

collared bears are monitored each year throughout the Yellowstone ecosystem and have been for many years. The Study Team conducts extensive observation flights looking for females with cubs several times each year. These observation flights cover all of the ecosystem including wilderness and national park areas. The combination of an organized study team with a dedicated full-time staff and a large stable budget, ecosystemwide monitoring, annual survey flights, large numbers of radioed bears captured and monitored throughout the ecosystem, and a standardized protocol for handling these data (Knight et al. 1995) makes the females with cubs data in Yellowstone a reliable and dependable source of information on the status of this population. The large amounts of population data gathered by the Yellowstone Study Team also allow the application of the new population monitoring methods to monitor trend and estimate total population size in this ecosystem. In contrast, to the Yellowstone situation, the collection of females with cubs data is not nearly as intense nor is it ecosystemwide in the Northern Continental Divide Ecosystem in northwestern Montana. The collection of females with cubs data in the Selkirk-Cabinet/Yaak ecosystem is somewhat similar to that in Yellowstone with dedicated personnel gathering data ecosystemwide, although the protocol for gathering and handling females with cubs sightings needs to be improved in this ecosystem.

The collection of females with cubs data in ecosystems other than Yellowstone is currently limited by available funding and personnel. In the NCDE, there is no organized ecosystemwide data collection effort nor any budget to do so. Reports of females with cubs are gathered from qualified observers and the few radio collared bears in the ecosystem. There is not sufficient data collected in the NCDE to allow application of the newer methods to calculate population trend and total size. The reason these data are not collected is due to the fact that the collection of such data is beyond the budgets of the agencies. A report prepared for the Interagency Grizzly Bear Committee in 1996 (Servheen et al. 1996; copy attached) details what it would take in terms of effort, budget, and time to collect the data necessary to apply the new methods to calculate population trend and total population size in the NCDE and the Selkirk-Cabinet/Yaak. This report presents in great detail the fact that it would take between $500,000 and $2.4 million to make trend and total size estimates in the NCDE and that continued estimates would require continued data collection costing at least $200,000 annually. There is no budget is available to gather such ecosystemwide data in the NCDE and there is no interagency study team of dedicated personnel to gather such data in this ecosystem.

The Service finds that it is necessary to improve the protocol to collect and handle reports of females with cubs in the NCDE and the Selkirk-Cabinet/Yaak and to continue to research methods to gather data on grizzly populations in a more cost effective manner. The Service also finds that the current level of effort in gathering data on females with cubs for the NCDE and the Selkirk-Cabinet/Yaak is not sufficient to make reliable statements about the status of these populations. The fault is with the effort and protocols that exist for the collection of the data, especially data on females with cubs. It is important to note that the 1996 report (Servheen et al. 1996) on the

application of the newer methods to estimate population size and trend in the NCDE and Selkirk-Cabinet/Yaak ecosystems clearly shows the need to balance precision in estimating population parameters with the cost, and therefor the ability, to measure these parameters. It is not possible to apply these new parameters to these ecosystems because the funds to collect such data are not available. It is also important to note that no alternative population monitoring methods to the methods in the Recovery Plan were suggested by the plaintiffs in the original lawsuit on the Grizzly Bear Recovery Plan nor by the commentors on the Further Information document. The Service remains committed to seeking more reliable and cost effective ways to improve population monitoring in the NCDE and Selkirk-Cabinet/Yaak, and to implement such monitoring advances if and when they become available.

In summary, the Service finds that the use of the 3 population monitoring systems used in the Recovery Plan provide valuable and useful information with which to judge the status of grizzly populations. The use of these 3 monitoring systems will be continued as follows:

1. Regarding the criterion of unduplicated females with cubs, the Service finds that this is a valuable criterion when used properly and under a careful protocol. The use of this criterion should be continued as per the following revisions:

    a. The current methods used to collect data on sightings of females with cubs is not sufficient in the NCDE and Selkirk-Cabinet/Yaak ecosystems to make reliable quantifiable statements about the status of these populations. The fault is with the effort and protocols that exist for the collection of the data, not the method of monitoring females with cubs itself. The Service finds that it is necessary to improve the protocol to collect and handle reports of females with cubs in the NCDE and the Selkirk-Cabinet/Yaak and to continue to research methods to gather data on grizzly populations in a more cost effective manner.

    b. There were concerns raised about the sighting efficiency estimate used for the NCDE and Selkirk-Cabinet/Yaak ecosystems data in the Recovery Plan that the number of females seen with cubs represents 60% of the total number of females with cubs in the NCDE, Selkirk-Cabinet/Yaak (no sightability factor is used in Yellowstone). Given that this sightability percentage is an estimate based on one study area in the NCDE, and that sightability is based on many factors especially the habitats inhabited by bears, the Service finds that it would be prudent to gather further data to improve this sightability estimate in order to improve minimum population estimates in the NCDE and Selkirk-Cabinet/Yaak ecosystems. The Service finds that the existing 60% sightability estimate for the NCDE, Selkirk-Cabinet/Yaak ecosystems should be improved by using any new data on sightability from radioed grizzly bears. The Service will continue to use the existing 60% sightability value in the Recovery Plan in these ecosystems while encouraging and supporting, as budgets allow,

continued research to establish a sightability factor based on the number of radio marked bears seen. Upon recalculation of sightability from sightings of radio-collared bears, this new sightability value and resulting calculations of mortality limits, as necessary, will be appended to the Recovery Plan. Prior to this recalculation of sightability in the NCDE and Selkirk-Cabinet/Yaak ecosystems, the Service will use the existing estimate of 60% sightability as in the Recovery Plan, but no proposal to change status in these ecosystems will be made until this sightability estimate has been recalculated and appended to the Recovery Plan. Since there is no sightability value used in the Yellowstone ecosystem, this sightability issue and limits on statements of population status do not apply to the Yellowstone ecosystem.

c. The court and commentors raised concerns about the effect of sighting effort devoted to finding females with cubs in the estimation of minimum population size. The Service finds no issue here in that the purpose of use of unduplicated number of females with cubs is calculate the minimum population size, and changes in effort will only change this minimum number. The Service finds that much of the confusion about effort is apparently related to the possible misuse of the annual minimum population estimates to estimate change or trend in the population size. The Service has clearly stated in the Recovery Plan that use of this parameter to indicate population trend would be an invalid use of these data. The Service has made every effort to state what the proper and biologically valid use of this criterion is. The misuse of this criterion by some or the fear of misuse despite specific direction by the Service in the Recovery Plan to the contrary should not invalidate this valuable monitoring parameter. The Service reiterates that this parameter is valid and will continue to be used to estimate minimum population size and should not be used to infer trend in a population over time. There is a new technique called a Maximum Likelihood Estimator (MLE) and other similar techniques now available (Boyce et al. 1999b) to use sightings and resightings of unduplicated females with cubs to estimate the total population of females with cubs and then to total population size. This is in contrast with the current estimate of minimum population size available with the current use of unduplicated sightings of females with cubs. This MLE technique and similar techniques using sightings and resightings of females with cubs can be used only where there is an organized research and monitoring effort that collects sighting and resighting data ecosystemwide. Such a research and monitoring system is only available at this time in the Yellowstone ecosystem. The Service realizes that it is illogical to set recovery parameters that cannot be measured due to lack of the resources to implement them. With this in mind, and since this new

technique can be implemented now in Yellowstone only, the Service will append to the Recovery Plan the application of the MLE or similar method to estimate total population size in the Yellowstone ecosystem only upon completion of scientific peer review of this methodology. The results of the application of this MLE method in Yellowstone will be used to estimate total population size, and this total population size will be used to set the sustainable mortality limit in the Yellowstone ecosystem only. As new techniques and efforts become available and are applicable in other ecosystems, these will be reviewed and the Recovery Plan modified in these ecosystems as necessary. The calculation of population trajectory or trend can be accomplished when significant amounts of data on female survivorship and reproductive rate are available on a population. This is the application of the Lotka equation to calculate λ (see Servheen et al. 1996 for a full explanation of the application of this technique to a large ecosystem for grizzly bears). When this method can be applied, it provides additional information on population status and substantiates the validity of attaining the existing population criteria in the Recovery Plan. The application of this technique requires detailed data from a significant number of radio-collared bears. For regular application of this trend estimate, many adult females must annually be captured, handled, radio-collared and radio-tracked. The Service recognizes the usefulness of this technique but also realizes, again, the illogical approach of requiring application of a criterion that cannot be annually applied due to the high cost and intrusiveness of the technique. With this in mind, the Service recommends calculation of λ when it is possible to do so with existing data, and the results should be used to provide further information on the status of the population in addition to the existing recovery criteria. The Service finds value in the application of all additional methods available to further substantiate the status of a population and recommends that all available methods beyond the 3 recovery criteria be used whenever possible to provide as much information as possible on the status of a population.

2. Regarding mortality, it is now possible to calculate the known:unknown human-caused mortality ratio using data from radio-collared bears in all ecosystems. This new information is a result of ongoing research and joint analysis of these new research data. This new information is largely a result of the significant number of new radio-collared grizzly bears monitored since 1993. These new data allow a calculation of the known:unknown ratio for all ecosystems and a revision, if necessary, of the 2:1 known:unknown human-caused mortality ratio estimated in the Recovery Plan. Since these new data are now available, the Service finds that the recalculation of the known:unknown human-caused mortality ratio should be completed for all ecosystems and if the results are different from the 2:1 ratio estimated in the Recovery Plan, that the

ratio should revised and the new ratio appended to the Plan. Any changes in this known:unknown ratio will change the way that the mortality limits are set and this change will also be revised and appended to the Recovery Plan as necessary.

3. Regarding the distribution of family groups across the ecosystems, the Service finds that this method is a valuable indicator of the distribution of reproducing adult females and it should be continued. Inferences about how the distribution of reproducing females indicates habitat sufficiency should be limited, however. It was never the intention of the Service that this parameter be a significant factor in judging the sufficiency of habitat. The Service finds that the monitoring of this criterion be continued and used solely to judge the distribution of reproducing adult female grizzly bears (the most important population age/sex class) across the landscape where grizzly bears are desired.

V. Summary of actions related to the Recovery Plan resulting from this finding.

This finding will result in the following actions related to the Grizzly Bear Recovery Plan:

1. The Service will append additional tasks to the Recovery Plan related to monitoring of changes in genetic diversity within and between populations and a response protocol for actions should significant reduction in genetic diversity be detected.
2. The Service will append a task to the Recovery Plan for the NCDE and Selkirk-Cabinet/Yaak ecosystems to research improved methods to monitor grizzly populations in these ecosystems in a cost effective and credible way.
3. The Service will improve the protocol for collection and handling of sightings of females with cubs in the NCDE and Selkirk-Cabinet/Yaak ecosystems to improve the scientific credibility of population status estimates from such data. The Service finds that it is necessary to improve the protocol to collect and handle reports of females with cubs in the NCDE and the Selkirk-Cabinet/Yaak. The improvements in this protocol will be accomplished with public input and scientific review.
4. The Service, working with agency partners, will recalculate the known:unknown human-caused mortality ratio on all ecosystems using the most recent data from radio collared bears and will revise the existing 2:1 known:unknown ratio that is currently in the Recovery plan as necessary with these results. If this ratio is revised in any ecosystem, it will require a revision in the calculation of sustainable human-caused mortality for that ecosystem and that revision will also be appended to the Recovery Plan as necessary. This recalculation will be accomplished with public input and scientific review.
5. The Service, working with agency partners, will recalculate the sightability estimate for females with cubs in the NCDE and Selkirk-Cabinet/Yaak ecosystems using available data from radio-collared bear as these data become available. Since there is no sightability value used in the Yellowstone ecosystem, this sightability issue and limits on statements of population status do not apply to the Yellowstone ecosystem. Prior to

this recalculation of sightability in the NCDE and Selkirk-Cabinet/Yaak ecosystems, the Service will use the existing estimate of 60% sightability as in the Recovery Plan, but no proposal to change status in these ecosystems will be made until this sightability estimate has been recalculated and appended to the Recovery Plan. This recalculation will be accomplished with public input and scientific review.

6. The Service will append to the Recovery Plan the application of the MLE or similar method to estimate total population size in the Yellowstone ecosystem only. This will be done only after completion of scientific peer review of this methodology. The results of the application of this MLE method in Yellowstone will be used to estimate total population size, and this total population size will be used to set the sustainable mortality limit in the Yellowstone ecosystem only.

7. The Service will monitor and cooperate with Canadian grizzly bear management programs regarding population and habitat management. The Service will evaluate habitat protection measures within the Forest Practices Code and other protective measures as they are implemented. The Service will continue to coordinate habitat protection programs designed to designate and protect important linkages between U.S. and Canadian grizzly bear populations.

Literature Cited

Apps, C. 1997. Identification of grizzly bear linkage zones along the highway 3 corridor of southeast British Columbia and southwest Alberta. WWF Canada.

Banci, V., D.A. Demarchi, and W.R. Archibald. 1994. Evaluation of the population status of grizzly bears in Canada. Int. Conf. Bear Res. And Manage. 9:129-142.

Boyce, M. B. 1995. Population viability for grizzly bears: a critical review. Rept. to the Interagency Grizzly Bear Committee. 79 pp.

Boyce, M. B., B. Blanchard, R. Knight, and C. Servheen. 1999a. Population viability for grizzly bears: a critical review. Ursus Monographs (in press)

Boyce, M. B., D.I. Mackenzie, B. J. Manley, M. A. Haroldson, D. Moody. 1999b. Cumulative counts of unique individuals for estimating population size. (In review)

British Columbia Ministry of Environment, Lands, and Parks. 1995. Conservation of grizzly bears in British Columbia background report. Victoria, B.C. 70 pp.

British Columbia Ministry of Environment, Lands, and Parks. 1998a. Letter to the grizzly bear scientific advisory committee from Minister Cathy McGregor. 6 pp.

British Columbia Ministry of Environment, Lands, and Parks. 1998b. Is British

Columbia s rich ecosystem diversity protected? Victoria, B.C. 18 pp.

British Columbia Grizzly Bear Scientific Committee. 1998. Letter to Minister Cathy McGregor. 8 pp.

Eberhardt, L.L. 1995. Population trend estimates from reproductive and survival data. Pp. 13-19 in R.R. Knight and B.M. Blanchard. Yellowstone Grizzly Bear Investigations, 1994. National Biological Service. Bozeman, MT.

Eberhardt, L.L. and R.R. Knight. 1996. How many grizzlies in Yellowstone. J. Wildl. Manage. 60:416-421.

Forest Practices Code. 1999. Managing identified wildlife: procedures and measures, Volume 1. B.C. Ministry of Forests. Victoria, B.C. 8 pp.

Gyug, L.W. 1998. Assessment of grizzly bear populations, habitat use, and timber harvest mitigation strategies in the North Cascades grizzly bear population unit, British Columbia. B.C. Ministry of Env., Lands, and Parks. Victoria, B.C. 45 pp.

Harris. R.B. 1986. Modeling sustainable harvest rates for grizzly bears. In: Final programmatic environmental impact statement for the grizzly bear in northwestern Montana. 1986. Mont. Dept. Fish, Wildl. And Parks. Helena. 287 pp.

Interagency Grizzly Bear Study Team. 1999. Annual Report - 1998. USGS Bozeman, Montana.

Jonkel, C. 1982. Five year summary report. Border grizzly project. Univ. Of Mont., Missoula. Special report 60. 274 pp.

Kasworm, W.F. and C. Servheen. 1995. Cabinet-Yaak ecosystem grizzly bear and black bear research 1994 research progress report. U.S. Fish and Wildl. Serv., Missoula, Mont. 42 pp.

Kehoe, N.M. 1995. Grizzly bear distribution in the North Fork of the Flathead River valley: a test of the linkage zone prediction model. M.S. Thesis, Univ. Of Mont., Missoula. 55 pp.

Knight, R.R., L.L. Eberhardt. 1985. Population dynamics of Yellowstone grizzly bears. Ecology 66:323-334.

Knight, R.R., B. Blanchard, and L.L. Eberhardt. 1995. Appraising status of the Yellowstone grizzly bear by counting females with cubs-of-the-year. Wildl. Soc. Bull. 23:245-248.

McCullough, D. R. 1983. The Craighead s data on Yellowstone grizzly populations: relevance to current research and management. Int. Conf. Bear res. And manage. 6:21-32.

McLellan, B.N. 1989. Dynamics of a grizzly bear population during a period of industrial resource extraction. I. Density and age-sex composition. Can. J. Zool. 67:1856-1860.

McLellan, B.N., F. W. Hovey, R.D. Mace, J.G. Woods, D.W. Carney, M.L. Gibeau, W.L. Wakkinen, and W.F. Kasworm. 1999. Rates and causes of grizzly bear mortality in the interior mountains of British Columbia, Alberta, Montana, Washington, and Idaho. J. Wildl. Manage. (in press).

Miller, S.D. 1990. Population management of bears in North America. Int. Conf. Bear Res. And Manage. 8:357-373.

Nagy, J.A. and J.R. Gunson. 1990. Management plan for grizzly bears in Alberta. Alberta For., Lands, and Wildl., Edmonton. 164 pp.

Servheen, C., R. Mace, R. Harris, W. Kasworm, W. Wakkinen, B. McLellan, D. Carney, A. Soulkkala, T. Wittinger, J. Waller, F. Hovey, S. Gniadak, K. Kendall, and T. Manley. 1996. Report on methods to determine population size and rate of change for grizzly bears at the ecosystem scale. Report to the Interagency Grizzly Bear Committee. Missoula, Montana 18 pp.

Simpson, K., J. Regnier, and L. Andrusiak. 1995. A grizzly bear management strategy for the Kootenay region. B.C. Ministry of Env., Lands, and Parks. Victoria, B.C. 60 pp.

Waits, L.P., S.L. Talbot, R.H. Ward, and G.F. Shields. 1998. Mitochondrial DNA phylogeography of the North American brown bear and implications for conservation. Cons. Biol. 12:408-417.

Wakkinen, W.L. and B.K. Johnson. 1997. Selkirk ecosystem project. Idaho Dept. Fish and Game, Boise. 47 pp.

Wakkinen, W.L. and W.F. Kasworm. 1999. Demographics, Movements, and Population Trends of Grizzly Bears in the Cabinet-Yaak and Selkirk Ecosystems of British Columbia, Idaho, Montana, and Washington. Presentation at Northwest Section of The Wildlife Society Meeting, Bozeman, Mont.

Wielgus, R.B., and F.L. Bunnell, W.L. Wakkinen, and P.E. Zager. 1994. Population dynamics of Selkirk Mountain grizzly bears. J. Wildl. Manage. 58:266-272.