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Comment On: FWS-R6-ES-2016-0042-0001
Endangered and Threatened Wildlife and Plants: Removing the Greater Yellowstone Ecosystem Population of Grizzly Bears from the Federal List of Endangered and Threatened Wildlife

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Native Ecosystems Council1

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General Comment

See Attached

Attachments

Native Ecosystems Council1

Native Ecosystems Council2

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Public Comments Processing
Attn: Docket # FWS-R6-ES-2016-0042
U.S. Fish and Wildlife Service
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Falls Church, VA 22042-3830

Hello,

Native Ecosystems Council (NEC) and the Alliance for the Wild Rockies (AWR) would like to submit the following comments on the USFWS's proposal to delist the threatened grizzly bear. Along with these comments we have provided "Attachment A" which includes copies of the various reports cited in these comments.

A. The proposed delisting is premature and unsupported by science; the grizzly bear population is not currently stable due to drastic changes in their food resources in the Yellowstone Ecosystem; long-term impacts on the population are unknown at this time, but clearly are troubling; to propose removing Endangered Species Act (ESA) protection for this species at this time clearly threatens their long-term viability and genetic diversity in this ecosystem.

1. The status of the Yellowstone grizzly bear population is controversial.

The current status of the Yellowstone grizzly bear is unclear. In 2012, at the Interagency Grizzly Bear committee meeting, it was reported that a comparison between 2 time periods (1983-2001 and 2002-2011), cub and yearling survival had declined in the last decade; mean litter size and the proportion of females with cubs also declined; the younger age classes have reduced survival this last decade; the annual population growth rate has decreased by about 5% over the last decade; under a more conservative mortality scenario, the population may be stable, with no growth; the population has leveled out across the ecosystem.

More recently, in a peer-reviewed study, Doak and Cutler (2013) reported that the government's data on grizzly bear population levels and trends was suspect; they reported inadequate attention to increasing observation effort and also to the life history characteristics of bears is likely to have substantially influenced past analyses of the populations' trajectory; they concluded that the Yellowstone grizzly bear population has probably increased far less than generally believed, but also that past analyses have been to inaccurate to allow any firm conclusions about the dynamics or status of this population; other problems noted were ignoring senescence in models, and changes in sightability of bears over time, as well as human recognition of new feeding sites. Their results case doubt on the assertion that this population underwent a sharp increase from 1980 to 1995 and has recently stabilized in number, or even continued to increase. They also noted that three trends were almost certain to have negatively impacted grizzly bears, the loss of trout runs, ongoing collapse of whitebark pine, and increasing rural development. Finally, they noted that very little is actually known about past trends of this population; they believed that in a rapidly changing landscape, it is quite likely that the population is now in fact declining. They concluded that more care is needed in making inferences about population trends, especially when these results are being used in a direct policy context.

Doak's study was reported in the Bozeman Daily Chronicle on 6/2/13. In that article, USFWS biologist Chris Servheen said that the government's research was reviewed by outside scientists. This is a concern, however, with some bear experts, such as Dr. David Mattson. He noted in a December, 2015 blog that the data set on grizzly bears in the hands of the Interagency Grizzly Bear Study Team is a monopoly that is withheld from other scientists.

In a recently published paper (Kamath et al. 2015), the grizzly bear study team claimed that the Yellowstone grizzly bear population had increased by 4.5 times (from 100 to 450) since the 1980s. However, bear scientist Dr.

Dave Mattson was quoted in the Chronicle about the same time that the grizzly bear study team's analysis was inconsistent with everything else we know about this population. Mattson said that most people would agree that the bear population has been largely stagnant since the early 2000s. In a blog, Dr. Mattson in December, 2015, he noted that there is something fatally flawed about the research reported in Kamath et al. (2015); their methods were among the most arcane out there and built on a veritable tower of assumptions about genetic, demographic, and sampling processes; the methods and derivative results are pretty far abstracted from any tangible reality; the results defy logic; this analysis warrants skepticism on the basis of first principles and the logical violations outlined above. He noted this type of problem arises when a government agency holds a monopoloy on scientific inquiry; the only way to produce reliable scientific results is to have multiple independent reviews with scientist double-checking each other's work. Also, in an article in the Bozeman Daily Chronicle on 6/25/13, Mattson is quoted as saying that Doak's conclusions were in line with his own conclusions that current estimation methods are "essentially worthless; there is this belief that somehow, through some sort of statistical magic, you can compensate for bias in your field methods; my conclusion is that's just not simply possible."

On November 6, 2015, the Bozeman Daily Chronicle had another article on the grizzly bear population trend, noting that the population estimate had been revised by a 6% reduction (714 down from 757); van Manen of the grizzly bear study team claimed that the long-term trend was still flat to slightly increasing.

Although the current population level is claimed to be 717 bears, this estimate covers a range that could be as low as 642 bears; given the loss of up to 90 bears in 2015 (59 deaths plus unrecorded deaths which could be another 30 bears), the current population estimate could be as low as 552 bears (Thuermer 2015). 600 bears is the lowest number of bears the USFWS would allow after delisting.

B. The inevitable declines in the Yellowstone grizzly bear population that will be triggered by replacing ESA protections for this bear with the proposed Conservation Strategy will exacerbate the current tenuous status of this population due to unraveling of the Greater Yellowstone Ecosystem and the associated permanent increase it is causing in grizzly bear-human conflicts that result in grizzly bear mortality.

1. **The proposed conservation strategy will allow a significant increase in habitat losses for the grizzly bear from logging, losses that will further exacerbate ongoing habitat losses caused from decline in whitbark pine, cutthroat trout, and elk.**

Habitat conditions that currently exist will decline with delisting, and thus affect grizzly bear population trends in a negative manner. The Conservation Strategy will allow an increase in timber harvest in occupied grizzly bear habitat because road densities will not be controlled in most of grizzly bear habitat. Unlimited road densities will promote timber harvest activities, which in the Greater Yellowstone Ecosystem, degrade grizzly bear habitat as well as increase mortality risk. Logging will degrade grizzly bear habitat because red squirrel habitat will be reduced (Holloway and Malcolm 2006). Red squirrels are essential to make whitebark pine nuts available to grizzly bears (Kendall 1981; Reinhart and Mattson 1989). Just protecting whitebark pine stands alone is not effective for maintaining red squirrel populations, because the most dense squirrel populations occur in low and mid-elevation forests, below the whitebark pine zone (Reinhart and Mattson 1989).

Timber harvest in the Northern Continental Divide grizzly bear population, and well as in British Columbia, has been shown to reduce grizzly bear habitat due to avoidance of recently-logged forests (McLellan and Hovey 2001; Waller and Mace undated). Apps et al. (2004) also noted in British Columbia that grizzly bear locations were strongly negatively associated with very young, logged forests. Negative impacts of logging have also been reported for grizzly bears in the Greater Yellowstone Ecosystem in the past, mainly due to the removal of the more heavily used older forest habitats as cover and foraging sites. Blanchard (1983) reported that 90% of aerial radio relocations of grizzly bears were in timber too dense to observe the bear; also the majority of feeding sites were in forest stands at least 3 meters in height. Radio locations and feeding sites indicate the majority of feeding activities and day beds occur in mixed age ands species stands of moderate to dense (26-75%) canopy cover. Although open habitats were also important, these were generally natural openings, not timber harvest areas. Blanchard (1983) thus noted that logging will negatively impact grizzly bears by reducing shelter.

Blanchard's (1983) conclusions on impacts of logging on grizzly bear habitat was followed with similar conclusions from an Interagency Grizzly Bear Study Team. Mattson (1983) evaluated grizzly bear feeding sites in the Yellowstone Area, and reported that a reduction of overmature and mixed-age stands over a broad area in favor of early successional, even-aged immature stands would very likely be detrimental to grizzly bears; average importance scores were much higher for late successional or climax cover types than for early successional cover types. A similar analysis completed by the Interagency Grizzly Bear Study Team in 1991 provided similar results. Mattson and Knight (1991) reported that on a broad scale, habitat value will likely decrease under short-rotation management regimes. They noted that the idea that food availability increases in early stages of forest succession does not generally hold in the Yellowstone area; in most places Yellowstone grizzly bears rely on ungulates and pine seeds for fattening; use of these 2 foods is primarily associated with older forest stands; use of globe huckleberry has also been associated with the semi-shaded and typically patchy conditions of mid- to late-successional stands; conversely, grazed fibrous foods that predictably increases in abundance in the earliest stages of forest succession cannot be efficiently digested by bears and are not critical to the nutrition of most Yellowstone grizzly bears; also foliage in open areas predictably cures sooner than foliage in shaded areas and thus would be effectively available for a shorter period; bears also used natural versus man-made ecotones created from timber harvest. They noted that timber harvest of any type in the whitebark pine and Douglas-fir areas would degrade grizzly bear habitat.

In a later report by the Interagency Grizzly Bear Study Team, Mattson (1997) analyzed more data on grizzly bear habitat use of lodgepole pine forests. He noted use was highly variable, but that there was no conclusion evidence that grizzlies favored young (under 40 years in age) forest stands in general, or their infrequent use of berried; they did favor young open areas that were wet and fertile sites for grazing; he noted that grizzlies used frequently-disturbed sites mostly for travel; use of berries was very low in this ecosystem, with only 15 instances of berry use from 16 years of data; he noted that these results do not support the premise that widespread conversion of lodgepole pine forests to early successional stages would benefit grizzly bears; there is no rational for systematic harvest of older stands to increase bear use of berries; and these results support the proposition that grazing opportunities for bears can be increased by logging on wet sites, although it is highly improbable that grazing opportunities limit grizzly bear densities anywhere in this ecosystem; he noted that removal of lodgepole pine stands that contain whitebark pine would be detrimental to grizzlies. We are providing this summary to demonstrate that logging should not be used as a claimed benefit to bears as an offset of the increased disturbances and mortality risks that will occur.

2. **The Conservation Strategy will allow significant increases in grizzly bear mortality risk over exising levels because unrestricted road access will promote increased logging in grizzly bear recovery habitat, logging which will increase mortality risk**.

Blanchard (1983) concluded that conventional logging negatively affects bears in part due to increases in human activity, which will in turn increase grizzly bear mortality risk. Mattson and Knight (1991) also noted that timber harvest will create an increase in grizzly bear mortality risk in the Greater Yellowstone Ecosystem. They noted that any increased exposure of bears to humans predictably results in a longer-term increase in mortality risk to bears, partly mediated through the process of habituation; under optimal conditions, bears may be able to minimize mortality risk over the short-term despite increased exposure to humans, by avoiding humans as much as possible; however, habituation and associated mortality risks will predictably increase with longer-term equilibration; implementation of short-rotation timber management requires increased access by humans; thus more widespread practice of intensive silviculture in occupied grizzly bear habitat predictably increase mortality risk to the population; this holds whether bears die because poachers are able to use road built to harvest timber, or whether bears that die elsewhere under divers circumstances are at least partially habituated or food-conditioned to humans by exposure around cutting units. They concluded that on the broad scale, mortality risk will likely increase and habitat value will decrease as short-rotation timber management increases in the Yellowstone area; timber harvest should be assumed to have a significant negative affect on the Yellowstone grizzly bear population until proven not to contribute to increased mortality risk or habitat degradation.

Mattson and Knight (1991) noted that designating security areas for grizzly bears during logging activities should include previously-disturbed areas; designating areas that are already providing security does not offer mitigation for increased disturbances due to logging.

3. **The Conservation Strategy will allow highly significant reductions in available habitat for grizzly bears by removal of almost all existing restrictions of open and total roads in grizzly bear habitat.**

The current best science for grizzly bears in northwestern Montana identified the displacement impacts of roads (Mace et al. 1996; Mace and Manley 1993). These reports noted that when open road densities exceed one mile per section, and when total road densities exceed 2 miles per section, grizzly bear use decreases. Based on this science, the Interagency Grizzly Bear Committee Taskforce Report (1998) identified road management as key to conservation of grizzly bears. It has also long been documented that roads in the Yellowstone ecosystem avoid roads (Mattson et al 1987); this displacement is believed to probably result in poorer conditions of adult females, and consequently higher mortality rates and lower fecundity for the cohort. Displacement of grizzly bears from roads, and thus habitat, is well documented in other areas as well (Apps et al. 2004; Chruszcz et al. 2003; Wielgus et al. 2002). Ciarniello et al. (2007) reported that grizzly bear densities in developed landscapes of British Columbia were only about a quarter of what they were in adjacent unroaded areas, even though habitat qualities were better in the former landscapes, indicating and disturbances and associated mortality risks were responsible for the differences in densities.

The Conservation Strategy only limits densities of permanent roads. The distinction between a permanent versus a temporary road is unclear; temporary logging roads could have a much higher traffic level than a permanent road. The Conservation Strategy does not identify specifically why a road being used for logging up to 5-10 years does not displace grizzly bears, or increase mortality risk. The Interagency Grizzly Bear Study Team at one time actually measured the mortality risk of bears in regards to road quality. Mattson and Knight (1991) found that secondary roads had a much high mortality effect on grizzlies than primary roads (see Table 1). As the level of human access in an area increases, so does the mortality risk to grizzly bears in the Yellowstone Ecosystem (Mattson et al. 1992).

4. **The Conservation Strategy will allow unlimited displacement of grizzly bears due to increases in logging activity that will be triggered by removal of road density restrictions upon delisting.**

The Conservation Strategy ignores the displacement impacts of logging on grizzly bears. These displacement effects will reduce habitat available to bears. Blanchard (1983) and Mattson and Knight (1991) noted that logging will displace grizzly bears. Even human recreational activity, nonmotorized, within Yellowstone National Park has been shown to displace grizzly bears. Coleman et al. (2013) evaluated grizzly bear activity within various bear management areas within Yellowstone National Park, and reported that grizzly bears were twice as likely to be within the area when the managements were restricted, or when people were inactive; their study provides evidence humans presence can displace grizzly bears if people are allowed unrestricted access to bear habitat; they noted that management closures are important to protect grizzly bear habitat use. Mattson (1991) used data on grizzly bear habitat use to conclude that 58% of the landscape should provide grizzly bear security, with security areas being a minimum of 5,400 acres in size. This recommendation was based on the need of grizzly bears to be free of human disturbances on a significant portion of their habitat, to avoid both displacement and increased mortality risk. Mattson et al. (1995) noted that providing secure undisturbed habitat is essential for grizzly bear conservation.

5. **The Conservation Strategy will allow highly significant increases in grizzly bear mortality risk due to removal of almost all existing restrictions on road densities.**

Research in the Greater Yellowstone Ecosystem has documented that roads increase grizzly bear mortality risk (Mattson et al. 1992; Schwartz et al. 2010). Road densities in the Primary Conservation Area (PCA) of the Yellowstone Area are currently limited, but will not be limited upon delisting. Open road densities in between secure areas for grizzly bears will not be limited, even though the current best science demonstrates that limits on road densities in these area are essential to ensure protection of grizzly bears (Schwartz et al. 2010). Simply providing some secure areas for grizzly bears will not address the mortality risk created by high open road densities when bears travel between security areas. Id. Other current research in British Columbia (Boulanger and Stenhouse 2014) also noted the problem of increased grizzly bear mortality risk due to roads; they noted that there has to be a threshold road density identified and implemented to ensure population stability for grizzly bears. Kite et al. (2015) also reported on the association between grizzly bear mortality risk and roads.

6. The science is not currently available to measure how logging projects, aside from increased road access, impacts grizzly bear displacement and mortality risk, even though logging is the primary use of occupied grizzly bear habitat outside the Park; limited data indicates that logging also changes the quality of grizzly bear habitat, changes that need to be identified as potentially detrimental to the grizzly bear.

There is currently no science that defines how logging activities affect grizzly bear mortality risk and displacement. With delisting, logging will increase in occupied habitat, both within and outside the PCA. The effects of these impacts on grizzly bears will not be measured, due to a lack of science. It is apparently why the Conservation Strategy does not address the impacts of logging on grizzly bears. The apparent assumption in this Strategy is that a lack of evidence means that there is no impact. Thus the impacts of logging on grizzly bear mortality risk and displacement has not been considered in the Conservation Strategy, so it will also not be considered when grizzly bears are delisted. In the Yellowstone Ecosystem, there are expansive ongoing plans to log grizzly bear habitat, such as for the Greater Red Lodge Project, the Lonesome Wood Project, and Bozeman Watershed Project, the Rendezvous Trails Project, the Millie Fire Salvage Project, and the upcoming North Hebgen logging project. These projects have been planned when the grizzly bear was listed. There will most likely be even more projects planned in occupied habitat following delisting. The impacts of logging activities, and habitat impacts, need to be addressed in the Conservation Strategy.

As with displacement and mortality risks to bears from logging, there is only limited information available as to how logging affects grizzly bear habitat, aside from its severe impact on red squirrels, which are needed to provide whitebark pine nuts to grizzly bears (Kendal 1981, Reinhart and Mattson 1989). Since logging will likely increase with delisting, the government needs to address how habitat changes will affect the population trend of grizzly bears due to increased logging.

7. **The Conservation Strategy does not require implementation of the current best science for grizzly bear security.**

The proposed level of security in the Conservation Strategy is arbitrary, as it suggests that 1998 levels of security are adequate for grizzly bears, without any actual analysis or data. The recommended level of security for the grizzly bear in the Greater Yellowstone Ecosystem is 58% of the landscape in occupied habitat (Mattson 1991). Individual security areas should be at least 3.5 miles wide, and total 5,400 acres in size. This level of security would provide enough secure habitat to allow grizzly bears to use their habitat, without undue exposure to humans. This limited exposure has been demonstrated to be essential to limit the mortality risk of bears (Schwartz et al. 2010; Mattson and Knight 1991; Mattson et al. 1996; McLellan and Shackleton 1988; Boulanger and Stenhouse 2014).

8. **The changing habitat conditions in the Yellowstone Ecosystem are alone causing increased, likely irreversible increases in grizzly bear mortality.**

In 2015, there was a record mortality level for grizzly bears (59 deaths), with another potential for 30 unrecorded deaths. These high deaths are likely due to the deteriorating habitat conditions in Yellowstone due to losses of whitebark pine, trout, and elk declines (Wilcox blog 3/18/16). Elk have been compensating for these losses by eating more meat, including livestock and elk hunter kills. Id. Thus trouble with livestock operators and hunters have increased. Id. The conflicts with hunters was recently addressed in a blog by Louisa Wilcox on 1/2/16, where she noted that bears are readily killed by hunters. In regards to livestock conflicts, the Montana Standard noted on 8/19/15 that more bears venturing out of the Park are eating more livestock, amid a long-term trend in declining livestock-bear conflicts. In addition, Yellowstone bears are moving further out of the Park to take advantage of moth concentrations in high alpine areas (Dave Mattson blog 4/14/16). He provided a map that shows where bears are moving to utilize moths, and these areas are far outside the PCA for the Yellowstone population. He also noted that bear-livestock conflicts have increased in this area due to increased use by bears.

In addition, cubs and yearling grizzly bears are increasing dying because their mothers are being forced to a meat diet with the loss of other key foods as whitebark pine and trout (Dr. Dave Mattson blog 12/17/15); meat-eating is an incredibly hazardous undertaking for any bear, especially those with vulnerable young. This increased mortality rate of these young bears is not going to change, at least any time soon.

These changes in bear use of habitat in the Yellowstone Ecosystem are unlikely to change any time soon, meaning that the increased bear mortality triggered by these changes in habitat use are not going away. These high mortality rates are likely to continue.

9. **The government's claim that grizzly bears have reached the carrying capacity of their habitat in the Yellowstone Ecosystem, and thus can tolerate delisting and hunting, are illogical and not supported by science.**

As was noted in Dr. Dave Mattson blog of 12/17/15, the notion by the government that there is no more room for any more grizzly bears in the Yellowstone Ecosystem is illogical. Grizzlies are living in roughly twice the area they were in during the 1970s; multiple analyses by government and independent scientists alike show that there is ample habitat with natural foods sufficient to support grizzly bears in places where grizzlies have not yet established themselves.

10. **The government's claim that hunting grizzly bears will reduce conflicts with people conflicts with science.**

In an article in the Bozeman Daily Chronicle on 6/25/13, the article noted that rising numbers of bear-human conflicts –such as a mauling last week south of Cody, that sent a man to the hospital with severe facial lacerations – have lent new urgency to calls to allow limited hunting to resume. Dr. Dave Mattson provided a blog on 1/19/16 regarding the claim that hunting will scare grizzlies, where he cited an editorial in the Chronicle as hunting to increase bear fears of humans as justification for delisting. He noted there is little to no empirical evidence to support this contention. He noted that grizzlies are "hard wired" to respond aggressively to threats, perceived or real. This response would increase, not decrease, when bears fear people. On the other hand, with benign encounters with humans, bear can learn to be more tolerant, known as habituation. He also noted that hunting bears would like increase the exposure of younger bears to humans, bears that are notoriously prone to push human boundaries. Social hunting would also disrupt the social order for the bear population, which often results in more cub-killing by males, and with that, unexpected and sometimes problematic population declines. Also, he noted there is little direct evidence that bears become warier with hunting, and certainly no evidence that people become safer. Surprise encounters and food encounters are the driving factors for risk. He noted that unless you kill most bears, you are not going to substantially reduce the chance of surprise encounters, or eliminate the hard-wired tendency of bears to defend themselves or their cubs when surprised. He also notes that essentially, we have been hunting grizzly bears in Yellowstone for decades, due to removals for various conflicts, real or imagined. There is no evidence that these bear removals have increased human safety. Finally, he noted that there would be no hunting in Yellowstone National Park, where many of the bears reside.

11. **The delisting of grizzly bears will greatly reduce their long-term viability by essentially eliminating the connectivity between the Greater Yellowstone and Northern Continental Divide Ecosystems.**

The Conservation Strategy will not protect any grizzly bears from any adverse effects outside the PCA. This means that the likelihood of grizzly bears eventually connecting with the NCDE bears is basically eliminated, even though this is believed to be key to long term viability of the Yellowstone grizzly bear (Dr. Dave Mattson, talk on 3/31/16 in Bozeman, MT). Given the high mortality risks that will be allowed on bears outside the PCA, their long term viability even in these areas is likely doomed. There will be no bears surviving that over time, could expand in the direction of the NCDE.

C.The process for delisting has no logical process; the process is severely fragmented making it impossible for the public to be involved, let alone provide input; the public has not been provided a draft environmental

impact statement which provides a detailed analysis of delisting impacts, including how bears will be managed with hunting, a significant change from management under the ESA.

The delisting process includes a Conservation Strategy that is not yet finalized for the public. This Conservation Strategy to date has no analysis of how delisting will affect grizzly bear mortality rates both inside and outside the PCA. Without this analysis, it is a violation of the NEPA, the NFMA and the ESA. The few standards in the Conservation Strategy are not supported with any science or analysis, nor do they demonstrate how grizzly bears will respond to the purported conservation measures, including restrictions only on "permanent roads." The public has yet to be provided any management plans by the 3 states that intend to hunt grizzly bears. The Conservation Strategy does not address how grizzly bears will survive outside the PCA. It is not clear why 600 bears has been selected as the threshold population level needed for viability. It is not clear why the loss of major food resources in the Park are not causing population declines for bears. The controversy over grizzly bear population trends is not addressed. The failure of the government to obtain outside peer review by other scientists is not addressed. Overall, this Conservation Strategy does not demonstrate that grizzly bears will remain viable after delisting.

A draft environmental impact statement needs to be completed to define specifically how grizzly bears will be managed upon delisting, as is required by the NEPA and the NFMA, since delisting is a major change from current management on public lands. This is necessary so that the public has an opportunity to review all the current best science, and how bear management will proceed, upon delisting, including hunting and management of bears both within and outside the PCA.

1. **The basis for the delineation of the PCA needs to be defined to the public in an environmental impact statement.**

There is no actual rationale provided, based on science, as to why bear management will be based on the PCA, an area that was established over 40 years ago. The government needs to provide the science and hence basis for delineating 2 separate management zones for grizzly bears upon delisting, including how different levels of management will affect the long-term viability of the bear, including in regards to genetic diversity. There are at least 2 critical issues that need to be addressed in the delineation of the PCA. How will this planned failure to protect bears outside the PCA promote connection between the Yellowstone and the Northern Continental Divide bears, and long-term viability. And what data specifically identifies that these are 2 distinct grizzly bear populations, and thus there is no overlap between bears within and outside the PCA, in order to justify different management proposals for what is actually more likely one grizzly bear population. If this is the case, then the failure to protect these bears when they move outside the PCA (for example, to obtain moths) means that the claimed management of bears within the PCA is misleading and doomed to failure.

2. **The ability of the government to provide accurate measurements of the grizzly bear population in occupied habitat of the Greater Yellowstone Ecosystem needs to be demonstrated in an environmental impact statement.**

There is currently significant controversy about the methods the government is using to measure the Yellowstone grizzly bear population (e.g., Doak and Cutler 2013; Mattson comments in newspaper articles and blogs). This controversy is based in part by the government's refusal to provide basic population data and parameters for measurement to the general public, in violation of the NEPA and the Freedom of Information Act (FOIA). The public needs to be provided with full access to the data on which delisting assumptions are being based. And the government also needs to provide a full public disclosure of the controversy in regards to population measurements on the threatened grizzly bear, so that the public has a full understanding of why this controversy exists. This controversy is at the heart of the delisting proposal, and public disclosure of all aspects of why the government has decided to proceed with delisting, based on their science, needs to be provided in an environmental impact statement.

This information is key to delisting, as the government claims that they will maintain the grizzly bear population within the PCA within an established threshold of 600 bears. If they are not able to actually provide valid measures of the grizzly bear population, by using inflated measures, this means that the 600-bear threshold is meaningless.

3. **<u>The impacts of increased logging and reduced requirements for road density controls need to be assessed in an environmental impact statement prior to delisting, so that the public can understand why delisiting will ensure continued viability of the Yellowstone grizzly bear.</u>**

We have noted many different aspects that will increase the mortality risk of grizzly bears, as well as habitat reductions due to displacement, that will negatively impact grizzly bears after delisting. IN order to demonstrate that the agencies have taken the requisite "hard look" required by the NEPA for significant government actions, the USFWS, Forest Service, and state agencies need to provide a complete a detailed analysis of the expected increase in grizzly bear mortality that will be triggered by delisting, and how this increase in mortality and reduction in available habitat will affect the population trend. This analysis also needs to include the cumulative impacts of habitat losses to the grizzly bear due to declines in whitebark pine, trout, and elk in the Yellowstone ecosystem, and how these changes have also added to what may be permanent increases in grizzly bear mortality as bears use more meat resources (increased mortality of cubs and yearlings) and increased human conflicts with livestock. The long-term effects of these changes in food resources appear to be highly significant for the grizzly bear population trend, and these impacts need to be added to the proposed impacts of delisting, including hunting.

4. **<u>The environmental impact statement for delisting the grizzly bear needs to fully disclose that funding for management of bears will be adequate to ensure the Conservation Strategy will be fully implemented in the long term</u>**.

It is not clear with delisting how funding to manage grizzly bears will be ensured. If funding is not ensured, then the Conservation Strategy is nothing more than a desired condition, not a standard. The mechanisms by which funding will be ensured over the long term needs to be fully disclosed to the public, which is part of the "hard look" requirement for the NEPA. If funding is not fully ensured over time, then the government needs to inform the public that there are no assurances that the Conservation Strategy will actually be implemented, including any protection measures for bears, including minimum population thresholds.

Sara Johnson of Native Ecosystems Council (NEC) would like to request a "hard copy" of the revised "draft" Conservation Strategy and draft environmental impact statement when these are released for public review and comment. Mike Garrity of the Alliance for the Wild Rockies (AWR) would be satisfied to receive an electronic copies of these documents.

Regards,

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5

2004

ESTIMATING GRIZZLY BEAR DISTRIBUTION AND ABUNDANCE RELATIVE TO HABITAT AND HUMAN INFLUENCE

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Abstract: Understanding factors that influence and predict grizzly bear (*Ursus arctos*) distribution and abundance is fundamental to their conservation. In southeast British Columbia, Canada, we applied DNA hair-trap sampling (1) to evaluate relationships of grizzly bear detections with landscape variables of habitat and human activity, and (2) to model the spatial distribution and abundance of grizzly bears. During 1996–1998, we sampled grizzly bear occurrence across 5,496 km^2 at sites distributed according to grid cells. We compared 244 combinations of sampling sites and sessions where grizzly bears were detected (determined by nDNA analyses) to 845 site–sessions where they were not. We tested for differences in 30 terrain, vegetation, land cover, and human influence variables at 3 spatial scales. Grizzly bears more often were detected in landscapes of relatively high elevation, steep slope, rugged terrain, and low human access and linear disturbance densities. These landscapes also were comprised of more avalanche chutes, alpine tundra, barren surfaces, burned forests, and less young and logged forests. Relationships with forest productivity and some overstory species were positive at broader scales, while associations with forest overstory and productivity were negative at the finest scale. At the finest scale, the strong negative association with very young, logged forests and with increasing values of the Landsat-derived green vegetation index became positive when analyzed in a multivariate context. For multivariate analyses, we considered 2 variables together with 11 principal components that describe ecological gradients among 4 variable groupings. We applied multiple logistic regression and used AIC to rank and weight competing subset models. We derived coefficients for interpretation and prediction using multi-model inference. The resulting function was highly predictive, which we confirmed against an independent dataset. We transformed the output using a multi-annual population estimate for the sampling area, and we applied the resulting grizzly bear density and distribution model across our greater study area as a strategic-level planning tool. We discuss conservation applications and design considerations of this DNA-based approach for grizzly bears and other forest-dwelling species.

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Key words: British Columbia, DNA, distribution, GIS, grizzly bear, habitat, human influence, landscape, population density, predictive modeling, resource selection function, *Ursus arctos*.

The spatial structure of a population has direct bearing on its dynamics, resiliency, and thus viability (Kareiva and Wennergren 1995, Ritchie 1997, Wiegand et al. 2002). Estimating the density and distribution of populations, monitoring spatiotemporal trends, and understanding factors that influence these trends are fundamental to an adaptive conservation strategy for any species. Yet, despite heightened management concerns, few examples are available at scales relevant to population conservation for solitary, wide-ranging species associated with forested environments. In addressing questions of population distribution and abundance over large spatial scales, options for using animal tracking systems such as radiotelemetry are limited by the ability to apply consistent and cost-effective capture effort and to achieve adequate sample sizes over a representative range of conditions. Moreover, researchers may not accept the associated disturbance to study animals, especially when less invasive techniques are available. Harvest or sightings data have been used to understand population distribution at very broad scales, but are typically subject to quality issues and nonrandom sampling bias at regional conservation planning levels (e.g., <30,000 km^2). Noninvasive sampling protocols have been developed for some species, but the regional application of these protocols may be subject to technological, logistical, and budgetary constraints (Zielinski and Kucera 1995, Foresman and Pearson 1998, Sargeant et al. 1998, Moruzzi et al. 2002).

For bears, recent advancements have been made in noninvasive hair-capture, genetic tagging, and population density estimation (Woods et al. 1999, Mowat and Strobeck 2000, Boulanger and McLellan 2001, Poole et al. 2001). These advancements have facilitated research to develop and refine spa-

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GRIZZLY BEAR - TIMBER RELATIONSHIPS IN THE YELLOWSTONE AREA

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Abstract: Grizzly bear (*Ursus arctos*) - habitat relationships were studied from 1976 through 1979 in a 20,000 km^2 area with Yellowstone National Park in the center. Ninety percent of the 2,261 aerial radio relocations of 46 instrumented grizzlies were in timber too dense to observe the bear. Three-fourths of the relocations were less than 100 m from a timber-opening edge. The majority (56%) of 515 feeding activities observed were recorded in timber over 3 m tall with a canopy cover greater than 5%, 20% were in open habitats, 18% were in timber over 3 m tall with a canopy cover of 5% or less, and only 6% were in timber less than 3 m tall. Most day beds were constructed less than 1 m from a tree, and usually in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type.

J. WILDL. MANAGE.

Key words: Grizzly bear, habitat, timber.

In 1975 the grizzly bear south of Canada was listed as a threatened species. To comply with the Endangered Species Act of 1973, Federal agencies must, therefore, avoid destruction or adverse modification of grizzly bear "critical habitat."

At that time insufficient data were available to define critical habitat, so management agencies were poorly equipped to evaluate the effects of land practices upon the grizzly. Research to determine the

Radio telemetry in this study has shown that grizzly bears in the Yellowstone system were located much more often in timber than in the open during the day. Examination of these locations has documented that substantial foraging by the bears occurred in the timber. Herrero (1978) has noted that "the brown bear has not lost its ability to forage on the forest floor, but it has gained the ability to exploit open habitat types at their peaks of productivity." Schallenberger and Jonkel (1979) found Rocky Mountain east front grizzly bears preferred timber to open (81% vs. 6% of total observations), while brown bears in Italy have also been found to prefer dense timber during the day (Roth and Osti 1979). Visual observation - in contrast to radio observations - suggests that "grizzlies appeared to occupy primarily fertile, open grasslands" (Mealey 1975) and that these bears appear to prefer open habitats as foraging grounds (Craighead 1979).

We don't know whether grizzly bears in the Yellowstone system presently use timber to the extent recorded because of an innate preference or in avoidance of contact with humans. Researchers in North America and Eurasia have documented negative correlations between the levels of human activity and grizzly/brown bear activity (Jurgenson 1968, Craighead and Craighead 1972, Priklonskij 1972, Zunino and Herrero 1972, Kaleckaja 1973, Pearson 1975, Martinka 1976, Chester 1977, Elgmork 1978, Nagy and Russell 1978). Others suggest that bears can become accustomed to activity associated with food sources (Cole 1972, Mundy and Flook 1973, Hamer 1974, Gilbert 1977). Yellowstone grizzly bears have been subjected to several selection pressures that may have caused them to seek out and remain in the timber. Bears outside the National Park were hunted until 1974 in Wyoming and Montana and are presently subjected to substantial poaching. Problem bears inside and outside the park are currently subject to control actions.

Despite the preponderance of observations in the timber, the importance of interspersion of timber and open habitats is apparent. Three-fourths of the total relocations were less than 100 m from a timber-opening edge. The importance of habitat interspersion to grizzlies has been documented by Graham (1978), Knight et al. (1978), Schallenberger (1976), Mealey (1976), Mealey and Jonkel (1975), and Craighead and Craighead (1972). A positive correlation between the length of timber to opening edge and the number of brown bear observations was noted by Elgmork (1978) in Norway.

Since Yellowstone grizzly bears use forested areas to a large extent, any alterations in the quantity and/or quality of timber cover may affect the availability of "preferred" habitat. Radio relocations and feeding sites indicate the majority of feeding activities and day beds occur in mixed age and species stands of moderate to dense (26-75%) canopy cover. Sterile lodgepole pine communities are frequently used as day bed sites and for certain feeding activities such as tearing logs for insects or carcass feeding. Mature and decadent stands are also used, largely as day bed sites.

Conventional logging negatively affects bears through reduction of shelter and increases in human activity. Black bears in the Whitefish Range of Montana used all seral stages of burned timber but did not use clearcuts or logged areas for about 10 years after logging (Jonkel and Cowan 1971). Brown bears in Norway were considerably disturbed by logging activities, especially networks of roads and the resulting secondary traffic (Elgmork 1978).

Logging operations may not be detrimental to the Yellowstone grizzlies if management actions are taken to minimize the negative impacts. Such actions would include: (1) permanently closing roads after logging; (2) making small, irregularly shaped clearcuts no greater than 300 m wide with long timber-to-opening edges; (3) making selective cuts and leaving a canopy over 3 m tall with cover greater than 25%; and (4) leaving strips between logging operations at least 100 m wide. Any measures taken to lessen the impacts of logging upon the grizzly will be worthless unless logging roads are permanently closed after logging because roads provide increased human activity and more frequent human-grizzly encounters. Increased human activity is clearly detrimental to the grizzly bear, both directly - through poaching and control actions - and indirectly through avoidance behavior.

PLOS | ONE

RESEARCH ARTICLE

The Impact of Roads on the Demography of Grizzly Bears in Alberta

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CrossMark

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Abstract

One of the principal factors that have reduced grizzly bear populations has been the creation of human access into grizzly bear habitat by roads built for resource extraction. Past studies have documented mortality and distributional changes of bears relative to roads but none have attempted to estimate the direct demographic impact of roads in terms of both survival rates, reproductive rates, and the interaction of reproductive state of female bears with survival rate. We applied a combination of survival and reproductive models to estimate demographic parameters for threatened grizzly bear populations in Alberta. Instead of attempting to estimate mean trend we explored factors which caused biological and spatial variation in population trend. We found that sex and age class survival was related to road density with subadult bears being most vulnerable to road-based mortality. A multi-state reproduction model found that females accompanied by cubs of the year and/or yearling cubs had lower survival rates compared to females with two year olds or no cubs. A demographic model found strong spatial gradients in population trend based upon road density. Threshold road densities needed to ensure population stability were estimated to further refine targets for population recovery of grizzly bears in Alberta. Models that considered lowered survival of females with dependant offspring resulted in lower road density thresholds to ensure stable bear populations. Our results demonstrate likely spatial variation in population trend and provide an example how demographic analysis can be used to refine and direct conservation measures for threatened species.

Introduction

One of the primary factors that has reduced grizzly bear populations in some portions of North America, has been the effects of unsustainable human caused

BOBCATS IN OUTER SPACE

MSU faculty, students counting down launch of solar mission they worked on

BIG SKY

LEAKING MILLIONS

Millions of dollars are disappearing through cracks in city policy

BUSINESS JOURNAL

BOZEMAN DAILY

CHRONICLE

DAILYCHRONICLE.COM TUESDAY, JUNE 25, 2013 75¢

Study: Yellowstone grizzly numbers lower than estimated

By MATTHEW BROWN
Associated Press

Trends within Yellowstone's bear population have taken on importance as the U.S. Fish and Wildlife Service considers lifting federal protections for the animals.

BILLINGS — Flaws in how the government measures Yellowstone's grizzly bear population raise questions about whether the animals have recovered sufficiently to merit lifting federal protections, according to a new study.

The study concludes that a major reason more bears have been counted in recent years is that more time is now spent counting bears. The authors argue that the region's bruin population could in fact be in decline, even as officials consider revoking the grizzly's threatened species status.

The peer-reviewed findings have been accepted for publication in the journal Conservation Letters. The work was partially funded by the Natural Resources Defense Council.

Population trends within Yellowstone's bear population have taken on added importance as the U.S. Fish and Wildlife Service considers lifting federal protections for the animals, possibly as early as next year.

Government biologists countered that there is no evidence of a decline. They said newly-revised population data shows more than 700 grizzlies living in and around Yellowstone National Park, an area that includes Wyoming, Montana and Idaho.

Meanwhile, rising numbers of bear-human conflicts — such as a mauling last week south of Cody, Wyo., that sent a man to the hospital with severe facial lacerations — have lent new urgency to calls to allow limited hunting to resume.

But the new study's lead author, University of Colorado environmental studies professor Daniel Doak, said shortcomings in the government's method of tracking grizzly numbers mean their recovery from widespread extermination last century may have been overstated.

The bears lost protections once, in 2007, before a federal judge ordered grizzlies back onto the threatened species list two years later. The reversal came in part over concerns that one food source for bears, the nuts from white bark pine trees, has grown increasingly scarce as insects kill large stands of the trees.

More BEARS | A8

AP

This May 30 photograph provided by Wolves of the Rockies shows a grizzly bear at Mary Bay along Yellowstone Lake in Yellowstone National Park.

FWS_Pub CMT_006184

Jun 29 Jul 8 Jul 15 Jul 22

Spokane	69/53/t	73/54/pc
Topeka	94/73/s	96/74/s
Washington, DC	95/75/pc	95/75/pc

Weather (W): s-sunny, pc-partly cloudy, c- fl-flurrie

For up-to-the-minute weather

Bears/from A1

Doak said the loss of whitebark pine and a decline in another food source, cutthroat trout, may have pushed bears into areas where they are more likely to be seen during aerial surveys done by government agencies. That doesn't necessarily mean there are more bears.

"It's a pretty standard thing in all of wildlife biology and conservation biology that if you triple the amount of time you're looking for some rare species, it's likely you're going to seem more of them, just because you spend a lot more time doing so," he said.

Doak and co-author Kerry Cutler also say wildlife officials have mistakenly assumed female grizzly bears reproduce throughout a 30-year lifespan, compounding the government's overly-optimistic population estimates.

They did not offer an alternative population size, nor say outright that the current estimate was wrong.

The government's latest estimate of 718 bears in the Yellowstone area is up from prior published estimates of roughly 600 bears.

That does not mean the bear population suddenly grew by about 100 bears. U.S. Geological Survey bear researcher Frank van Manen said the new figure results from revisions to the prior estimate based on increased survival rates for adult male bears in recent decades.

One reason more effort has gone into counting bears is that they are now spread across a much bigger landscape, said van Manen, who leads an interagency grizzly bear study team for the Yellowstone region. The results of those aerial surveys are corroborated by other factors, including the expansion of the animals' range and a trapping program that consistently identifies new bears, he said.

U.S. Fish and Wildlife Service grizzly bear coordinator Chris Servheen said the government's methods are reviewed by outside scientists and other government agencies.

"We're certainly interested in what they did," Servheen said of Doak's work. "But we've done a lot of work on this. We've given very careful consideration and critiques to everything we've done multiple times."

Another U.S. Geological Survey bear researcher, David Mattson, said Doak's findings were in line with his own conclusions that current estimation methods are "essentially worthless."

"There is this belief that somehow, through some sort of statistical magic, you can compensate for bias in your field methods," Mattson said. "My conclusion is that's just not simply possible."

Yellowstone's grizzly population is the second largest in the Lower 48, behind an estimated 1,000 bears in the Northern Continental Divide region that includes Glacier National Park. Smaller populations live in the Cabinet-Yaak, North Cascades and Selkirk areas of Idaho, Montana and Washington state.

Immigration/

He said the measure would be good for the economy, for

Leaving little to chance, the U.S. Chamber of Commerce

fied on the vote.

Republicans were anything

P F a a i t c r h li ea in en da Jo as slic J that final firm Mont Bet up an out he

Police Reports

The Bozeman Police Department reports for Monday included the following:

■ At 12:40 a.m., an officer found two young adults in the rear seat of a car with fogged up windows parked at Lindley Park. The officer told them the park was closed and warned them.

■ An officer stopped and offered some education to a driver who purchased a new vehicle and was unfamiliar with how to turn the

11:30 a.m.; strength ing, 12:30 p.m.; pin bingo, 1 p.m.; arthri ness, 2 p.m.; 586-24

BMRG Al-Anon, 7:30 p.m., Bozeman Church of Christ, 1 Kagy Blvd., 599-824

Cancer Support C munity: yoga, 8:45- 9:45 a.m.; Breathing breathing and relax techniques, 5:30-6:3 102 S. 11th Ave., Bo 582-1600, cancersu montana.org. Progr only for those affect

k hunters kill 2 grizzly ears, drivers kill 3

ELENA (AP) — e wildlife officials say hunters in southwest- Montana reported ng two female grizbears in self-defense weekend while three er grizzly bear deaths e reported along dways in northwest- Montana.

hunter near Gar-

told Fish, Wildlife and Parks officials that he came upon a bear feeding on a carcass on Oct. 28. The West Yellowstone hunters said a female grizzly bear with two cubs charged them on Oct. 31.

Grizzly bear management specialist Tim Manley says a female

Former government researcher disputes grizzly study results

By **MICHAEL WRIGHT**
Chronicle Staff Writer

A former government scientist has doubts about a recent grizzly bear study that said the number of Yellowstone area bears passing genes to the next generation had more than quadrupled since 1980, saying it's an attempt to shore up evidence to remove federal protections for the bears.

Former government grizzly researcher David Mattson criticized the study in a post on www.grizzlytimes.org. Mattson says the study's claims don't "pass the laugh test."

In an interview Tuesday, Mattson went on to say that the study was "inconsistent with everything else we know about this population." Moreover, he said the Interagency Grizzly Bear Study Team — which produced the study — and U.S. Geological Survey work to support the "sanctioned political agenda" of delisting the bears.

Pauline Kamath, one of the study's authors, said in an email the U.S. Geological Survey is "committed to providing unbiased, objective scientific information upon which other entities can use to base their actions and/or decisions on."

This comes as grizzly managers and advocates are meeting in Wyoming, where some expect a push for a delisting of the bears. Except for a brief time between 2007 and 2009, the grizzly bear has been listed as threatened under the Endangered Species Act since 1975. Lately, though, the push to delist has resurfaced.

The study found the effective population of Yellowstone National Park grizzly bears had increased from 100 to 450 since the early 1980s. A higher effective population means a slower loss of genetic diversity, which could mean bears would be better prepared to adapt to climate change or other environmental changes.

That doesn't mean the population size itself quadrupled in that time — just the number of bears passing genes along. Mattson — who researched carnivores for the federal government for 30 years and now is a lecturer at Yale University — said most people would agree that the population size of the Yellowstone bears has been largely stagnant since the early 2000s. The latest USGS count put the overall population at 757 bears.

More GRIZZLIES | C2

Recent YNP grizzly bear count shows decline

JACKSON, Wyo. (AP) — The estimated number of grizzly bears in and around Yellowstone National Park has been revised downward by 6 percent from a year ago, but wildlife biologists say the drop isn't cause for concern that the animals are in trouble.

"There's no evidence of a major change in the long-term trend of the population, and the long-term trend is still flat to slightly increasing," Frank van Manen, a wildlife biologist with the U.S. Geological Survey, said.

The number of grizzly bears in the Greater Yellowstone Ecosystem, which includes areas of Wyoming, Montana and Idaho, is estimated at 714 this year, down from 2014's estimate of 757, according to information released at a meeting of wildlife biologists Wednesday.

The decline comes during debate about whether federal protections for the grizzly bear should be lifted. Wildlife advocates say grizzly bear numbers are not sufficient enough to warrant lifting protections and subjecting the bears to possible hunting. But delisting advocates say grizzly bear populations have grown to the point where they are expanding beyond their current habitat and are coming more and more into conflict with humans.

Van Manen, a team leader with the Interagency Grizzly Bear Study Team, said the new grizzly bear population estimate is a single-year snapshot and not any indication that the population is in decline.

"It is within the range of variability, and we know there's sampling bias involved," he told the Jackson Hole News & Guide. "What we look at is that trend line over time, and if we look at that, there's no evidence of an actual decline."

The model that federal bear managers use to gauge grizzly numbers is biased low, van Manen said.

"We are underestimating probably by about 40 percent, according to these calculations," van Manen said.

Adjusting for the model's underestimation, the grizzly population would have come in this year at around 1,000.

Van Manen presented data Wednesday to the Yellowstone Ecosystem Subcommittee that counted 52 grizzly bear deaths so far this year and 90 percent of those deaths have been caused by people.

But mortality levels for both sexes are still within the limits set by recovery plans, van Manen said.

Nearly 6 percent of female grizzlies have died this year, he said, which is below the 7.6 percent threshold that can lead to decline. Among boar grizzlies, 11.4 percent have died, again below the acceptable mortality limit of 15 percent.

The grizzly bear has been a protected species under the Endangered Species Act for all but two years since 1975.

Officials with the U.S. Fish and Wildlife Service have said there are no firm plans to propose a rule that could lift protections for the Yellowstone ecosystem's grizzly bears.

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SECTION C | FRIDAY, NOVEMBER 6, 2015

CHILD'S PLAY

Families demand push for pint-sized medical devices for sick kids PAGE C3

Police reports, obituaries PAGE C2

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Relationships among grizzly bears, highways, and habitat in the Banff-Bow Valley, Alberta, Canada

Bryan Chruszcz, Anthony P. Clevenger, Kari E. Gunson, and Michael L. Gibeau

Abstract: Banff National Park and surrounding lands constitute one of the most developed landscapes in the world where grizzly bears (*Ursus arctos*) still survive. We examine the relationships among roads, grizzly bears, and their habitat in a protected area with low road density but dominated by a major transportation corridor and highway system. We examined grizzly bears' spatial response to roads, road-crossing behaviour, crossing-location attributes, and habitat and temporal patterns of cross-road movements. Grizzly bears used areas close to roads more than expected, particularly roads with low traffic volume (low volume). Habituated bears were closer to roads than wary bears. Males were closer to low-volume roads than females but crossed roads less than females during the berry season. Bears were more likely to cross low-volume roads than high-volume roads and were more likely to cross at points with higher habitat rankings. In addition, bears were more likely to cross high-volume roads when moving from areas with low habitat values to areas with high habitat values. Efforts to prevent loss of habitat connectivity across highways should involve maintenance of high-quality grizzly bear habitat adjacent to roads and should address the effects of traffic volume on the road-crossing decisions of grizzly bears.

Résumé : Le parc national de Banff et les terres avoisinantes représentent un des paysages les plus développés au monde dans lesquels les grizzlis (*Ursus arctos*) survivent toujours. Notre étude examine les relations entre les routes, les grizzlis et leur habitat dans une région protégée avec une faible densité de routes, mais traversée par un important corridor de transport et un axe routier majeur. Nous avons étudié la réaction spatiale des grizzlis aux routes, leur comportement de traversée des routes, les caractéristiques de leurs points de traversée et les structures spatiales et temporelles reliées aux déplacements de traversée. Les grizzlis utilisent les espaces près des routes plus que prévu, particulièrement celles qui ont peu de circulation (volume faible). Les ours habitués se tiennent plus près des routes que les ours méfiants. Les mâles se tiennent plus près des routes à faible volume de circulation que les femelles, mais ils traversent les routes moins volontiers que les femelles durant la saison des petits fruits. Les ours sont plus susceptibles de traverser des routes à faible plutôt que forte circulation et de traverser aux endroits où l'habitat est de plus grande qualité. De plus, les ours sont plus susceptibles de traverser des routes à forte circulation lorsqu'ils se déplacent d'un habitat de faible qualité à un autre de qualité supérieure. Dans le but de prévenir la perte de connectivité entre les habitats à travers les routes, il faudrait maintenir près des routes des habitats de qualité pour les grizzlis et étudier les effets du volume de la circulation sur les décisions des ours de traverser la route.

[Traduit par la Rédaction]

Introduction

Many landscapes are undergoing extensive and rapid change as a consequence of human activities (Hansson and Angelstam 1991; Houghton 1994). One of the major changes associated with landscape modification is the fragmentation and loss of habitat (Bennett 1999). Less conspicuous than other forms of habitat disturbance, linear features such as roads can have immense and pervasive impacts on wildlife populations (Forman and Alexander 1998; Trombulak and Frissell 2000). In an increasing number of landscapes, the regular movements of animals involve road crossings.

In view of their great mobility and extensive spatial requirements for survival, large mammalian carnivores are vulnerable to road effects (Noss et al. 1996; Woodroffe and Ginsberg 2000). Currently, many wide-ranging predatory species are a source of conservation concern worldwide (Landa et al. 1997; Breitenmoser 1998; Sanderson et al. 2002), and the need to protect them from the harmful consequences of roads is paramount (Kerley et al. 2002).

Landscape fragmentation due to human activities and blockage of wildlife movement in the Bow Valley are major stressors affecting the Banff National Park (BNP) ecosystem (Banff – Bow Valley Study 1996). The Trans-Canada Highway (TCH) is a potential barrier to large-mammal movement in the mountain parks and the significantly larger Central Rocky Mountain ecosystem. Given the national importance of the cross-country transportation corridor (McGuire and

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Components of Grizzly Bear Habitat Selection: Density, Habitats, Roads, and Mortality Risk

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ABSTRACT We used resource selection functions (RSF) to estimate the relative probability of use for grizzly bears (*Ursus arctos*) adjacent to the Parsnip River, British Columbia, Canada, 1998–2003. We collected data from 30 radiocollared bears on a rolling plateau where a large portion of the landscape had been modified by human activities, primarily forestry. We also monitored 24 radiocollared bears in mountain areas largely inaccessible to humans. Bears that lived on the plateau existed at less than one-quarter the density of bears in the mountains. Plateau bears ate more high-quality food items, such as meat and berries, leading us to conclude that food limitation was not responsible for the differences in densities. We hypothesized that plateau bears were limited by human-caused mortality associated with roads constructed for forestry activities. Independent estimates of bear population size from DNA-based mark–recapture techniques allowed us to link populations to habitats using RSF models to scale habitat use patterns to population density. To evaluate whether differences in land-cover type, roads, or mortality risk could account for the disparity in density we used the mountain RSF model to predict habitat use and number of bears on the plateau and vice versa. We predicted increases ranging from 34 bears to 96 bears on the plateau when switching model coefficients, excluding land-cover types; when exchanging land-cover coefficients, the model predicted that the plateau population would be 9 bears lower than was observed. Large reductions in the numbers of mountain bears were predicted by habitat-selection models of bears using the plateau landscape. Although RSF models estimated in mountain and plateau landscapes could not predict bear use and abundance in the other areas, contrasts in models between areas provided a useful tool for examining the effects of human activities on grizzly bears. (JOURNAL OF WILDLIFE MANAGEMENT 71(5):1446–1457; 2007)

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KEY WORDS British Columbia, density estimation, forestry, grizzly bear, habitat selection, mortality, risk, roads, resource selection function, *Ursus arctos*.

Landscapes contain temporal and spatial variation among and within habitat patches (Southwood 1977), and habitat selection has a direct impact on population density and behavior (Rosenzweig 1981). Frequently, the spatial distribution of foods has been used to explain the spatial distribution and dynamics of animals (MacArthur and Pianka 1966, Charnov 1976). In theory, animals should optimize their foraging strategy by choosing richer patches over poorer patches (Charnov 1976). Higher quality habitats are assumed to be linked to increased fitness at a given density, generally resulting in higher densities of animals in higher quality habitats (Fretwell and Lucas 1970, Garshelis 2000, Bock and Jones 2004). Also, experimental studies have shown that avoidance of predation risk can alter habitat selection (Gilliam and Fraser 1987, Abrahams and Dill 1989, Resetarits 2005).

In our study area, a relatively pristine mountainous landscape contained 4 times the density of grizzly bears (*Ursus arctos*) as an adjacent plateau landscape that had been heavily harvested for timber (Mowat et al. 2005). A similar pattern occurs in Alberta, Canada, where the highest density of bears exists in the mountains and bear densities decline further east in the foothills, where access to development has been greater (Boulanger et al. 2005). High-quality habitats close to areas of human use are often areas of high bear mortality (Knight et al. 1988, McLellan 1989, Mattson and Merrill 2002, Nielsen et al. 2004), thereby negatively affecting populations (Mattson and Merrill 2002). Further, high-risk food-rich habitats that attract individuals can serve as local population sinks, or ecological traps (Delibes et al. 2001, Kristan 2003, Robertson and Hutto 2006). Consequently, individual occurrence and abundance are not necessarily related to habitat quality (Hobbs and Hanley 1990, Kristan 2003).

In areas with high food availability, particularly meat, bears tend to have increased reproductive success, larger body mass, and a higher population density (Hilderbrand et al. 1999). Elsewhere we reported significantly larger body masses, better condition, and higher cubs-of-the-year survival in our low-density area (i.e., the plateau); however, survival of subadult and adult bears was lower on the plateau than the mountains (Ciarniello 2006). Based on these observations we surmised that the density of bears on the plateau was limited by human-caused mortality linked to access afforded by forestry activities rather than habitat quality per se (Ciarniello 2006). In this paper, we evaluate this conclusion using 2 methods: 1) examining the foods consumed by bears that lived in the mountains compared with those that lived on the plateau to investigate whether bears on the plateau were limited by available forage; and 2) modeling the relationship between habitats and population structure using mechanistic and or statistical approaches to habitat selection.

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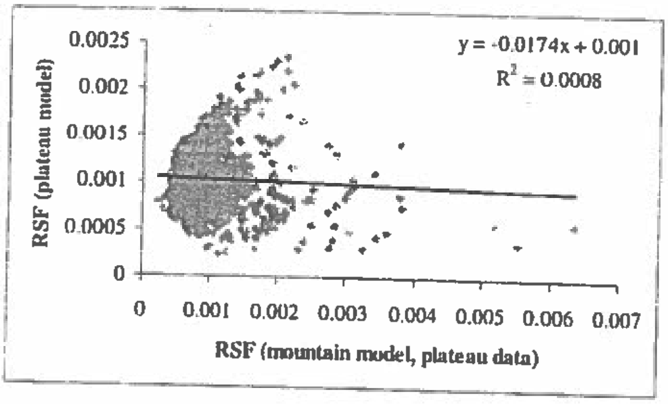

Figure 6. Plot of each resource selection function (RSF) point predicted in the plateau landscape versus the RSF scores predicted using the mountain model with the plateau data for the Parsnip River study area, British Columbia, Canada, 1998–2003. We define the RSF to be $\sqrt{|w(x)|}$ (see eq. 3).

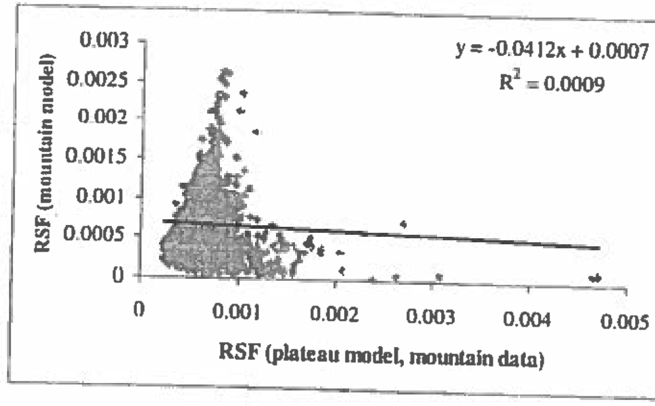

Figure 7. Plot of each resource selection function (RSF) point predicted in the mountain landscape versus the RSF scores predicted using the plateau model with the mountain data for the Parsnip River study area, British Columbia, Canada, 1998–2003. We define the RSF to be $\sqrt{|w(x)|}$ (see eq. 3).

Mowat et al. (2005; Table 4); however, the confidence interval represents a large range in density.

We estimated changes in population size obtained by switching models by comparing our estimated N with the observed N obtained from the DNA mark–recapture estimate adjusted for study area size ($N = 127$). The only predictor variables that predicted a reduced number of bears on the plateau were the available land-cover types. We predicted a decrease of 9 bears on the plateau (i.e., obs N of 127 bears in plateau study area minus predicted land-cover-swap N of 118 bears) when we applied the land-cover data from the mountains into the plateau RSF model. Conversely, the plateau population increased by 34 bears when we took the model coefficients associated with primary and secondary logging roads from the mountain model (i.e., if plateau bears avoided secondary logging roads similar to mountain bears, we would expect 34 more bears on the plateau landscape). If the risk of human-caused mortality was similar to what we observed in the mountains we estimate an increase of 49 bears on the plateau (Table 4). Lastly, we examined the effect of switching the model coefficients for all variables. If bears on the plateau had similar patterns of selection to mountain bears, we expect that the population of bears on the plateau would be 1.75 times higher than the observed population (predicted $N = 223$).

We also performed the analysis in reverse (i.e., using data from the plateau in the mountain RSF model). We predicted a lower density of grizzly bears when the plateau model was applied on the mountain landscape, which were well below the confidence intervals outlined in Mowat et al. (2005; Table 4). We obtained a slightly larger effect by switching the risk of human-caused mortality. We predicted a decrease to 31 bears (4 bears/1,000 km^2) if the risk of human-caused mortality was similar to what we observed in the plateau. Similarly, swapping coefficients for primary and secondary or decommissioned logging roads, and available land-cover types provided a predicted N of 34–36 bears (5 bears/1,000 km^2). Applying the plateau bear model to the mountain landscape reduced the model-predicted number of bears in the mountains from the observed 363 bears to 42 bears (Table 4).

DISCUSSION

Our results suggest that the availability of foods does not appear to be limiting the density of bears on the plateau. Our habitat use data supported earlier work using stable isotopes, which revealed that plateau bears ate up to 10 times the amount of meat and or ants as mountain bears (Mowat and Heard 2006), whereas body condition indices showed they were considerably heavier and in better condition (Ciarniello 2006). Because body mass and access to meat has been correlated with increased density in grizzly bear populations (Hilderbrand et al. 1999), we expected the density of bears to be at least as high on the plateau as in the mountains. Instead, compared with other DNA-based population estimates in interior British Columbia, grizzly bear density in the mountains was high (McLellan 1989, Hovey and McLellan 1996), but density on the plateau was low (Mowat and Strobeck 2000) despite the high-calorie foods they consumed.

We suggest that the density of bears was affected by bear selection or avoidance of areas close to open roads and the risk of human-caused mortality rather than differences in habitat. We found no evidence that the 4-fold difference in bear density between the mountains and the plateau could be attributed to differences in the respective land-cover types. Indeed, based on differences in land-cover alone, swapping model coefficients predicted a reduction in the number of bears on the plateau. Because we exchanged coefficients for only the variables in question, this suggests the effect of habitat alone cannot account for the difference in the number of grizzly bears between the mountains and the plateau.

Our model-swapping results point to the importance of roads and associated risk of human-caused mortality on bear density between the mountains and the plateau, although the magnitude of response does not account for the entire 4-fold difference. We do not think that the selection by bears for areas closer to the highway on the plateau was a true road "harmful" to population persistence. For example, if we had not previously examined the type and location of mortalities (Ciarniello 2006), we might have improperly interpreted model results by suggesting that increasing the number of roads (e.g., highways on the plateau or primary logging roads in the mountains) on the landscape would result in an increase in grizzly bears. However, if caution is applied during extrapolations, proper application of the link between habitat and density provides a useful tool for examining and quantifying the effects of human activities on grizzly bears.

We suggest that the decrease in density of mountain grizzly bears predicted by the plateau RSF model was also likely due to extrapolation to a landscape with a different suite of available resources regardless of similar underlying selection patterns by bears (Figs. 4, 5). Our results suggest caution when applying RSF results to different areas even though bears in both landscapes had comparable selection for variables that influence food availability in northern environments (i.e., SW-aspect hillshade values, open canopies, and higher greenness scores). Unlike Manly et al. (2002:187) where the presence of galaxiid fish were predicted "very well" at sites where trout were present, we predicted markedly different RSF models in our adjacent areas (Figs. 6, 7), even though both of our models had excellent internal predictive capability and were proportional to the probability of use. Such extrapolations have been completed for grizzly bears in the Bitterroot Mountains of Idaho and Montana, USA, where it was thought that bear densities could be predicted because the RSF models were from landscapes assumed to contain similar available resources (Boyce and Waller 2003). From our results, we suggest that extrapolation of RSF models into areas with a different suite of available resources may be misleading. For example, we had to omit a highly used land-cover type (i.e., alpine) by mountain bears when using the plateau model to predict the number of grizzly bears in the mountains, which likely underestimated mountain-bear density. We likely would have predicted a higher number of bears for the mountain landscape had grizzly bears on the plateau used alpine areas and had we been able to estimate the alpine beta coefficient.

The results of the habitat-based density modeling suggest that simply providing habitat is not enough to sustain grizzly bear populations at their current numbers. We predict that if our current system of forestry management continues, and logging roads remain accessible to the public after the timber has been extracted, the number of bears will decline. We suggest that for grizzly bears to remain viable outside of protected areas, we must maintain places secure from the risk of human-caused bear mortality across each landscape.

MANAGEMENT IMPLICATIONS

The opposite road coefficients and their effect on grizzly bear density suggest that emphasis should be placed on both the level and type of human use on roads rather than road networks. Access management plans should focus on reducing active road density. We suggest using indirect techniques such as removal of a bridge prohibiting human access past the obstruction to influence the extent and location of human impacts. We also suggest placing core secure areas throughout working forests where regeneration of blocks is encouraged to promote early seral bear foods and human access is restricted. For example, we suggest leaving debris in blocks and on roadways to increase opportunities for bears to forage on ants while restricting human access. Similarly, allowing natural regeneration promotes berry-producing shrubs, whereas planting alder (*Alnus* spp.) on roadways restricts motorized access.

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Human Dimensions

Grizzly Bear and Human Interaction in Yellowstone National Park: An Evaluation of Bear Management Areas

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ABSTRACT Wildlife managers often rely on permanent or temporary area closures to reduce the impact of human presence on sensitive species. In 1982, Yellowstone National Park created a program to protect threatened grizzly bears (*Ursus arctos*) from human disturbance. The bear management area (BMA) program created areas of the park where human access was restricted. The program was designed to allow unhindered foraging opportunities for bears, decrease the risk of habituation, and provide safety for backcountry users. The objective of our study was to evaluate human-bear interaction in BMAs and determine if they were effective. We used human and grizzly bear global positioning system location data to study 6 of 16 BMAs from 2007 to 2009. We contrasted data when BMAs were unrestricted (open human access) and restricted (limited human access). We used location data collected when BMAs were unrestricted to delineate a human recreation area (HRA) and determined a daily human active and inactive period. We applied the HRA and daily activity times to bear location data and evaluated how bear movement behavior changed when people were present and absent. We found that grizzly bears were twice as likely to be within the HRA when BMAs were restricted. We also found that grizzly bears were more than twice as likely to be within the HRA when BMAs were unrestricted, but people were inactive. Our results suggest that human presence can displace grizzly bears if people are allowed unrestricted access to the 6 BMAs in our study. Our study provides evidence for the utility of management closures designed to protect a threatened species in a well-visited park. Our approach can be reapplied by managers interested in balancing wildlife conservation and human recreation. © 2013 The Wildlife Society.

KEY WORDS bear management, displacement, global positioning system (GPS), grizzly bear, human-bear interaction, recreation, *Ursus arctos*, Yellowstone National Park.

Mitigating human disturbance of sensitive, threatened, or endangered species in protected areas is important because they serve as core areas for species recovery and provide a baseline for research (Sinclair and Byrom 2006). Concerns arise when places suitable for wildlife conservation are also popular with people. Human presence can alter wildlife behavior and ultimately change foraging patterns (Steidl and Anthony 2000, Rode et al. 2007), modify intra- and interspecific interactions (Mattson et al. 1987, Skagen et al. 1991, Rogala et al. 2011), increase physiological stress (Creel et al. 2002, Barja et al. 2007), reduce survival (Ruhlen et al. 2003), decrease reproductive output (Ellenberg et al. 2007), and lead to habituation (Herrero et al. 2005). Also, some wildlife species can be defensive over food, personal space, or mates, placing people at risk. Therefore, land managers use various methods to minimize potential human disturbance and reduce human-wildlife overlap (Leung and Marion 1999). One commonly used method is to close or restrict human access to allow foraging, nesting, or breeding behavior (Ashe et al. 2010, Burger and Niles 2012). However, this approach can constrain human recreation or exclude people from popular places and activities. Therefore, considerations must be made when closing or restricting human access. Managers must understand the consequences of human-wildlife interaction and determine if management closures provide adequate protection for animals and people (Whittaker and Knight 1998, Fernández-Juricic et al. 2004, Ashe et al. 2010). They must also determine if specific areas, times, and dates are effectively reducing potential interactions. These considerations allow managers to understand the consequences of inaction and help refine protocols to reduce unnecessary regulation.

Management closures involving moose (*Alces alces*; National Park Service 2013), grizzly bears (*Ursus arctos*; Parks Canada 2013), killer whales (*Orcinus orca*; Williams

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Re-Evaluating Evidence for Past Population Trends and Predicted Dynamics of Yellowstone Grizzly Bears

2013

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Conservation Letter

Abstract

Sampling effort and demographic assumptions may powerfully shape conclusions about the status of endangered species. We re-examined data sets that suggest recent increases, and hence relative safety from future extinction, of the grizzly bear population inhabiting the Greater Yellowstone Ecosystem, one of the best studied large carnivore populations in the world. We find that inadequate attention to increasing observation effort and also to the life history characteristics of bears is likely to have substantially influenced past analyses of the population's trajectory. We conclude that the GYE grizzly has probably increased far less than generally believed, but also that past analyses have been too inaccurate to allow any firm conclusions about the dynamics or status of this population. The problems we illustrate here apply to many other threatened species, and suggest the need for more careful consideration of observation processes that can shape our perceptions of species' history and status.

and survival senescence are included in the model, we arrive at predictions of somewhat lower or extremely little growth from 1983 to 2002.

Discussion

Confidence in the recent growth and hence health of the GYE grizzle population has largely rested on Fcoy estimates, and their correction via the Chao2 estimator, as well as on the corroborating evidence from demographic rates. In all studies we found that use the Fcoy or Chao2 grizzly data dataset, authors take published estimates of these numbers at face value, as stable estimators of relative numbers. Even the most recent discussion of population trend data have accepted the basic narrative of long term growth of this population, even while, in some cases, concluding that new ways to estimate numbers are needed (Eberhardt and Breiwick 2010, IGBST 2012). Our results suggest the need to reevaluate these apparent trends. We find that a plausible and parsimonious explanation for most or all of the rise in Fcoy estimates is rising search effort, along with possible shifts in the mean and variance in sightability of bears, and that the Chao2 estimator does not meaningfully correct for these issues. Similarly, we show that the approach taken in past demographic analyses of ignoring senescence has likely resulted in overly high population growth estimates, and that incorporation of senescence patterns known for grizzlies results in substantially lower growth estimates for the recent past. These results suggest that a reevaluation of the acceptable mortality limits for bears is also needed.

Three recommendations follow from our work. First, one of several methods should be used to re-evaluate the last several decades of data on bear numbers, and to do so with explicit treatment of the rapidly changing observation effort. The most reasonable approach would be to analyze only the data collected on standardized

Our results cast doubt on the assertion that this population underwent a sharp increase from 1980 to 1995 and has recently stabilized in numbers, or even continued to increase (Harris et al 2007, Eberhardt and Breiwick 2010). Beyond addressing the status of this population, our results illustrate how shifts in the observation process can alter the perception of population viability and risk. As species become rare, or are proposed to be recovered, it is common for formal and informal observation effort to change substantially, and our results caution that unless these changes are carefully analyzed (e.g., Boyd 2010, Kery et al. 2010, Senyatso et al 2013), they can result in substantial misunderstanding of a population's history and hence safety from future extirpation.

BACKGROUND

Over the last 50 years many changes have taken place in the Greater Yellowstone Ecosystem that are likely to influence grizzly populations, and multiple shifts in the knowledge and monitoring of grizzles have also occurred. Some of these changes are illustrated in Figure 1 (also see Supporting Information). The changes most likely to influence our study questions are increasing effort searching for bears each year, increasing bear use of feeding sites where they are easily seen, as well as human recognition of these sites (in particular, high elevation moth aggregations, which have been increasingly used by bears since 1981 and were first recognized as feeding sites in 1986; Mattson et al. 1991), and three trends almost certain to negatively impact bears: loss of trout runs, ongoing collapse of white-bark pines (both important food sources), and increasing rural development.

Virtually all data on the dynamics of the GYE population come from the ongoing work of the Interagency Grizzly Bear Study Team (IGBST). The first data set we consider comprises annual estimates of minimum population numbers, used to infer trends in observation flights, so that effort could be treated clearly in the estimation of relative numbers. Dealing with the shifting observability of bears is more problematic, but even if this issue cannot be fully resolved, the overwhelming effects of effort could be dealt with in such a re-analysis.

Second, demographic rates should be re-estimated with acknowledgement of senescence effects. Given that senescence is well-known in bears, and that past work has used GYE data for the estimation of both reproductive and survival senescence, it is puzzling that these effects have not been included in past estimates of population growth rates. Verbal arguments that senescence is relatively unimportant (e.g., Schwartz et al. 2003) only make sense if age-representative samples of bears are used to estimate all pooled adult rates, which does not seem likely, given that average adult survival estimates suggest large fractions of adults living the maximum age of 30.

Finally, our results suggest that we actually know very little about the past trends of this population, and hence about their likely future fate, especially with rapid declines in multiple food resources and increases in opportunities for human conflicts (Fig 1). While our most basic conclusion is that we cannot confidently assess the past or future trends of this population without further and more careful work, our analyses show that trends in Fcoy and Chao2 are consistent with a population that has grown little, or perhaps not at all, in the recent past, but also that was higher in the past than was realized. In a non-changing landscape, this might imply considerable safety from future extinction. However, with rapidly accelerating impacts, and with Chao2 estimates flattening in the last decade, even as search effort has continued to increase, it is quite likely that the population is now, in fact, declining.

Our basic conclusion is that the perceived dynamics of this population rest on overly-simplified uses of the basic data sets available. While the GYE grizzlies have been for observation effort and realistic treatment of life history patterns) are likely to have resulted in misunderstandings of the data collected, systematic bias in the inferences about the dynamics of this population, and over-confidence in apparent trends. Given the wide-spread use of the Chao and related estimators in many other contexts, our work also suggests that caution is needed in interpreting patterns in this statistic in studies of either population numbers or species richness.

More generally, these results highlight the need to carefully consider shifting observation processes for species of conservation concern. Changing knowledge of a species, increasing attention to its plight, or shifts in individual behaviors in the face of habitat changes can all alter the observation process, with non-trivial effects on estimated population viability (e.g., Hernandez-Manrique et al. 2013). In different situations, these changes might lead to the perception of greater or less risk than is real, compounding other problems of implementing necessary management interventions (Martin et al. 2012). While a great deal of careful attention has been paid to the observation process in many areas of wildlife and conservation biology (Bellemain et al. 2005, Olea and Mateo-Tomas 2011, Chaudhary et al. 2012), this is not always the case, especially with very rare species. Our work highlights that in many circumstances more care is needed in making inferences about population trends, especially when these results are being used in a direct policy context (Mace et al. 2010).

Acknowledgements

K. Cutler received partial support from the Natural Resources Defense Council to work on this project.

Red Squirrels Snags 2006

Research Article

Sciurid Habitat Relationships in Forests Managed Under Selection and Shelterwood Silviculture in Ontario

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Abstract

Although partial forest harvesting is practiced over large areas, managers know little about its impacts on sciurid rodents, particularly on northern (Glaucomys sabrinus) *and southern flying squirrels* (G. volans) *in the northeastern United States and Canada. We examined habitat relationships of sciurid rodents (northern flying squirrels, southern flying squirrels, red squirrels* [Tamiasciurus hudsonicus], *and eastern chipmunks* [Tamias striatus]) *at 2 spatial scales in managed and unmanaged coniferous and hardwood forests of Algonquin Provincial Park, Ontario, Canada. We live-trapped rodents in 26 northern hardwood stands and in 16 white pine* (Pinus strobus) *stands from 2002 to 2004. Northern flying squirrel and red squirrel densities were significantly lower in recently harvested (3–10 yr since harvest) shelterwood stands than in unmanaged stands. In contrast, southern flying squirrel densities were higher in selection-harvested stands than in old-forest areas. The densities of northern flying squirrels and red squirrels had a strong relationship with the density of large spruce* (Picea *sp.) and hardwood trees and snags in conifer sites. Southern flying squirrel numbers had a positive association with the density of mast trees at the landscape level but not at the stand level in hardwood forests. Eastern chipmunk density had a positive correlation with the volume of old downed woody debris and the stems per hectare of declining trees. We recommend forest managers retain more large spruce and hardwood trees to mitigate the impacts of shelterwood harvesting on northern flying squirrels and red squirrels, and that they maintain high mast availability at the landscape level to ensure the persistence of southern flying squirrels.* (JOURNAL OF WILDLIFE MANAGEMENT 70(6):1735–1745; 2006)

Key words

eastern chipmunk, Glaucomys sabrinus, Glaucomys volans, *habitat use, northern flying squirrel, Ontario, partial harvesting, red squirrel, southern flying squirrel, stepwise regression,* Tamias striatus, Tamiasciurus hudsonicus.

Many jurisdictions in North America, including Ontario, Canada, have selected flying squirrels (*Glaucomys* spp.) as indicators of sustainable forest management practices. This designation has resulted in a relatively large body of research on these and other tree squirrels in landscapes managed under clearcut logging (Rosenberg and Anthony 1992, Witt 1992, Carey 1995, 2000, Martin and Anthony 1999, Cote and Ferron 2001). However, partial harvesting techniques, such as selection and shelterwood logging, have received less attention. These are common silvicultural techniques employed in temperate mixedwood forests in northeastern Northern America. In these systems, forest operators remove a portion of the overstory at relatively shorter intervals (approx. 20 yr), creating a more frequent, but less intensive disturbance regime, than under clearcut logging. The effects of partial harvesting on canopy-dwelling organisms are likely to differ from those resulting from clearcutting because partial harvesting maintains a relatively closed-canopy mature forest throughout the harvest cycle. Unfortunately, only 2 studies have examined the effects of partial harvesting (shelterwood harvesting) on flying squirrels (Waters and Zabel 1995, Taulman et al. 1998). These studies found that relatively high harvest intensities (<10 m^2/ha residual basal area) negatively affected flying squirrel populations. Researchers have not examined the effects of selection harvesting systems in hardwood forests, which typically leave greater residual basal areas than shelterwood logging.

Although partial harvesting systems retain canopy cover on sites, impacts on tree squirrel populations may manifest through other logging-induced changes in forest structure. Partial harvesting typically involves a reduction in the abundance of diseased and dead trees (McComb and Lindenmayer 1999, McGee et al. 1999, Costello et al. 2000) and often results in more homogenous forest structure, with reduced tree density and size (Costello et al. 2000). These changes may be important for arboreal mammals (Gerrow 1996, Carey 2000) and could result in negative effects for cavity nesters (Imbeau et al. 2001).

Most past studies on sciurids have only considered local (site-level) effects; however, organisms may demonstrate different responses to the same factor at different scales (Wiens 1989). Studies in fragmented landscapes suggest that flying squirrels may be sensitive to area effects (Nupp and Swihart 2000) and indicate that large clearcuts may act as barriers to dispersal and movement (Bendel and Gates 1987). Taulman (1999) found that flying squirrels nested in adjacent unharvested forest following partial harvesting, suggesting that the amount and configuration of unharvested stands might modulate flying squirrel responses to forest harvesting. In concert, these studies raise the possibility that local responses to forest harvesting might,

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Fall 2012 YES Meeting Minutes
November 7- 8, 2012
Hilton Garden Inn, Bozeman, MT

Attendees:
Mary Gibson Scott, Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway;
Steve Cain, Grand Teton National Park;
Dan Wenk, Yellowstone National Park;
Jacque Buchanan, Bridger-Teton National Forest;
Chuck Mark, Beaverhead-Deerlodge National Forest;
Brent Larson, Caribou-Targhee National Forest;
Mary Erickson, Gallatin and Custer National Forests;
Joe Alexander, Shoshone National Forest;
Pat Flowers, Montana Fish Wildlife and Parks;
Tom Ryder, Wyoming Game and Fish;
Gregg Losinski, Idaho Fish and Game;
Maureen Davey, Montana County Commission – Stillwater County;
Frank van Manen, USGS Interagency Grizzly Bear Study Team;
Ann Bellman, USFWS – Wyoming;
Mark Wilson, USFWS – Montana;
David Kampenwerth, USFWS – Idaho;
Chris Servheen, USFWS Grizzly Bear Recovery Coordinator;
Scott Jackson, USFS Carnivore Program Lead;
Mike Stewart, BLM - Wyoming.

WELCOME - Mary Gibson Scott – YES Chair

- Introductions
- At the next meeting we will elect a new vice-chair from a Federal Agency.
- Motion to approve spring 2012 Meeting minutes by Jacque Buchanan, Seconded by Maureen Davey. *Motion carried*

IGBST DEMOGRAPHIC WORKSHOP REPORT - Frank van Manen (USGS IGBST)
This is an effort that involved 3 demographic workshops that took place over the last couple of years.

- Recognized the partner agencies involved (NPS, USFWS, FS, WYG&F, MTFW&P, IDF&G, Wind River Fish and Game).

Workshop Objectives
1. Improve estimation of population abundance
2. Update our understanding of grizzly bear vital rates from telemetry data
3. Examine intrinsic and extrinsic factors associated with grizzly bear vital rates
4. Recommend revisions to sustainable mortality limits.

Objective 1: Improve estimation of population abundance

- Current protocol is based on the Knight et al. rule set (1995) which was to distinguish unique females with cubs-of-the-year (F_{COY}).
    - An important part of this rule set is a distance criterion.
- Once we have assessed the number of F_{COY}, we use an estimator (Cherry et al. (2007)) to estimate the total population size of Fcoy - accounting for heterogeneity in sighting probabilities.
- Trend assessed using linear and quadratic regression models to detect changes in the population trend over time.
- This number goes into a flow chart (very complex) and goes through a set of ratios and rates that generates an estimate for the entire population and from that we develop mortality limits for the individual age classes.
- The problem with this approach is that it is biased when there are more and more animals on the landscape – so we know our population estimate is biased low.

The IGBST explored alternatives:

Alternative #1: Ancillary Data Resampling – lead by Dr. Meghan Higgs, MSU.

- This approach was very elegant but unfortunately involved one assumption about the distribution of animals on the landscape that we couldn't deal with effectively.
- As a whole, the group decided that it was too complex and the assumptions too rigorous to meet with this particular data set - so it was not further explored.

Alternative #2: Mark-Resight Technique (Dr. Higgs and Gary White)

- Standardized aerial surveys conducted since 1997
    - 2 surveys/year; all bears counted, focus on F_{COY}
    - Once an animal is seen, telemetry is used to determine if F_{COY} is marked.
    - We know how many marks are on the landscape.
- Proportion of marked F_{COY} seen (0, 1, or 2 times) during both surveys.
- Assume proportions are the same for unmarked F_{COY}

Key to making this technique work is:

- Aggregate the sightability for all the years.
- Should result in an approximately unbiased estimate.

We looked at the assumptions of this technique and generally met them with one exception:

- At moth sites unmarked F_{COY} have greater sightability than marked F_{COY}.
    - Positive bias if this is not accounted for.
- Solution: exclude moth sites from estimate and add in census of F_{COY} based on moth site only surveys.

Mark-Resight Considerations

- Small number of sightings of marked F_{COY} affects precision.

- Annual variation in estimates: smoothing of trend line needed.
- Radio-marked sample of adult females must be maintained.
- Annual observation flights must be continued and moth site-only surveys must be added.

We hope to be done with this by the end of Calendar Year 2012:
- Dr. Higgs and co-authors have submitted a manuscript that has come back with favorable reviews and is now in revision.
- Power analyses to examine trade-offs between sample size, precision, and ability to detect changes in trend over time.
- What is zone of influence for F_{COY} observed at moth sites?

Objective 2 and 3: Update Grizzly Bear Vital Rates
- Update vital rates for 2002-2011 period.
- Compare with 1983-2001 vital rates.
- Evaluate correlations with intrinsic (indicators of density-dependence) and extrinsic factors (e.g., whitebark pine indices).
- 2011 was the first year that the quadratic model had slightly more weight (.51) than the linear model and this triggered a demographic review and is why we reanalyzed vital rates for the 2002-2011 period.
- The system worked – the trigger that was in place for monitoring worked, it forced us to look at what has changed in the population.
- Repeat Monograph analyses – using the exact same methods with one exception – proportion of females with cubs based on Schwartz and White (2008).

Comparison of the two time periods (1983-2001 vs. 2002-2011)
- Cub and yearling survival
  - Reduced for the last decade as compared to 1983-2001.
  - Stronger signal that this is associated with population density parameters rather than a whitebark pine (WBP) effect.
  - Knowing what we know about bear populations, these are the two parameters where we expect density dependent effects to take place if they exist.
- Fecundity
  - Mean litter size and proportion of females with cubs did not decrease that much in the second time period.
    - Stronger signal that this decrease is associated with a WBP effect rather than a population effect.
- Independent bear survival (2 scenarios: Known Mortalities and Assumed Mortalities)
  - Known Mortalities
    - Not much of a change with female survival in this scenario but quite an increase in male survival.
  - Assumed Mortalities
    - More conservative scenario.

- Male survival has increased quite a bit and female survival is pretty much the same.
- We have to separate out sub-adult survival for this scenario and we see that this younger age class has reduced survival in this last decade.
- Did not find a strong association with WBP or population (density) covariates.

- When you use those vital rates to then estimate population growth under the Known Mortality scenario we see that the annual population growth rate has decreased by about 5% over the past decade.
- Under the more conservative scenario, Assumed Mortality, we see that the population is stable, no growth.

There are a couple of independent data sources that support that something changed in the population during the second time period (2002-2011). We asked Dr. Higgs to look at this series of data and to define a change point in the data.

- 2001 is the one spot statistically that rose to the surface.
  - Indicates the same time as our previous analysis showed something had changed.
- The growth rates match very well with our vital rate analysis.
- Additional evidence to support this change comes from Population Reconstruction (capture records).
- How do these estimates of annual population growth (lambda) change around the ecosystem? Based on the Known Mortality Scenario:
  - Lambda in Yellowstone National Park (YNP) = slight decrease
  - Lambda outside YNP but inside recovery zone (RZ) = quite a decrease
  - Lambda outside RZ = increase

When Chuck looked at the proportion of time bears spent outside the RZ in the original Monograph there was a strong correlation with the estimate of annual population growth.

- The more time spent outside the RZ the lower the population growth.

If we look at this for the last 10 years (2002-2011), this line has flattened out quite a bit and we find no statistical difference in these lambda estimates for the three zones.

- Indicating that the population has leveled out across the ecosystem - we are filling up the ecosystem so to speak.
- If you look at residency that is confirmed.
  - Look at the number of radio locations from these different zones and we see a marked increase outside the RZ in the last decade.
- If you look at occupancy based on any type of location data we have about bears in the ecosystem you see that the range has expanded quite a bit.
- There is not a lot of suitable habitat anymore that is not occupied.

Objective #4: Revisions to Sustainable Mortality Limits

Current protocol

Interagency Grizzly Bear Study Team
P. O. Box 1376
Bozeman, MT 59715

BEAR-SQUIRREL-PINE NUT INTERACTION 1981

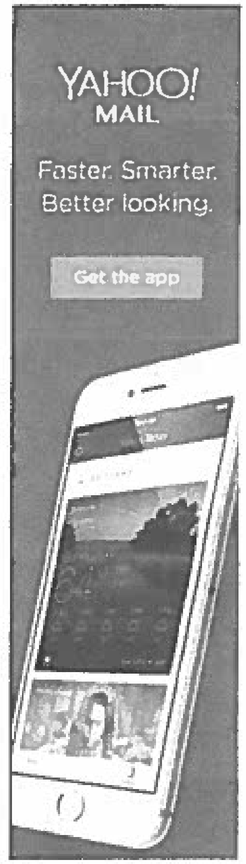
KATHERINE C. KENDALL
Interagency Grizzly Bear Study Team
P. O. Box 1376
Bozeman, MT 59715

Abstract: Whitebark pine (Pinus albicaulis) - red squirrel (Tamiasciurus hudsonicus) - grizzly/black bear (Ursus arctos/U. americanus) interactions were studied in Yellowstone National Park and adjacent areas during 1978 and 1979. Bear activity in whitebark pine stands was determined by ground examination of aerial observation sites of radio-instrumented and unmarked bears. Squirrel caching behavior and whitebark pine cone production were recorded in 10 x 25 m plots within bear activity areas. Results indicated that whitebark pine nuts are a preferred food source for Yellowstone bears, constituting 84% of the volume of all scats containing pine nuts in 1979. Pine nuts are used by bears in proportion to their availability. Virtually all pine nuts eaten by bears were obtained from red squirrel caches. Spring bear activity in squirrel middens was earliest on steep, south-facing slopes with 0.3 - 1 m of snow. Yellowstone bears and some captive bears obtain nuts from cones without consuming cone debris.

J. WILDL. MANAGE.

Key words: Black bear, food habits, grizzly bear, pine nuts, red squirrel, whitebark pine, Yellowstone National Park.

Whitebark pine nuts are an important fall and spring food for grizzly and black bears in the Yellowstone area (Mealey 1975, Blanchard 1978) and western Montana (Tisch 1961, Jonkel 1967,



Fwd: Grizzly bears (et al): Add roads, remove co ver, watch mortality increase Tuesday, January 12, 2016 9:59 AM

From: "George Wuerthner" <gwuerthner@gmail.com>
To: "Michael Garrity" <wildrockies@gmail.com>
Cc: "Sara Johnson" <sjjohnsonkoa@yahoo.com>
"Keith Hammer" <keith@swanview.org>

Full Headers Printable View

---------- Forwarded message ----------
From: Lance Olsen <lance@wildrockies.org>
Date: Tue, Jan 12, 2016 at 8:44 AM
Subject: Grizzly bears (et al): Add roads, remove cover, watch mortality increase
To: climateandbiodiversity@bigskynet.org

Biological Conservation Volume 195, March 2016, Pages 24-32
doi:10.1016/j.biocon.2015.12.020

A movement-driven approach to quantifying grizzly bear (*Ursus arctos*) near-road movement patterns in west-central Alberta, Canada
Robin Kite, Trisalyn Nelson, Gordon Stenhouse, Chris Darimont

Keywords
Wildlife movement; Disturbance; Spatial autocorrelation; Zone of influence; Grizzly bear; Roads

Highlights
*Subjective proximity thresholds limit the analysis of wildlife movement patterns.
*Consistency in movement parameters can quantify human influence on wildlife.
*Our method captures consistency in pattern to define the spatial scales of response.
*Response scales around roads varied by age, sex, and season in grizzly bears.
*Seasonal mortality can be linked to near-road movement characteristics.

Abstract
http://www.sciencedirect.com/science/article/pii/S0006320715301993
Advances in GPS telemetry and remote sensing technologies provide researchers with abundant data that can be used to investigate detailed questions about wildlife behavior. Existing methods for linking wildlife movement to remotely sensed landscape data generally rely on the application of subjectively derived distance thresholds to represent proximity (i.e., near or far) relative to disturbance, thereby possibly limiting the scope of research questions and insight gained. We develop an alternative method based on semivariogram modeling that quantifies consistency in movement parameters as a function of distance to disturbance features. Our approach uses movement data to identify spatially explicit scales of wildlife response to linear features. We illustrate the benefit of movement-driven approaches for generating hypotheses about wildlife movement with grizzly bear (*Ursus arctos*) movement data. We concentrate specifically on building hypotheses to explain how seasonal mortality is linked to near road movements. The movement-driven method demonstrated consistency in step length (i.e., spatial scales of response) ranging from 35 m-90 m from roads, depending on age, sex, and season. Given this pattern, our data suggest a minimum vegetation buffer of 90 m to serve as screening cover along roadsides to improve survival in this ecosystem. More broadly, our generalizable method can identify definitive spatial scales of response around human disturbance features in any wildlife system, thereby providing managers with movement-driven insight to reduce impacts on wildlife in multi-use landscapes.

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"But we need to be clear, the large-scale predicament and the emergent socio-economic stresses that we are beginning to experience has very little to with fraud, corruption and the greed of a tiny few. It has a lot to do with our human civilization running into limits."
http://www.resilience.org/stories/2014-03-25/anger-complicity-in-a-time-of-limits

PRELIMINARY ASSESSMENT OF SHORT-ROTATION (70-120 YEAR) TIMBER MANAGEMENT EFFECTS ON FOREST COVER TYPE COMPOSITION AND GRIZZLY BEAR

Interagency Grizzly Bear Study Team

December 10, 1983

Prepared by David J. Mattson

DEFINITIONS AND DESCRIPTIONS

Cover Type Code	Description
ASP	Aspen forms predominant or entire forest overstory
DF	Mixed-age stand of predominantly Douglas-fir
DF1	Sapling to mature stand of even-aged Douglas-fir
LPO	Regenerating stand of predominantly seedling to sapling lodgepole pine
LP1	Usually dense, closed canopy, pole-size to mature, even-aged lodgepole pine stand
LP2	Closed canopy, mature, more or less even-aged lodgepole pine stand
LP3	Usually moderately open to moderately dense, uneven-aged lodgepole pine stands, where lodgepole pine is persistent seral or climax species
LP4	Overmature, moderately open lodgepole pine overstory with spruce and fir well represented in sapling to pole or mature categories
SF1	Sapling to pole-sized stand of typically dense, more or less even-aged spruce and fir
SF	Mature to overmature spruce and fir stand, characteristically uneven-aged
WB1	Sapling to pole-sized stand of predominantly whitebark pine
WB	Mature to overmature, characteristically uneven-aged, stand with greater than 50% of the overstory composed of whitebark pine
NF	Nonforest cover type, including lithic, mesic and wet nonforest areas
LP2/NF	Either a mosaic of LP2 and NF cover types or an open mature lodgepole pine stand over characteristically lush graminoid-forb vegetation
DF/NF	Open stand of uneven-aged Douglas-fir
WB/NF	Open stand of characteristically uneven-aged whitebark pine
DF3	Mature to overmature Douglas-fir with spruce and fir well represented in sapling to pole or mature categories

Variables	Definition
PF:	$\ln(1 + \frac{OBS_x}{EXP_x})$, where OBS is the proportion of all feedsites (or daybeds) found in cover type X and EXP is the proportion of cover type X available (proportionate use versus proportionate availability) = preference
EMP. IV:	PF x USE_x, where USE_x is the proportion of all feedsites (or daybeds) found in cover type X = empirical importance value
P-ACT:	Proportion of radio relocations in cover type X at which no sign of feeding was found = in part indicates proportion of time bears were not feeding in cover type X; more appropriately used as an index
DER. IV:	(FVS_x x H_x) ÷ .621; FVS_x (food value score) is derived by the summation of weighted feeding activities known to occur in cover type X. H_x is the diversity index for feeding activity in cover type X. The value, .621, standardizes DER. IV to a maximum value of 1.0. = derived importance value.

Feeding Activity Code	Description
UNG	Feeding on ungulates, primarily elk; both carrion and kills
GOPH	Digging for voles or pocket gophers and their caches
CAMB	Stripping bark from conifers and eating cambium/licking sap
PIAL	Digging in squirrel middens primarily for whitebark pine cones
LOCO	Digging for biscuitroot (*Lomatium* spp.) roots
PEGA	Digging for yampa *(Perideridia gairdneri)* roots
CISC	Grazing thistle *(Cirsium scariosum)*
MUSH	Grazing mushrooms
SHCA	Eating Sheperdia *(Sheperdia canadensis)* berries
CLLA	Grazing and digging spring-beauty *(Claytonia lanceolata)*
ANT-LOGS	Digging in decomposing logs for ants
ANT-HILLS	Digging in ant-hills
FISH	Fishing for cutthroat trout
GRM	Grazing graminoids

Feeding Activity code (cont'd)	Description
WRMS	Digging for earthworms
EQAR	Grazing horsetail (primarily *Equisetum arvense*)
POTA	Digging for *Potamogeton* spp. roots
TAOF	Grazing dandelion (*Taraxacum* spp.)
EPAN	Grazing fireweed (primarily *Epilobium angustifolium* and *E. glandulosum*)
TRFL	Grazing and digging clover (*Trifolium* spp.)
STRW	Eating strawberry (*Fragaria* spp.)
VAGL	Eating huckleberries (*Vaccinium globulare*)
VASC	Eating whortleberries (*V. scoparium*)

Table 1. Feeding activity importance values, food value score and feeding activity diversity index by cover type.

		Feeding Activity															
		.52	(.32)	(.01)	.58	.08	.26	.16	(.01)	(.20)	.37	.13	.13	.01	.96	(.01)	.2
CT	n	UNG	GOPH	CAMB	PIAL	LOCO	PEGA	CISC	MUSH	SHCA	CLLA	ANT LOGS	ANT HILLS	FISH	GRM	WRMS	EQA
ASP	12	.17		.08								.42	.33				
DF1	7	.71										.28					
DF3	9											.89					.11
DF	22	.14		.09	.04							.54	.18				
DF/NF	1															(1.00)	
LP0	2	(.50)										(.50)					
LP1	13	.23		.08					.08	.15	.08	.38					
LP2	56	.23		.12					.07	.05		.38	.11			.04	
LP2/NF	16	.25		.31								.31	.06			.06	
LP3	36	.22			.08	.08			.08		.03	.33	.11				
LP3/NF	2										(.50)				(.50)		
LP4	42	.19		.12	.28							.38	.02				
LP4/NF	1										(1.00)						
SF1	5									(.20)		(.80)					
SF	92	.05		.15	.54							.29	.01				.02
SF/NF	3											(1.00)					
WB1	2				(1.00)												
WB	30				.87							.13					
WB/NF	2				(.50)	(.50)											
NF	236	.05	.24	.004		.10	.19	.06			.02	.01	.12	.03	.09	.01	.00

Table 2. Assessment of probable short-rotation timber management effects on grizzly bear feeding values or opportunities.

	Successional status index	Z*	Cover type	PF	EMP. IV	P-ACT	DER. IV	
Early	1	0	LPO	(.19)	(.002)	(.33)	(Low)	Mid elev
		3	ASP	(2.40)	(.12)	(.25)	(.37)	Low elev
	2	0	WB1	(.20)	(.001)	(.00)	(Low)	High elev
		-	SF1	-	-	(.17)	(.12)	High elev moist
		2	LP1	(.25)	(.01)	(.24)	(.59)	Mid elev
		2	DF1	(3.35)	(.09)	(.22)	(.39)	Low elev
	3	2	LP2	(.42)	(.13)	(.37)	(.52)	Mid elev
		2	LP2/NF	(2.87)	(.24)	(.41)	(.41)	Mid elev riparian (moist)
	4	2	LP4	(.34)	(.06)	(.29)	(.69)	Mid-high elev
		-	DF3	-	-	(.47)	(.08)	Low elev
	4.5	0	WB/NF	(.10)	(.001)	(.50)	(Low)	High elev
		3	LP3	(.65)	(.10)	(.26)	(.63)	Mid elev dry
Late		2	DF	(1.00)	(.11)	(.40)	(.39)	Low elev
↓		0	DF/NF	(.10)	(.0005)	(.50)	(Low)	Low-mid elev dry
(Climax)	5	1	WB	(.36)	(.04)	(.22)	(.32)	High elev
		4	SF	(1.51)	(.56)	(.26)	(.78)	Mid-high elev

Cover types likely to be propagated by short-rotation (70-120 yr) management:

LPO - 0
LP1 - 2
LP2 - 2
SF1 - 0
DF1 - 2

Average importance score (Z): 1.2

Cover types likely to be reduced or eliminated by short-rotation management:

LP4 - 2
DF3 - 0
LP3 - 3
DF - 2
SF - 4
(WB) - (1)

Average importance score (Z): 2.2 (2.0)

*Number of criteria (0-4) establishing importance of each cover type.

Table 3. Assessment of probable short-rotation timber management effects on grizzly bear daybed value or opportunities; 1977-78 daybed data.

	Successional status code	Z*	CT	PF	EMP. IV	
Early	1	0	LPO	.34	.01	Mid elev
		2	ASP	2.40	.13	Low elev
	2	1	WB1	1.10	.06	High elev
		-	SF1	-	-	High elev moist
		0	LP1	.28	.02	Mid elev
		0	DF1	-	-	Low elev
	3	2	LP2	.68	.52	Mid elev
		2	LP2/NF	2.40	.13	Mid elev riparian (moist)
	4	1	LP4	.46	.15	Mid-high elev
		-	DF3	-	-	Low elev
	4.5	0	WB/NF	.41	.03	High elev dry
Late		0	LP3	.40	.04	Mid elev dry
		2	DF	.95	.20	Low elev
		0	DF/NF	-	-	Low-mid elev dry
Climax	5	1	WB	.59	.17	High elev
		2	SF	1.69	1.00	Mid-high elev

Cover types likely to be propagated by short-rotation (70-120 yr) management:

LPO 0)
LP1 0)
LP2 2) Criteria "score" (0-2)
SF1 -)
DF1 0)

Average importance score: .50

Cover types likely to be reduced or eliminated by short-rotation management:

LP4	1
DF3	-
LP3	0
DF	2
SF	2
(WB)	1

Average importance score: 1.25 (1.20)

*Number of criteria (0-2) by which C.T. is "important."

RESULTS

Table 1 lists the occurrence of feeding activities by cover type and the relative importance (table value) of any feeding activity by cover type. Food value scores (FVS) and diversity index (H) for feeding activity are also listed by cover type. Food item weights associated with each feeding activity are listed above feeding activity code.

Sapling to mature, typically even-aged stands of Douglas-fir and lodgepole pine (DF1, LP0, LP1, LP2, LP2/NF) derive a substantial portion of their importance from ungulate (elk) feeding. Most often this feeding occurs in the spring coincident with elk winter range. Typically mature to over-mature spruce-fir and whitebark pine stands (SF, WB, WB/NF) derive substantial importance from feeding on whitebark pine nuts in middens. Almost all forest cover types are associated with digging in logs for ants.

Tables 2 and 3 list cover types and corresponding numeric evaluations of importance (PF, EMP. IV, P-ACT, DER. IV). Variable Z is the number of numeric evaluations substantiating the importance of corresponding cover types. Values of Z ranging from 3 to 4 reliably indicate the high importance of corresponding cover types. An average value of Z is also calculated for groups of cover types either likely to be propagated or reduced by short rotation management.

DISCUSSION

These results are substantive although not final. Several feeding activities not discernible by feed-site analysis are not accounted for by the derived importance values. Later analysis will account for these more elusive feeding activities; derived importance values will likely not change significantly, however.

The use of several criteria (two for daybed cover-type use and four for feeding activity cover type use) lends weight to the assessment of cover type importance to grizzly bear. Actual importance is a probable function of feeding and cover opportunity as well as intangibles such as learned or habitual behavior not readily attributable to site characteristics other than location. Therefore, "importance" is only estimated by this assessment.

Data from the entire grizzly bear range in and around Yellowstone Park was used. The nature of cover type use appears to be more or less consistent throughout grizzly bear range. Availability of cover types differs, however. Consequently, in any one area, grizzly bear may eat more ants, for example, in one cover type than another based strictly on availability.

Use of the Douglas-fir (DF and DF1) and probably aspen (ASP) cover types very likely reflects the availability of winter-killed or weakened ungulates (primarily elk) (Table 1). Therefore, the "importance" of these cover types may be a substantial function of coincidence with elk winter range.

Tables 2 and 3 results show that the reduction of overmature and mixed-age stands over a broad area in favor of early successional, even-aged immature stands would very likely be detrimental to grizzly bear. Average importance score (Z) for early successional cover types (LP0, LP1, DF, SF1, LP2) is less than for late successional or climax cover types (LP3, LP4, DF, SF, WB). On the other hand, the assessment does not indicate elimination or reduction of early successional cover types would benefit grizzly bear either. Rather, grizzly bear utilize almost all cover types, with a preference towards late successional types. Maintenance of area-wide stand diversity approximating natural conditions, including late successional and climax stands, is a management objective suggested by this assessment.

Effects of access and cover type juxtaposition are factors not covered by this assessment. Both factors are influenced by short rotation timber management and likely have critical influence on grizzly bear well-being and survival.

6/7/91

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MICRO-SCALE SECURITY AREAS FOR YELLOWSTONE GRIZZLY BEARS

Rationale

Historically, North American grizzly bears did not persist in areas with even moderate densities of humans and livestock (Mattson 1990). Grizzly bears continue to be killed by humans for numerous reasons, most commonly because of conflict over common resources (e.g., livestock and other human foods) or because the bear is percieved as a threat (Craighead et al. 1988). Human-bear conflicts often revolve around bears habituated to humans as they pursue natural or human-food related feeding opportunities near humans (Meagher and Fowler 1989; Mattson et al., in prep.). By inference, as human access and acitivites increase in an area, increasing numbers of bears are forced to come into contact with and tolerate humans as they use their natural habitat. Circumstantial evidence suggests that this results in an increased frequency of bears habituated to humans (McArthur-Jope 1983; Mattson 1990; Mattson et al., in prep.), and increased bear mortality either because of chance encounters with humans, where humans claim self-defense, or because management agencies judge the bear's tolerance to be a risk to humans (Mattson et al., in prep.).

Almost certainly, existing grizzly bear populations survived where frequencies of contact with 19th and 20th-century technological humans were very low. Although grizzly bear mortality can be regulated and influenced by changes in human attitudes, it seems unlikely that humans will generally tolerate much contact with an animal, like the grizzly bear, that is a direct competitor for foods (Mattson 1990) and a potential hazard (Herrero 1985). Thus there is a strong case for preserving areas where grizzly bears will be secure from encounters with humans; where bears can meet their energetic requirements while at the same time chosing to avoid people. Such areas would foster the wary behavior in grizzly bears that most managers consider to be desirable. In conjunction with management of attractants around human facilities and town sites, security areas could help to significantly reduce the incidence of poached bears, and bears killed out of self-defense or killed by management agencies because of undesirable behavior.

Parameters

Existing analyses of telemetry data from radio-collared grizzly bears provide a basis for estimating dimensions and spacing of security areas, suitable for the scale of an individual bear's home range. Wary bears consistantly avoid areas within 2 km of major roads and 4 km of major human developments or townsites (Mattson et al., in prep.). Bears that use areas near roads and developments exhibit disrupted foraging behavior out to the same distances (Mattson et al. 1987). These patterns logically suggest that security areas should be a minimum of 4-8 km in diameter to provide any buffer for bears exhibiting the preferred wariness of humans. Ideally this core area should be surrounded by an additional buffer corresponding to the average 24-48 hour foraging radius of grizzly bears, to allow bears additional space to meet foraging requirements without confronting people. The average 48-hour foraging radius of 3 adult female grizzlies monitored a total of 8 times was 0.96 km (Haroldson and Mattson 1985). Thus, micro-scale security areas should be an absolute minimum of 6 km in diameter or 28 km^2 (ca. 5,400 acres). If these areas were roughly pentagonal in shape, radii would vary from a maximum of 3.4 to a minimum of 2.8 km.

Ideally, spacing of these security areas would allow near full use of habitat by bears wary of humans. Thus distances between neighboring security areas would be no more, on average, than 2X the mean 48-hour foraging radius. After accounting for angular irregularities, this distance averages 1.8 km. If an entire analysis area or bear home range (averaging 884 km^2 for an adult female life range [Blanchard and Knight, in press]) were apportioned by these guidelines, 58 % would be security areas. Under less favorable conditions, existing or planned security areas should contiguous and part of a functional network rather than be scattered and isolated.

Identification

No absolute criteria are avialable for identifying security areas. However in a general sense security areas should receive very little or no use by humans. This may be due to poor human access, and could be achieved in candidate areas by effective road closures (i.e., closures that discourage even foot travel). Security areas may vary temporally as well as spatially as human use varies. Back-country or non-roaded areas should not automatically be considered security areas. Some back-country areas receive high densities of human use, especially during big-game hunting seasons. Optimally, security areas consist of areas not only secure from human access but also areas containing high value bear habitat.

Functionally, security areas can be identified by a series of map overlays done either manually or by a GIS. The optimal sequence will be (1) an initial screening with respect to existing open roads, (2) a subsequent screening to identify high-priority security areas containing high-quality bear habitat; and (3) a final screening to identify canditate areas where sufficient road-closures could create a security area.

To facilitate use and recognition of security areas by bears, these tracts should be secure for a minimum of 5 and preferably 10 years. Although not as critical, security areas should be secure during all seasons, but especially during the season of peak value to bears.

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USE OF LODGEPOLE PINE COVER TYPES BY YELLOWSTONE GRIZZLY BEARS

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Abstract: Lodgepole pine (*Pinus contorta*) forests are a large and dynamic part of grizzly bear (*Ursus arctos*) habitat in the Yellowstone ecosystem. Research in other areas suggests that grizzly bears select for young open forest stands, especially for grazing and feeding on berries. Management guidelines accordingly recommend timber harvest as a technique for improving habitat in areas potentially dominated by lodgepole pine. In this paper I examine grizzly bear use of lodgepole pine forests in the Yellowstone area, and test several hypotheses with relevance to a new generation of management guidelines. Differences in grizzly bear selection of lodgepole pine cover types (defined on the basis of stand age and structure) were not pronounced. Selection furthermore varied among years, areas, and individuals. Positive selection for any lodgepole pine type was uncommon. Estimates of selection took 5–11 years or 4–12 adult females to stabilize, depending upon the cover type. The variances of selection estimates tended to stabilize after 3–5 sample years, and were more-or-less stable to slightly increasing with progressively increased sample area. There was no conclusive evidence that Yellowstone's grizzlies favored young (<40 yr) stands in general or for their infrequent use of berries. On the other hand, these results corroborated previous observations that grizzlies favored open and/or young stands on wet and fertile sites for grazing. These results also supported the proposition that temporally and spatially robust inferences require extensive, long-duration studies, especially for wide-ranging vertebrates like grizzly bears.

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Key words: cover types, feeding activity, forest management, grizzly bears, habitat ecology, habitat selection, lodgepole pine, resource selection, Yellowstone National Park, *Ursus arctos*

Lodgepole pine is the most common overstory tree in the Yellowstone ecosystem. About 67% of forests in Yellowstone National Park (Despain 1990) and 48% of forests on adjacent public lands (Greater Yellowstone Coord. Comm. [GYCC] 1987) are dominated by this species. The structure and age of lodgepole pine forests have been influenced in recent years primarily by stand replacement fires, mountain pine beetle (*Dendroctonus ponderosae*) epidemics, timber harvest, and increasing dominance of more shade tolerant species (Cole and Amman 1980, Lotan and Perry 1983, McGregor and Cole 1985). Major mountain pine beetle epidemics swept through the western-half of the ecosystem from the 1960s through the mid-1980s (McGregor and Cole 1985, Despain 1990). Timber harvest was increased on national forests to salvage merchantable beetle-killed timber, reduce fire hazard, and support local timber industries (Cole and Amman 1980, Cole 1985). About 68,000 ha of lodgepole pine forests on public lands were harvested during this period, typically by clear-cutting (Cole 1985, GYCC 1987). An additional ca. 562,000 ha of the ecosystem were partially or completely burned by wildfires during 1988, including substantial areas that had been occupied by mature lodgepole pine forests (Romme and Despain 1989, Schullery 1989).

Because Yellowstone's lodgepole pine forests are extensive, I anticipated that changes in their manage specific areas with allowance for seasonal or annual variation in use. Making the critical assumption that sampling bias was spatially and temporally uniform, use of years and analysis areas as sample units allowed me to estimate variation in these explicit dimensions, and also provided estimates of selection that were specific to a given time or place.

Grizzly Bear Activity

By negative evidence (i.e., lack of feeding and bedding sign or coincidence with a trail), grizzly bears used the recently disturbed LP0 type primarily for travel. These relatively open sites presumably facilitated movement, although I question whether this result would be repeated with data collected 20 years after the 1988 fires, after most currently standing snags had fallen (Lyon 1984). As expected by studies elsewhere, grizzlies also made greatest use of the open LP0 and LP/NF types for grazing forbs and graminoids, especially on wetter, more fertile sites. Based on these results, I confidently rejected H_{a3}. On the other hand, and again as expected by open stand conditions, grizzlies strongly avoided the LP0 type for bedding. Together, these observations suggested that grizzly bears derived less net energy from their use of the LP0 type especially compared to their use of the LP1, LP, and LP/NF types.

With the exception of mushrooms, grizzly bear use of the highest quality foods in lodgepole pine forests was not associated with forest structure, and in the case of berries and ungulates, was not contingent upon habitat type. This result was partly a function of small sample sizes and low statistical power, especially in the case of berry and whitebark pine seed use. Only 15 instances of berry use were recorded at radiotelemetry locations in lodgepole pine forest during 16 years of data collection. This infrequent use of berries agrees with the infrequent presence of berries in grizzly bear feces from the Yellowstone area, especially in contrast to the feces of grizzlies in northwestern Montana and southern Canada (Mattson et al. 1991). Nonetheless, these 15 instances of berry use were not obviously related to successional stage, and are a tentative basis for not rejecting H_{a2}. In the case of whitebark pine, it is implausible, a priori, that use was not related to stand age. Whitebark pine does not produce seeds under typical stand conditions within 40 or even 100 years of stand replacement disturbance (Mattson and Reinhart 1994). However, forest structure probably had little effect on seed use after canopy closure.

MANAGEMENT IMPLICATIONS

These results do not support the premise that widespread conversion of lodgepole pine forests to early successional stages would benefit grizzly bears in the Yellowstone area. There is no rationale here for the systematic harvest of older stands to increase bear use of berries. Yellowstone's grizzlies consume few berries probably because of climatic constraints especially upon globe huckleberry production (Mattson et al. 1991, Mattson and Reinhart 1994). There is also evidence that in areas of Yellowstone where berry consumption is more common (as on the Targhee National Forest), globe huckleberry is substantially diminished by total overstory removal, especially on drier or more exposed sites (Martin 1983, Orme and Williams 1986). On the other hand, these results support the proposition that grazing opportunities for bears can be increased by logging on wetter sites, although it is highly improbable that grazing opportunities limit grizzly bear densities anywhere in the Yellowstone ecosystem (Bunnell and Hamilton 1983, Pritchard and Robbins 1990, Mattson 1997*b*).

Even so, these results suggest that Yellowstone's grizzlies would not respond strongly to any changes in lodgepole pine forest structure, per se, with the following 2 provisos. First, I cannot address the effects of changes in landscape-level structure of lodgepole pine forests beyond the range of what was analyzed here. This point holds for effects of the 1988 fires, especially given the attrition of snags expected during the next 2 decades (Lyon 1984) and the possible complications to movement posed by such an accumulation of large woody debris (Fancy and White 1985). Second, because whitebark pine seeds are a high quality food, and because seed production is limited to mature or near-mature trees, grizzlies will be affected adversely by the removal of lodgepole pine-dominated stands that contain productive whitebark pine (Mattson and Reinhart 1994).

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genetics rebuttal Tuesday, December 15, 2015 9:57 AM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "SJ Johnson" <sjjohnsonkoa@yahoo.com>

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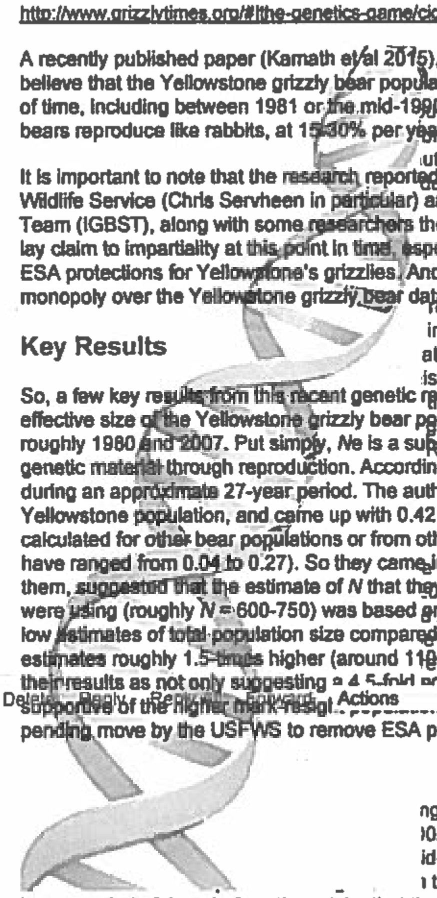
Sarah, here is David's response on my web site and the link. doak is trying to get a colleague with genetics expertise to take a look too... best, Louisa

http://www.grizzlytimes.org/#!the-genetics-game/cigia



A recently published paper (Kamath et al 2015), featuring genetics, could lead a naive reader to believe that the Yellowstone grizzly bear population had increased by 4.5-fold during some period of time, including between 1981 or the mid-1990s and 2002. (More on that a little later.) Or, that bears reproduce like rabbits, at 15-30% per year. This doesn't pass the laugh test.

...uld be understandable if the average reader simply surrendered him-or herself to ...biased) authors. But there are some major logical problems with the results prese... ...uthors. Moreover, the deployed methods are yet another instance where arcane ... ...ded on numerous often dubious assumptions, are offered up as some sort of

It is important to note that the research reported in this paper was funded by the US Fish & Wildlife Service (Chris Servheen in particular) and authored by the Interagency Grizzly Bear Study Team (IGBST), along with some researchers they invited to participate. None of these players can lay claim to impartiality at this point in time, especially when it comes to the agenda of removing ESA protections for Yellowstone's grizzlies. And all have fought tooth and nail to maintain a monopoly over the Yellowstone grizzly bear data.

Key Results

So, a few key results from this recent genetic research: This paper claims that the genetically effective size of the Yellowstone grizzly bear population (denoted Ne) increased 4.5-fold between roughly 1980 and 2007. Put simply, *Ne* is a subset of the total population (denoted N) contributing genetic material through reproduction. According to this research, *Ne* increased from 100 to 450 during an approximate 27-year period. The authors also calculated the ratio of *Ne* to *N* for the Yellowstone population, and came up with 0.42 to 0.66, which is substantially higher than ratios calculated for other bear populations or from other data (other results, at least the point estimates, have ranged from 0.04 to 0.27). So they came in more than twice as high. Which, according to them, suggested that the estimate of *N* that they were using was too low. In fact, the estimate they were using (roughly *N* = 600-750) was based on the Chao2 method, which is known to produce low estimates of total population size compared to another method (mark-resight) which produces estimates roughly 1.5-times higher (around 1100; see The Numbers Game). So they interpreted their results as not only suggesting a 4.5-fold population increase since 1980, but also as being supportive of the higher mark-resight population estimates... which is clearly supportive of a pending move by the USFWS to remove ESA protections for Yellowstone's grizzlies.

...researcher, Craig Miller, also estimated *Ne* for the Yellowstone grizzly population ... including a dissertation published in 2004 (for a summary of his results relative to ... at *Ne* for Yellowstone's grizzly bear population was around 80 between roughly 1... ...is. But Craig also estimated *Ne* for the 1990s using data collected from Yellowsto... ...this period that was a bit more than 100. On top of this, consider that the mark-re... ...grizzly bears suggests that there was no increase (possibly even a decrease) bet... ...Remember that these mark-resight estimates are recommended by the research...

...us for the 1990s (Craig Miller's estimate) and accept that there has not been ...002, then the 4.5-fold increase in *Ne* offered by the Kamath paper would have had ...to 2002. That is roughly a 21% per annum rate of increase...which is unheard of in ...ever recorded have been closer to 10-15% per annum. And there is no indicatio... ...ates of the growth trend of the Yellowstone grizzly bear population ...Only the most optimistic (and biased) estimates of growth are

...ng advocates is to either reject Craig Miller's estimate for the 1990s or reject the e... ...002. The latter move would be in defiance of some pretty overwhelming evidence. ...id-1990s, you would be looking at sustained annual rates of increase for the perio... ...the most ardent apologists for population growth don't claim this rate of increase ...long a period of time. In fact, they claim that the turn-around for the population didn't happen until the late 1980s. And you woul... having to explain why you rejected Craig's estimate.

Illogical Extrapolations

Another problem has to do with the tacit assumption, embedded in the Kamath paper results, that *Ne* is essentially perfectly cor... with *N* over time. Meaning, that because (presumably) *Ne* has increased by 4.5-fold, then total population size did as well. Whic... bear managers have quickly claimed. This gets us into The Numbers Game.

Pretty much all of the available population estimates suggest that the Yellowstone population grew little if at all up until the 199... (see The Numbers Game). However, there are two population estimates from the 1990s that provide a helpful benchmark. One ... around 1992, and came in at 325 (with a huge confidence interval). Another was made for 1997, and came in around 420. So le... that the population itself (*N*) grew by 4.5-fold since either 1992 or 1997. This would mean a current population of between 1500

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1900 bears, and a growth rate between either 1992 or 1997 and 2002 of around 15-30%. All of these numbers are totally out of Not even close to what's biologically possible, or in line with any other available evidence. The highest population estimates cur being bandied about are 1000-1200 and (as noted earlier) the most optimistic population growth rates come in at only 4-7%.

The Problem of Models

The most logical conclusion from all of this is that there is something fundamentally flawed about the research reported in the K paper. Is this possible? Answering this question gets into the nature of the methods used to estimate *Ne* and the assumptions u which those methods and related models are built. Suffice it to say, the methods are amongst the most arcane out there and bu veritable tower of assumptions about genetic, demographic, and sampling processes. For a brief overview see the paper by Ha colleagues. Even a cursory overview of how an analysis might go wrong gets into the deep dark weeds. But perhaps it is suffici say that the methods and derivative results are pretty far abstracted from any tangible reality. So, yes, the analysis done by Kla warrants skepticism on the basis of first principles and the logical violations outlined above.

Let's Play Monopoly

But this critique needs to end, yet again, with the problems that inevitably arise whenever any group of scientists holds a monop scientific inquiry. In short, such circumstances debar any confidence in the results produced by such a group—such as the IGB: the scientists it invites to participate. The only way to produce reliable scientific results is to have multiple independent (and con scientists double-checking each others' work, whether by repeating experiments or reanalyzing data in instances where there is one possible dataset. And such is the case for Yellowstone's grizzly bears, where there is only one Yellowstone population, anc one set of data. The extent to which the IGBST and its primary funders have fought to maintain a monopoly can only invite susp especially in instances such as this one where some of the results defy logic and any other available evidence.

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Fwd: Thursday, December 17, 2015 10 40 AM

From: "Louisa Willcox" <wildgriz1@gmail.com>
To: "Louisa Willcox" <wildgriz1@gmail.com>
Bcc: sjjohnsonkoa@yahoo.com

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All, here is David's first blog... enjoy! Louisa

http://www.grizzlytimes.org/#!Grizzly-Sardine-Can-Blues/c1ou2/5672e2ab0cf2fb0fe5b252ad

Grizzly Sardine Can Blues

December 17, 2015

|

David Mattson

We can't support any more bears. We've got bears coming out of our ears. We've reached carrying capacity Such is the purported state of grizzly bears in Yellowstone.

Sound familiar? It should. For those of you who have been paying attention to the rhetoric voiced by agency spokespeople during the last few years, you will have heard the refrain about too many bears in too little space over and over again. In fact, this claim undergirds much of the argument made by the US Fish & Wildlife Service (FWS) and state wildlife managers for removing ESA protections from Yellowstone's grizzlie (which is to say, "delist" them). Just a few weeks ago, in a conversation with environmentalists, FWS Direct Dan Ashe emphasized that "the Yellowstone ecosystem just can't hold any more bears." Frank van Manen, leader of the Interagency Grizzly Bear Study Team (IGBST) put it another way: "we are packing more sardines in the sardine can."

If you were inclined to defer to the agency experts, you would probably heave a sigh and say, "well, I guess we just need to move ahead with delisting Yellowstone's grizzly bears. We've reached carrying capacity." In fact, that is the outcome that the agency experts probably hope for and expect.

Well... I would argue that there is cause to question the experts in this instance. In fact, there is an increasin and to my mind wholly justified tendency for the public to question experts, especially when there is reason suspect that they are politically motivated. And there is ample evidence for political motivations behind what we are hearing from spokespeople for all of the agencies involved in managing Yellowstone's grizzly bears, including the government's scientists (for more on this follow this link and this link).

Unpacking the Sardine Can

To start, it is worth unpacking the concept of "carrying capacity" given that this term is being bandied about with such abandon by government scientists and managers. To listen to van Manen you would think that the number of grizzlies able to live in the Yellowstone ecosystem (i.e., "carrying capacity") is a static food-relate attribute of the land contained within a fixed box. Hence the sardine metaphor.

The truth could hardly be more different. Even accepting the notion of fixed boundaries, within those bounds the food-related capacity of any given acre varies from month to month and year to year. In fact, we've seen a long-term and sustained decline in the availability of high-quality foods that has almost certainly caused a decline in the intrinsic food-related capacity of Yellowstone's core habitat to sustain grizzlies. Cutthroat trout have nearly disappeared; whitebark pine has been substantially reduced; and elk herds have declined, som dramatically. That's three of the four legs of the food stool that has supported Yellowstone's grizzly bears (tl fourth leg is army cutworm moths). All of the evidence belies any claims, implicit or otherwise, that food-related carrying capacity is static. If anything, the sardine can has shrunk in size.

More importantly, carrying capacity is determined not only by the food-driven rate at which females produce cubs, but also by the rate at which grizzly bears of all description die. So, mortality is a major part of the equation. And guess what causes most deaths of adult grizzlies in Yellowstone? People do. So our lethality to bears is a big part of the carrying capacity equation. Which comes down to our collective attitudes and behaviors, and the extent to which they translate into dead bears. More on this a little later.

And the rate at which young bears (i.e., cubs and yearlings) die also matters. As it turns out, death rates of cubs and yearlings have increased substantially of late, primarily due to "natural" causes—including bears killing bears. Again, to listen to van Manen you would think that young bears in Yellowstone are dying in increasing numbers simply because of increasing densities of adult grizzlies, likening these adults to a bunc of equally lethal pinballs bouncing around according to some random Brownian motion in a fixed space. Toc many damn sardines. More on this a little later as well.

The notion of fixed boundaries to an immutable box is a final major fallacy in the government's "carrying capacity" argument. The capacity of Yellowstone's ecosystem to support grizzlies is determined not only by the per acre abundance of foods and the unit area lethality of the landscape, but also by the extent of the area within which bears can live and contribute to the larger population. And clearly, this extent has increas substantially over time. We have grizzlies living in roughly twice the area we had them in the 1970s. Moreover, there have been multiple analyses, by government and independent scientists alike, showing tha there is ample habitat with natural foods sufficient to support grizzly bears in places where grizzlies have no yet established themselves: the southern Wind River Range, the Palisades area, the Centennials, and more

A Social Sardine Can?

And, yet, the FWS and their minions claim that the box is fixed, invoking yet another pseudo-idea, that of "social carrying capacity." More to the point, the FWS claims that there is no more space for grizzlies in Yellowstone because "people" will not accept them anywhere else. So now we have gone from the simplisti static, food-based, box of van Manen's to a concept fielded by the FWS that begins to grapple, at least on tl face of it, with the aspect of carrying capacity that relates to human attitudes and lethality.

But who are these "people" anyway, and who queried them, how? As it turns out, "people" amount to ranchers, outfitters, and others with enough political clout to bully not only state wildlife managers, but also the FWS. As a result, "social carrying capacity" has been defined by a few regressive energy executive as well as some sheep and cattle ranchers who don't want to live with grizzlies, not by the people whom the agencies are supposed to be serving under the rubric of the public trust. "Social carrying capacity" turns out to be a convenient political ruse, not any sort of on-the-ground reality determined by the attitudes, choices, and behaviors of a wide range of relevant people. In fact, the sardine can could be a whole lot bigger.

The Density Ruse

So, let's return briefly to the density issue, which is closely tied to the notion of carrying capacity and blithely invoked to explain rising deaths of young bears. Have grizzly bear densities actually increased, as van Manen claims? And, if so, are high densities the reason for increasing death rates among young bears? We the answers are No, and Probably Not. As it turns out, the Yellowstone grizzly bear population has not increased to any extent during the last 15 years. It may have even been declining since 2007 (see some inf on all of this here and here). At the same time, the distribution of this population has increased by over 40% Ergo, density axiomatically decreased—not increased. Which debars a connection between deaths of cubs and yearlings and densities of adults, as such. More likely, cubs and yearlings are dying in greater numbers because their moms have turned increasingly to eating meat (including livestock) to compensate for losses whitebark pine and cutthroat trout. And meat-eating is an incredibly hazardous undertaking for any bear, especially those with vulnerable young (for more information follow this link).

Putting this all together, we have a narrative being promoted by our government officials that is based on a simple-minded, poorly conceived, and highly-politicized notion of this thing called carrying capacity.

Moreover, the government narrative is at odds with the best available evidence. All of this politicized spin being billed under the rubric of "science" is clearly designed to support the agenda of delisting Yellowstone's grizzly bears.

Out of the Sardine Can

In fact, what we have is a picture altogether different from that being painted by government managers and scientists. We have a box with highly fungible and potentially much expandable boundaries within which we have experienced major declines in food-related carrying capacity, but within which, also, we've increased carrying capacity attributable to major beneficial changes in human attitudes and behaviors—related to increased sanitation, other controls on human foods, and reductions in livestock. Bear densities have declined, at the same time that distributions have expanded and grizzlies have turned to eating alternative foods, many of which are concentrated on the peripheries of the current ecosystem. This is not a sardine ca being crowded by ever greater numbers of sardines.

But perhaps the most important point is one that features us—and what goes on between our ears. History has shown that perhaps the most important determinant of the numbers of grizzly bears that can live in any given area is our behaviors. In turn rooted in our worldviews; how we see ourselves in relation to the world and to the creatures in it. There is no doubt that our European ancestors saw no place for grizzlies in the world. And they proved it by killing 99% of all grizzlies in 98% of all the places they once lived. But we are n our ancestors.

We have the chance to create a world where grizzlies and people coexist in places where we probably can't even imagine it is possible. But, believe me, it is possible. Grizzlies have proven that they can tolerate us ar live among humans with few problems. The famous mother grizzly of Pilgrim Creek, bear #399, is one amor many that has proven the point (for some more information on her see thisChristian Science Monitor article) It comes down to us, and the grace and compassion we can bring to coexisting with grizzly bears.

Director Ashe and Dr. van Manen are wrong. We can have more grizzly bears in Yellowstone. And we shou have.

--
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- Why Delisting is a Bad Idea: http://www.grizzlytimes.org/#!delisting-a-bad-idea/c15sd

- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sy
- Cool Video: The Changing World of Yellowstone Grizzly Bears: https://m.youtube.com/watch?feature=share&v=VqgRHZr0bNQ

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Fwd: Grizzly Times, Hunting to Scare Grizzlies? Dr. David Mattson, 1.13.2016 Thursday, January 14, 2016 11:19 AM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Hi All,

Another from David,

Seems timely given the mounting rhetoric on grizzly hunting. Louisa

http://www.grizzlytimes.org/#!Hunting-to-Scare-Grizzlies/c1ou2/5695cb910cf263fc5a89bf50

Hunting to Scare Grizzlies?

January 13, 2016

|

David Mattson

Kill grizzly bears to make them afraid of humans. This idea has gotten a lot of air time in recent years as one of several justifications for removing endangered species act (ESA) protections for Yellowstone's grizzlies, most recently in a January 10th editorial by the Editorial Board of the Bozeman Chronicle. Delisting (another term for removing ESA protections) would clear the way for a sport hunt managed by the states of Wyoming

Montana, and Idaho, which are currently squabbling over a share of the sport kill in anticipation of devolutio of authority from the federal government to them.

The idea of instilling fear in grizzlies through a hunt is emotionally charged because there have been severa bear-caused human fatalities in the Yellowstone region during the last few years. The media, of course, has duly sensationalized each death. So the idea is to have sport hunters kill grizzlies to teach them to fear people. As a result, there will be fewer bear attacks. People will be safer. To borrow a phrase from Valerius Geist, a proponent of hunting bears, people will have "freedom of the woods." Hmm. Well...

Although some people obviously consider hunting to be a self-evident guarantor of human safety, there is, i fact, little or no empirical support for this proposition. There is essentially no evidence that a sport hunt instil fear in grizzlies. The proposition also defies logic and everything that we otherwise know about grizzly bear If nothing else, how can a dead bear learn anything? A point that has been made by many others besides me.

Having made my assertion, I should probably elaborate, noting, though, that a thorough review of the evidence (or lack thereof) would probably bore you, the reader, to tears. Which means that I will confine myself to a (relatively) brief and necessarily cursory overview. So put on your seat belt and send me your questions if you want more detail.

Grizzly Bear Fundamentals

The first point to be made is that grizzly bears exist at a baseline characterized by a greater tendency to respond aggressively to perceived threats compared to other bear species. Steve Herrero, a Canadian behavioral ecologist, was the first to speculate that this aggressiveness was rooted in the evolutionary histo of grizzlies. Grizzlies (AKA brown bears) evolved in open environments where safety depended on standing your ground and intimidating or beating back any threat. (You can find more on the formative evolutionary environments of grizzlies by following this link and this link).

Even so, grizzlies can exhibit a high degree of tolerance for humans and other bears that might otherwise b viewed as threats. You can see this in coastal environments where bears have become highly socialized an tolerant of each other because of frequent interactions with conspecifics concentrated around salmon spawning streams. Or among bears that have interacted enough with benign humans to internalize a less fear-based response—a process known as "habituation."

So, a couple of key points are worth making at this juncture: First, grizzlies seem to be hard-wired genetical to deal with perceived threats aggressively. Second, and perhaps more importantly, grizzlies can become less reactive to people, not as a result of heightened fear, but rather as a result of the opposite. These fundamentals alone call into question the logic of using hunting to increase human safety. Killing grizzlies (and, as I address later, we've done a lot of that even with ESA protections) is unlikely to rewire the genetic underpinnings of their behavior; and less fear rather than more is probably going to make people safer, especially if we continue to reduce the number of circumstances (e.g., garbage around human residences o hunters near freshly-killed elk) that allow people to do things that trigger aggressive responses from even th most tolerant bears. More on that a little later.

Welcome to the Vacuum

Another important point to make up front is that we know virtually nothing about the behavioral and motivational responses of bears to hunting, certainly little that is grounded in research. The closest we come is a study out of Scandinavia showing that hunted brown bears increased their night-time activity, with little obvious relevance to whether humans were thereby safer. A coarse-grained review by Jon Swenson, a Scandinavian bear researcher (and, for a while, a Montana biologist), suggested that hunted European brov bears might be more wary, but that this possible behavioral response was trumped by whether food was available near people. Bears were likely to seek out food regardless of whether they were hunted or not, which goes back to my point immediately above about garbage and hunter-generated carrion.

By contrast, we know quite a bit about the negative and often unintended consequences of selectively hunting adult males of various carnivore species. Insofar as livestock depredation and other conflicts are concerned—including the type that could lead to human injury—we tend to get more rather than fewer. This is because adolescent males tend to gravitate to areas where the dominant resident males have been removed by hunters. And adolescent male bears are notoriously prone to push human boundaries. Moreove sport hunting tends to disrupt the social order of bear populations, which often results in more cub-killing by males and, with that, unexpected and sometimes problematic population declines.

So, a couple more points: There is little or no direct evidence that bears become warier with hunting, and certainly no evidence that people become safer. On the other hand, conflicts with people can paradoxically increase, along with unanticipated declines in bear populations. So, again, not a compelling case for the benefits of sport hunting.

The Immediate Circumstances of Attacks

At this point I return to Steve Herrero, who has spent essentially his entire professional career looking at the immediate circumstances of bear attacks, with emphasis on behaviors of the involved people and bears. Hi research shows that most attacks by grizzlies happened because people were moving quietly (or sometime rapidly) through the woods, or because the bears were lured to the vicinity of people by food. The former se of circumstances led to surprise encounters. Adult females with cubs almost invariably responded aggressively to protect their young. On the food front, when grizzlies spent more time around people the od mounted of us doing something stupid (or unintentionally risky), or of bears simply getting curious. So, surprise encounters and foods that attract grizzlies are prominent drivers of risk. And, again, foods were typically in the form of garbage or the remains of elk and moose that hunters had recently killed. Only rarely did Steve find that outright predation was a factor, typically as night attacks on people camping in tents.

This comports with what we know of circumstances surrounding the bear attacks that have occurred around Yellowstone. Several people have been injured or even killed because they were moving quietly through the woods (sometimes jogging), surprising a female that then defended her cubs, or a bear that defended a carcass, or, in the case of some hunters, just simply a bear that defended its personal space. But surprise encounters are a central theme. Then there were the few night attacks on people in tents, probably (or, in o instance, almost certainly) by bears that were in the habit of checking out campgrounds for food. So, the foc factor. And then there were the odd-balls, such as the botanist killed by an enraged boar grizzly recovering from being trapped and drugged (again, a surprise encounter), or the photographer killed by a frantic female that he had pushed beyond endurance. In this latter case, the stupidity factor.

So, given these concrete circumstances, what can be deduced about prospects for increasing human safety by hunting grizzlies? Well... unless you kill most bears, you are not going to substantially reduce the chance of surprise encounters. Nor, as I noted earlier, are you going to eliminate the hard-wired tendency for grizzli to defend themselves from a perceived threat when surprised, especially when guarding cubs or food. Hunting also does not deal with the availability of foods near people. And we would be foolish to expect that grizzlies will be less motivated to procure food because we are hunting them. Obtaining food is another harc wired drive for bears, especially during the late summer and fall when they are putting on fat to get through hibernation. And hunting does not address the stupidity factor.

As a bottom line, when looking at the reasons why people get injured by grizzlies, I am hard-pressed to divi how hunting will increase human safety. Unless, perhaps, we kill most of the grizzly bears in and around Yellowstone, as our European ancestors did.

And We've Already Run the Experiment

On top of this, we've already run the experiment and found no evidence that it has worked. Which is to say, we've functionally been hunting Yellowstone's grizzlies for years, complete with gunshots, blood, gory remains, and lots of associated human scent and sign. Think, for example, of all the grizzlies that have beer killed by big game hunters during surprise encounters or in conflicts over hunter-killed elk—increasingly. Or by ranchers and other people in defense of life-and-property. Functionally this is probably little different from a sport hunt, except in the heads and on the balance-sheets of wildlife managers. We've essentially been hunting grizzlies in Yellowstone, without any evidence that it has affected human safety one way or another

And What About Yellowstone Park?

And then there is Yellowstone National Park, where a substantial proportion of the bear attacks and resulting human fatalities have occurred. There will not be a sport hunt in the Park, even with a delisted grizzly bear population. So, even assuming the unlikely--that hunting would cause bears to avoid us becaus they are more fearful, how will this effect be propagated through over 2 million acres in the core of the ecosystem? From hunted bears on the periphery, which will presumable be killed by humans at a higher rat compared to protected bears living in the core--in Yellowstone Park? In the face of a resulting net movemen of bears outward rather than inward? Unlikely.

But We Probably Can Make Bears Fear Us Even More

At this point I've run much of the gauntlet of evidence and found little or no support for the idea that human safety can be enhanced by sport hunting. At least the traditional kind of sport hunting that focuses on killing trophy-worthy adult males, with little overt selection for bears known to be involved in conflicts with humans.

But there is a kind of hunting that probably could have an effect, and to understand this potential we need tc look at what we know about relations among bears. More specifically, bears fear other bears, more than the probably fear humans. And there are reasons for this.

For example, there is ample evidence that fear motivates adolescent bears and females with young cubs to exert themselves to avoid other adults, even to the extent of spending more time near people. In fact, we ca unintentionally serve as shields of sorts for bears that are seeking protection from aggressors of their own species. There are several reasons for all of this. Adolescents are often chased by solitary adults, and on occasion, probably thrashed to within inches of their lives... sometimes even killed. Likewise, cubs can be killed during encounters with adult grizzlies other than their mother, a phenomenon known as infanticide. All of this entails unpleasant experiences and interactions that happen on a relatively frequent basis, which fosters learning and even generalization of experiences.

So, what does this have to do with how we might hunt Yellowstone's grizzlies, with the objective of engendering fear of humans? It seems pretty obvious. You selectively hunt and kill cubs--but leave the mothers alive. And you trap bears, with an emphasis on adolescents, club them to within inches of their live and then let them go. And do this repeatedly and for as many bears as possible.

Having suggested such an approach, I find the prospect disgusting. But, then, I am sure there are some hunters out there that would relish the prospect of killing cubs and torturing trapped bears. The same hunter that have done something similar with wolves and coyotes. But the backlash from the broader public would be predictable, dooming such a hunting strategy to an early demise. Moreover, not unlike abused dogs, abused bears might, in fact, be even readier to attack a human should a surprise encounter happen.

Still, if the issue really is just simply about making grizzlies fear us... Or is the ardent promotion of sport hunting really about something else?

Concluding Thoughts

Take the case of Terry Schramm, a self-styled cowboy from Pennsylvania working for self-styled out-of-stat ranchers who own the Walton Ranch in Jackson Hole. Or the legislator-rancher Albert Sommers who raises cows in the Upper Green River of Wyoming thanks to heavy subsidies by environmentalists (in the form of a $1 million plus conservation easement), by the federal government (in the form of well-below-market-price grazing fees), and by the state of Wyoming (in the form of generous compensation for any cows that he claims are lost to predators). In a recent Wyofile article, both of these icons of the modern west explicitly or implicitly suggested that their fraught lives would be a lot less problematic if there were many fewer grizzlies in a lot fewer places.

The fundamental idea here is to kill grizzlies. The more the better, by whatever means, including sport hunting. My point being that many of those who promote hunting as a means of increasing human safety ar probably using the argument simply as cover for getting rid of grizzly bears that they see as an incoveniencı or an affront to their personal ideologies.

Without having the space here to elaborate, I will leave you with a related thought. Perhaps those promotinç the sport hunting of grizzlies are doing so viscerally, out of a place of fear and a derivative need to dominate and subjugate anything that subjectively threatens them. A dark place. A place that gives rise to the logic of owning lots of guns and affirming self through the act of killing—especially beings such as grizzly bears that somehow impart a sense of potency. Or that the habit of killing is so deeply ingrained personally and institutionally that it is impossible for most hunters and wildlife managers to conceive of wildlife managemen in any terms other than hunting. Possibly? Certainly not from a place informed by an objective and thorough examination of the evidence.

--
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- Why Delisting is a Bad Idea: http://www.grizzlytimes.org/#!delisting-a-bad-idea/c15sd
- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sy
- Cool Video: The Changing World of Yellowstone Grizzly Bears: https://m.youtube.com/watch?feature=share&v=VggRHZr0bNQ

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Fwd: Grizzly Times: The Grizzly Bear Moth-Eating Jig, Dr. David Mattson

Thursday, April 14, 2016 12:29 PM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Friends of Grizzly Bears,

David does it again – weaves a great story about the magic of bear ecology, here involving moths. Even I was surprised at some of his connections, like with cows...

For the bears,

Louisa

http://www.grizzlytimes.org/#!The-Grizzly-Bear-MothEating-Jig/c1ou2/570d59610cf29719a3860158

The Grizzly Bear Moth-Eating Jig
April 14, 2016
|
David Mattson

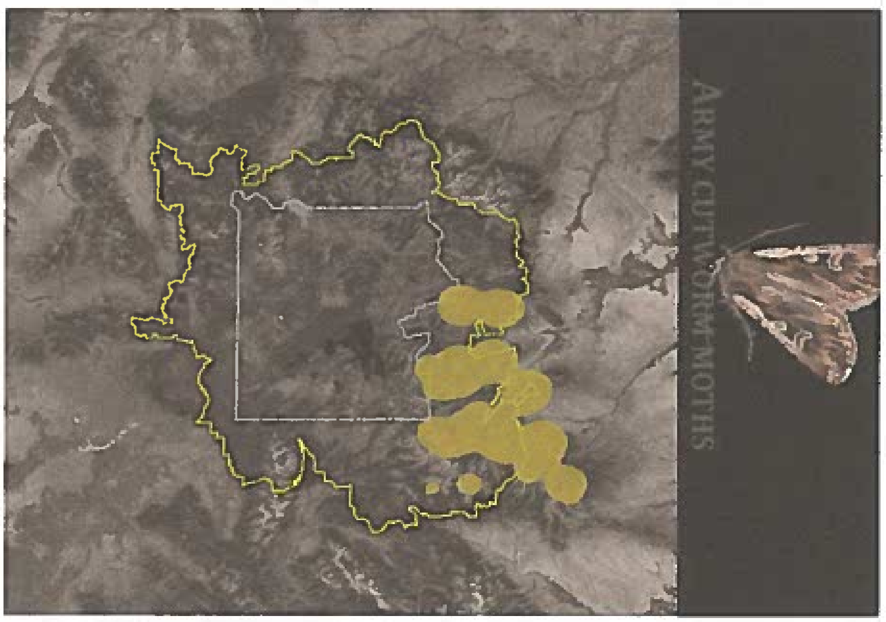
Public domain photo by the US Geological Survey

Back in 1955, a year after I was born, John Chapman published a paper in the journal Ecology describing a peculiar feeding activity by bears in the Mission Mountains of western Montana. Grizzlies and black bears were both rummaging through alpine talus fields—eating something. As it turned out, they were slurping up both ladybird beetles and army cutworm moths that had concentrated there during the summer to either aestivate or to feed on nectar of high-elevation flowers. Twenty plus years later John Craighead and his colleagues described grizzly bears gobbling up cutworm moths from under overturned talus rock in alpine reaches of the Scapegoat Mountains roughly 50 miles east of the Missions. Barring a few published descriptions by early mountaineers, these were the first and—for a while—the only written descriptions of bears feeding on cutworm moths.

In the late 1970s and early 1980s, when I first started working for the Interagency Grizzly Bear Study Team (IGBST), the Missions, Scapegoats, and their resident grizzlies seemed pretty remote and exotic, albeit only about 250 miles away as the crow flies from where I was working in the Yellowstone ecosystem. The idea that grizzlies in Yellowstone might feed on cutworm moths seemed equally strange and exotic. In fact, if anyone had asked me in 1985 if bears in Yellowstone ate moths I would have said "nope, no evidence of it at all," and this after having covered over 1000 miles by shanks mare each of the previous six years in this ecosystem. But one year later I would be proven wrong.

In July of 1986 the IGBST's veteran pilot, Dave Stradley, located a radio-collared grizzly camped on a talus slope straddling an alpine divide in the Absaroka Mountains east of Yellowstone Park. It seemed odd. Next year the same bear camped in the same location. Moreover other radio-collared bears were found camped on yet other remote talus slopes in the same area. This anomaly catalyzed an expedition to find out what the heck was going on, consisting of myself, Bart Schleyer, Carrie Hunt, and Kurt Inberg. Carrie and Kurt were employees of Wyoming Game & Fish at the time. What we found were multiple grizzlies on the site where our collared bear had first been located during 1986, all rummaging through alpine talus, feeding on slithering masses of cutworm moths. The same phenomenon was documented on three more sites during 1987 and 1988 thanks to strenuous efforts by IGBST field crews that included Gerry Green, Jamie Jonkel, Dan Reinhart, and Doug Dunbar.

Since then, ever more grizzlies have been found on ever more alpine sites gobbling up cutworm moths—a total of 31 now. All of the sites are above 10,000' elevation, all in the Absaroka Mountains east and southeast of Yellowstone Park (see the map immediately below). Anymore, it is probably not too much of a stretch to claim that the majority of the bears in this part of the ecosystem spend the majority of their time between mid-July and mid-September on these exceedingly remote moth sites eating moths gathered to feed on nectar of alpine flowers. The moths feed primarily during nighttime, dawn, and dusk, and spend the remainder of the day in the chilly cracks and crevices of angular rocks accumulated on talus slopes, which is where the bears find them. Why congregate like this in a cold microenvironment if you are moth? Who knows, but I suspect it has something to do with avoidance of predators and parasites—barring bears.

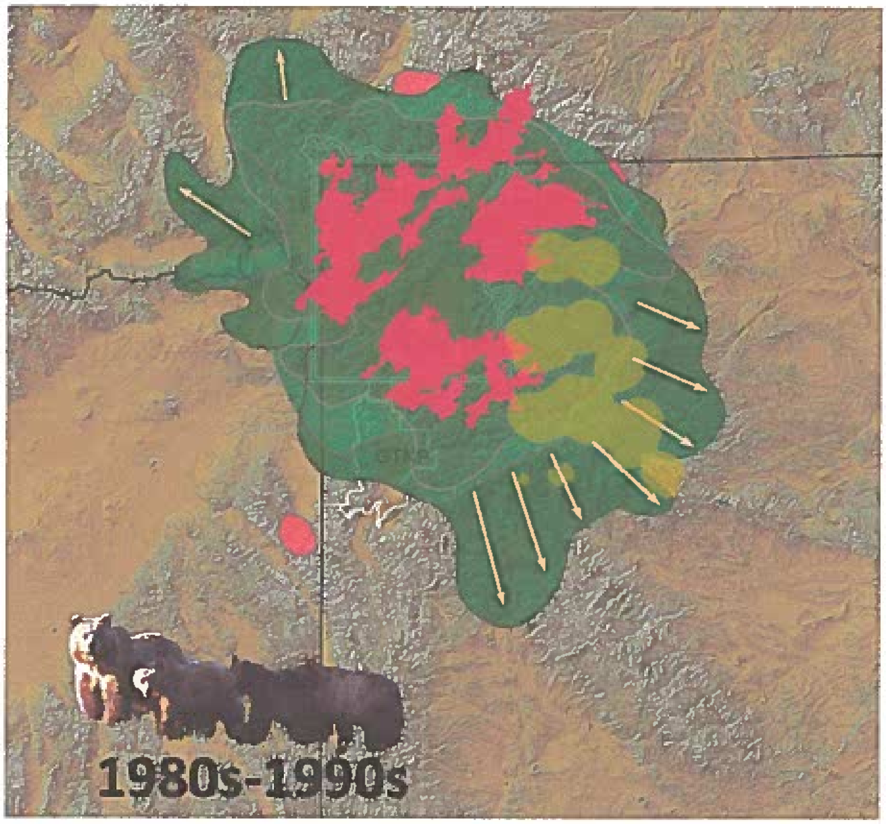


The moth sites in this map are encompassed by the yellowish-green blobs, with reference to the boundary of Yellowstone National Park (the gray line) and the Primary Conservation Area (PCA) for Yellowstone's grizzly bears (yellow line). There are three take-away points: first, all of the moth sites are in the Absaroka Mountains on the east side of the ecosystem; second, all of the sites are outside of the Park; and, third, some moth sites are outside of the PCA.

Since the early 1990s the phenomenon of grizzly bears eating moths in Yellowstone has been pretty thoroughly documented thanks to an initial research publication in 1991, successive papers by Steve and Marilyn French (in 1994) and Sean O'Brien (in 1998), and annual updates in the IGBST's Annual Reports. Of even greater import, bears eating moths in the remote and startlingly beautiful alpine haunts of Yellowstone has captured the public imagination, aided and abetted by the efforts of several enterprising and sometimes intrusive film crews, most notably from BBC. Their footage has probably been seen by millions of people worldwide thanks to being aired as part of the BBC series *Planet Earth*.

I could wrap things up here and leave this simply as an interesting bit of history. But I can't help think of larger ramifications for Yellowstone's grizzly bears, our current approaches to research and management, and a pending move by the US Fish & Wildlife Service (USFWS) to remove Endangered Species Act (ESA) protections for this bear population. Making these kinds of connections seems to be my plight.

As it turns out, the burgeoning use of moth sites by Yellowstone's grizzly bears probably explains much of the major increase in their distribution to the east and southeast that occurred between the mid-1980s and 2000. The match between where we find moth sites and where the greatest expansion occurred is uncanny. Remember, too, that this period was on the heels of the 1988 wildfires that killed nearly 30% of cone-producing whitebark pine in the core of the ecosystem (whitebark pine is another key source of bear food). The map below shows details of all this.



Here the moth sites are superimposed on the distribution of Yellowstone's grizzly bears, represented by the green shading, with the beige arrows denoting areas of major increase in distribution between the 1980s and 1990s. The red represents areas burned during the epic wildfires of 1988. There are two takeaway points: first, the largest increase in distribution was in the direction of the newly-discovered moth sites; and, two, these increases also occurred after the 1988 fires had taken out roughly 30% of the whitebark pine in the core of the ecosystem.

Coincidentally, dramatic increases in grizzly bear activity on moth sites have also contributed to inflated estimates of growth for the Yellowstone grizzly bear population. Bears on moth sites are almost certain to be seen by airborne researchers and managers out looking for females with cubs-of-the-year (COY) at their side. By contrast, bears engaged in virtually any other kind of feeding activity are likely to be seen only 1%...at most only 40% of the time... when somebody flies over. Which is to say, grizzlies have, in the net, become one heck of a lot easier to see in the last couple of decades, at the same time that managers and researchers have quadrupled their efforts to find bears. Given that sightings of females with COY are the foundation of all estimates of population trend, these estimates have correspondingly been inflated upward—because of increased search effort, but also by the increased ease of sighting females with COY on moth sites. Perhaps an unintended consequence? Maybe not.

Less positively for Yellowstone grizzlies, their expansion into Wyoming in apparent pursuit of moths has taken them deeper into cow country. Not surprisingly, a considerable portion of the increasing number of conflicts between grizzlies and ranchers over cattle (another nutritious bear food) in the Yellowstone ecosystem is concentrated not too far downslope from a number of moth sites. So, perhaps paradoxically, increasing exploitation by grizzlies of a food in some of the most remote parts of the ecosystem (that is, moths) has probably contributed to a substantial increase in the numbers of bears dying downslope and down-elevation in retaliation for predation on livestock.

And having expanded well inside the frontier of regressive Wyoming politics and attitudes, the arrangements proposed by the US Fish & Wildlife Service as part of a package for removing ESA protections from Yellowstone's grizzly bears would leave some of the moth-eating grizzlies high and dry outside the zone of meaningful protections, and the rest exposed to the potential excesses of Wyoming Game & Fish Department's post-ESA management. Wyoming is frothing at the mouth to institute a sport hunt, and there is going to be no easier bear for a hunter to find (albeit a little difficult to reach) than one camped on a moth site. The Department also seems dedicated to the proposition of reducing grizzly bear densities on the ecosystem periphery, which coincides with the areas containing all of the moth sites—this as part of a putative strategy for reducing levels of livestock depredation. The net prospects for moth-eating grizzly bears are not good. And, as I pointed out a little earlier, these moth-eaters comprise a substantial portion of the total Yellowstone grizzly bear population.

In light of all this, it only makes sense to expand the Primary Conservation Area out to include all of the known moth sites, and then protect these sites and a substantial surrounding area from any sport hunting. Better yet, don't hunt delisted grizzlies. And, even better yet, don't remove ESA protections and, instead, prioritize the protection of these grizzly bears that are otherwise at the edge of all protections, and the most exposed of all to thuggish enclaves of Wyoming citizenry.

But, I have one more thought that arises from the grizzly bear x moth phenomenon. As I noted before, the emergence of moth-eating by Yellowstone's grizzly bears was a complete surprise for me. And I've continued to be surprised by all sorts of things that I never could have imagined: the 1988 Yellowstone wildfires; the near-extirpation of cutthroat trout in Yellowstone Lake by climate change and predation by an illegally introduced predator; the widespread losses of whitebark pine to an unprecedented bark beetle outbreak driven by a warming climate; massive declines in virtually all of the ecosystem's elk herds, also driven in part by climate change; the emergence of Chronic Wasting Disease as a threat to larger mammals in the ecosystem; and more... The theme here is surprise and, barring cutworm moths, all of the surprises have so far been (more or less) really unpleasant.

The take away? Perhaps humility is in order for our federal and state wildlife managers—humility and caution. As is, I see little evidence of either in the USFWS's rush to remove ESA protections, Wyoming Game & Fish's eager embrace of lethal grizzly bear management, or the cocky attitudes of the current crop of IGBST researchers. What to do? I don't know exactly, other than sure as Hell don't turn the keys to the car over to Wyoming any time in the near future.

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Web: www.grizzlytimes.org

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- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sy
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IMPLICATIONS OF SHORT-ROTATION (70-120 YEAR) TIMBER MANAGEMENT TO YELLOWSTONE GRIZZLY BEARS

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Mattson, D. J., and R. R. Knight. 1991. Implications of short-rotation (70-120 year) timber management to Yellowstone grizzly bears. U.S.D.I. Natl. Park Serv. Interagency Grizzly Bear Study Team Report 1991A.

Executive Summary: We synopsized analyses of grizzly bear (*Ursus arctos horribilis*) use of forest successional stages and assessed changes in habitat value and bear mortality risk likely associated with short-rotation timber management in the Yellowstone area. We rejected our null hypotheses and concluded that, on the broad scale, habitat value will likely decrease and mortality risk increase under short-rotation management regimes. The Yellowstone grizzly bear population has not yet been proven viable. Consequently, any timber harvest and associated activities should be assumed to have a negative affect on the bear population unless proven through appropriate consultation to not contribute to mortality risk or habitat degradation. We also suggest measures to mitigate for timber harvest effects in instances where harvest has been deemed appropriate or is on-going.

INTERAGENCY GRIZZLY BEAR STUDY TEAM REPORT: 1991A

STATEMENT OF PURPOSE

Interagency Grizzly Bear Study Team Reports are intended to facilitate the timely transfer of research results and perspectives to management of Yellowstone's grizzly bear population. These reports are also a forum for presenting results that, while not suited for journal publications, are relevant to management. We have made every effort to validate the information presented here and have subjected this report to critical review.

INTRODUCTION

With the more aggressive pursuit of increased U. S. Forest Service timber production goals, conservation groups and Federal agencies in the Yellowstone area have expressed concern over the consequences of expanded timber programs to the grizzly bear population. More intensive management typically entails relatively foraging on whitebark pine seeds do not produce sufficient numbers of seeds to sustain bear use until stands reach approximately 100 ± 20 years of age". They also concluded that "... there seems little that active timber management can do to augment bear use of whitebark pine in drier portions of the Rocky Mountains, although in areas where timber harvest has already occurred or is being planned for other reasons, judicious planting of whitebark pine in mixtures with other tree species will likely benefit bears in the future".

Discussion. - The Yellowstone area and its associated bear food habits and habitat use are unique among most occupied grizzly bear habitat in North America. It resembles drier portions of the Rocky Mountain Front in Montana, where ungulates and pine seeds supersede fleshy fruits as critical fattening foods, but is most similar to central Siberia, in the vicinity of Lake Baikal (Mattson and Jonkel 1990, Mattson et al. 1991). Most general principles regarding the relationship of bear food production to silvicultural practices, derived from other bear habitat, are not extrapolable to Yellowstone.

Specifically, the idea that food availability increases in early stages of forest succession does not generally hold in the Yellowstone area. In most places Yellowstone grizzly bears rely on ungulates and pine seeds for fattening. Use of these 2 foods is associated primarily with older forest stands. Use of globe-huckleberry fruits, important in some areas, and sweet-cicely roots, important during some years, has also been associated with the semi-shaded and typically patchy conditions of mid- to late-successional stands. Conversely, grazed fibrous foods that predictably increase in abundance in the earliest stages of forest succession cannot be efficiently digested by bears (Bunnell and Hamilton 1983, Pritchard and Robbins 1990) and are not critical to the nutrition of most Yellowstone grizzly bears (Mattson et al. 1991). Further, foliage in open areas such as recently harvested timber stands predictably cures sooner than foliage in shaded areas (Graham 1978, Hammond 1980) and, thus, would be effectively available for a shorter period.

Productivity of grizzly bear habitat may be enhanced by the edge effect associated with timber harvest. Analysis of telemetry data has suggested that Yellowstone grizzly bears make disproportionally heavy use of areas near natural forest-nonforest ecotones (Blanchard 1983, Knight et al. 1984). This weighting of forest-nonforest edges is responsible for virtually all of the increased habitat value associated with timber harvest activities by the Habitat Submodel of the Yellowstone Cumulative Effects Model (Weaver et al. 1986). However virtually all of the data that suggest this phenomenon were collected from bears using natural rather than man-made ecotones, in remote wilderness areas. Natural timber edges tend to differ from edges associated with timber harvest because natural edges more often reflect natural ecotones and attendant greater vegetational diversity. Thus we do not have a high degree of confidence in the extrapolation of results from these data to man-made edges in areas with road access.

Problems may be associated with extrapolating analyses of cover type use to timber-harvest scenarios because, as with edge effect, most data were collected in wilderness areas, from bears using mosaics that resulted from fire and natural ecotones. However, most studies suggest that, if anything, silvicultural treatments have historically often decreased productivity of early successional stages compared to conditions following fire (Mattson 1990). Thus, our data would likely be biased towards over-estimating bear use of early-successional cover types, and reinforce the conclusion that timber harvest has, on average, degraded habitat conditions.

With appropriate future silvicultural prescriptions, grizzly bear habitat values (not considering mortality risks) could be maintained or even enhanced in places. This is most likely in subalpine fir (Abies lasiocarpa) habitat types below the whitebark pine zone, where lodgepole pine is the primary successional species, and with treatments other than clear-cutting. Timber harvest will most likely degrade grizzly bear habitat, regardless of treatment, in the whitebark pine zone and on Douglas-fir habitat types.

Grizzly Bear Mortality Risk

Most (80-90%) grizzly bear mortality in the Yellowstone area, 1975-1990, has been human caused (Craighead et al. 1988, Mattson and Reid 1991). Much of this mortality has been a consequence of humans killing food-conditioned or human-habituated bears that were either judged to be a risk or vulnerable because they exposed themselves to poachers (Craighead et al. 1988; Mattson et al., in prep.). Human-habituation and, in some cases, food-conditioning predictably increase as the frequency of encounter between bears and humans increases (McArthur-Jope 1983; Mattson et al. 1987; Mattson et al., in prep.). Thus any increased exposure of bears to humans predictably results in a longer-term increase in mortality risk to bears, partly mediated through the process of habituation (Mattson et al., in prep.). Under optimal conditions, bears may be able to minimize mortality risk over the short-term despite increased exposure to humans, by avoiding humans as much as possible (as along the North Fork of the Flathead River [McLellan and Shackleton 1988]). However, as in Yellowstone, habituation and associated mortality risks will predictably increase with longer-term equilibration (McLellan 1990).

Implementation of short-rotation timber management requires increased access by humans. Thus more widespread practice of intensive silviculture in occupied grizzly bear habitat predictably increases mortality risk to the population. This holds whether bears die because poachers are able to use roads (legally closed or not) built to harvest timber, or whether bears that die elsewhere under diverse circumstances are at least partially habituated or food-conditioned to humans by exposure around cutting units.

Few data from the Yellowstone area relate directly to timber-harvest effects on mortality, because timber harvest has not been historically wide-spread and because linkage of bear deaths with ultimate causes is difficult. However 2 analyses have bearing on mortality associated with timber harvest. Blanchard et al. (in prep.) analyzed changes in distribution of the Yellowstone grizzly bear population between the periods 1973-79 and 1980-89. Distribution increased the most to the east and southeast, in areas with the most wilderness acreages, and remained static to the west, where timber harvest and associated road building has been most extensive. These patterns suggest a causal relationship between extensive timber harvest and a static distribution, especially in light of gains achieved in wilderness areas.

Another analysis (Mattson 1991) looked at grizzly bear mortality associated with roaded and non-roaded areas, management jurisdiction, and primary developments in the Yellowstone area. Data from Craighead et al. (1988) and Knight et al. (1988, 1989) were used. This analysis showed that the unit-area mortality rate (1983-1990) associated with areas impacted by secondary road systems, typical of areas managed for timber harvest, was second only to the rate associated with primary developments. The secondary-road rate was also 5.0X that associated with Yellowstone National Park's back-country. Virtually all non-livestock-related mortality (51.4% of the total) associated with secondary roads was attributable to poaching, either with (12 of 22) or without (10 of 22) an attractant.

This deductive analysis is the best available for anticipating the effects of increased timber harvest on grizzly bear mortality risk. Because the argument presented is based on well-documented phenomena, we feel confident in its validity pending further analysis of mortality data.

CONCLUSIONS

Based on our assessment of mortality risk and grizzly bear use of different forest successional stages, we reject both of our null hypotheses and conclude that, on the broad scale, mortality risk will likely increase and habitat value will decrease as short-rotation timber management increases in the Yellowstone area. This conclusion will not hold for all specific circumstances, but is warranted when considering the welfare of the entire grizzly bear population, in keeping with the premises of cumulative effects analysis. This conclusion is relevant to long-term viability of the Yellowstone grizzly population because, as stated in the introduction, no one has yet proven that the population is not in danger of extinction. Given these considerations, current or planned timber harvest within Yellowstone's occupied grizzly bear habitat should be assumed to have a significant negative affect on the Yellowstone grizzly bear population until proven not to contribute to increased mortality risk or habitat degradation.

More research is needed to directly assess the effects of timber harvest on Yellowstone grizzly bears. These studies would ideally include both telemetered bears and site-specific transect studies of bear sign and foods. Such studies are underway under auspices of Wyoming Fish and Game and Montana State University, although research specific to conditions on the Targhee National Forest will still be lacking even with completion of these studies.

Increased administrative data collection is also needed. Ideally this would take the form of data collected along transects prior to timber harvest and any proposed mitigations, followed by post-harvest data collection along the same routes. Only by efforts such as this will we be able to evaluate the consequences of management actions, specific to given sites and treatments.

Mitigation. - Under circumstances where timber harvest has been deemed suitable or is already underway, several measures could be taken that would considerably mitigate for the associated risks to bears:

(1) Effectively close all roads after completion of timber harvest - This would require making roads unattractive even for foot, horse-back, or ATV travel and installing gates that could effectively bar 4-wheeled vehicles. Conceivably road-beds could be piled with slash and other debris, the surface ripped, and trees planted. Mere signing and installation of barricades is not likely to effectively mitigate for mortality risk associated with increased access.

(2) Schedule timber harvest so as to concentrate rather than disperse equal amounts of activity - If a given number of harvest units need to be cut in a given time, impacts on bears would be reduced if harvest activity were concentrated over time in specific sections of the timber management area. If equivalent timber harvest were continually dispersed over the entire area, bears would have a much harder time avoiding the involved people.

(3) Designate certain nearby areas as either permanently or temporarily closed to all humans - Designation of such areas would offer bears additional options for avoiding people and would be especially useful in areas that had previously been subject to some degree of use by humans; i.e., designation of an area already unused by people would offer little mitigation.

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We appreciate the critical reviews of this report by D. Mike Cole, Bert Harting, and Daniel Reinhart.

EFFECTS OF ACCESS ON HUMAN-CAUSED MORTALITY OF YELLOWSTONE GRIZZLY BEARS

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Mattson, D. J., and R. R. Knight. 1991. Effects of access on human-caused mortality of Yellowstone grizzly bears. U.S.D.I. Natl. Park Serv. Interagency Grizzly Bear Study Team Report 1991B.

Executive Summary: We analyzed grizzly bear mortality data by three 8-year periods (1962-1969, 1975-1982, and 1983-1990) and by association with different levels of human access (major developments, primary roads, secondary roads, and back-country areas). Unit-area mortality rates associated with all levels of access decreased over the 3 time periods. However, there is doubt whether this reduction in mortality is sufficient to insure the population's viability. Yellowstone Park's back-country remains the safest for bears, and areas impacted by secondary roads and major developments, remain the most lethal. Given questions about the grizzly bear population's viability, we cannot afford to increase the area impacted by secondary roads and major developments. It is also likely that the easiest gains in reducing grizzly bear mortality risk, associated with management of attractants, have already been made. Further reductions in grizzly bear mortalities will likely be much more difficult. Minimizing encounters between grizzly bears and humans remains the best option for minimizing mortality risk to Yellowstone grizzly bears.

INTERAGENCY GRIZZLY BEAR STUDY TEAM REPORT: 1991B

STATEMENT OF PURPOSE

Interagency Grizzly Bear Study Team Reports are intended to facilitate the timely transfer of research results and perspectives to management of Yellowstone's grizzly bear population. These reports are also a forum for presenting results that, while not suited for journal publications, are relevant for management. We have made every effort to validate the information presented here and have subjected this report to critical review.

INTRODUCTION

Management of human-caused mortality is key to the Yellowstone grizzly bear population's future viability; and of all the bear cohorts, mortality among adult females is most critical (Knight and Eberhardt 1985). Reduction of bear mortalities is contingent on identifying manipulable or constraining causal factors. Ultimately, management will be optimized by time- and space-specific analysis of mortality risks associated with existing or proposed human activities. This is dependent on assigning realistic time- and space-specific coefficients of mortality risk to various human activities and management regimes.

Several analyses have looked at factors historically influencing mortality risk for Yellowstone grizzly bears. Armed herders attending free-ranging domestic sheep have been clearly identified as a major mortality factor, primarily because sheep are a preferred prey of bears (Mattson 1990) and because the herders are intolerant of any risks posed by bears (Griffel and Basile 1981, Johnson and Griffel 1982, Knight and Judd 1983, Jorgensen 1983). Outfitters operating back-country camps have also been identified as a major risk to bears because edibles associated with their camps attract bears, and the outfitters have often retaliated by shooting the scavenging animal (Hoak et al. 1983). Human-food-conditioning (cf. Herrero 1985:51) increases mortality risk

Table 1. Numbers of grizzly bear mortalities and 1,000-km^2 8-year mortality rates, by time period and stratum; for the Yellowstone area.

Stratum	Number of mortalities			Mortalities per 1,000 km^2			Proportion of total area
	1962-69	1975-82	1983-90	1962-69	1975-82	1983-90	
Developments[a]	65	27	24	34.0	14.1	12.6	0.088
Primary roads[b]	6	13	7	2.2	4.9	2.6	0.123
Secondary roads[c]	16	26	14	6.3	10.2	5.5	0.118
Forest Service backcountry	48	18	12	5.8	2.2	1.4	0.385
Park Service backcountry	2	6	7	0.3	1.0	1.1	0.286

[a]6-km-radius buffers.
[b]6-km total width parallel buffers.
[c]3-km total width parallel buffers, plus inclusions.

1984:70). However because of major differences, we found it instructive to look at proportional distribution of mortalities among causes (Table 2). As we expected most of the mortality around developments resulted from lethal resolution of bear-human conflicts by management agencies. The largest portion of mortality associated with secondary road systems was attributable to conflict over domestic sheep. Assuming that this cause has been mitigated in recent years by closure of most sheep grazing-allotments and removal of sheep from other areas (U.S. Fish and Wildl. Serv. 1990), the largest portion of remaining mortality associated with secondary roads was from poaching not associated with any detected attractant. In the Forest Service back-country, cause of death was divided between incidents, legal or otherwise, involving armed non-agency individuals with (48%) and without (40%) an attractant involved. Distributions of mortalities among sex- and age-cohorts (excluding known dependent young) did not differ significantly among strata (df = 8, n = 92, X^2 = 9.79, P = 0.21), although there was a tendency for subadult males and adult females to die proportionally less often around secondary roads compared to developments and the Forest Service back-country.

poaching

DISCUSSION

Sources of Bias. - The mortality data was likely affected by considerable bias attributable to varying intensities of documentation with time and among different causes of death. In general, illegal back-country bear mortalities were probably under-represented during all time periods (Knight and Eberhardt 1985). It is likely that illegal mortalities in back-country areas were most under-represented for the period 1962-1969, especially on Forest Service lands, because there was less concern for the population and research was focused in central Yellowstone Park. For the same reasons, over-all mortality was probably under-documented for the period 1962-1969 compared to the later 2 periods. Natural mortality has also probably been consistently under-represented because it is less likely to be detected.

These biases compromised our results to varying degrees. In general, the disparity between front- and back-country mortality rates is probably not as great as indicated by the data, especially for the period 1962-1969. It is very improbable, however, that this bias entirely negates the orders-of-magnitude difference between front- and back-country rates. On the other hand, when comparing among time periods, the disparity in rates between 1962-1969 and the later 2 periods is probably greater than indicated by the data. Because illegal mortality has apparently dropped since 1982, mortalities attributable to secondary roads and the back-country were probably proportionally greater during 1975-1982 compared to 1983-1990.

Stratification. - In most areas of occupied grizzly bear habitat, management concern focuses on the implications of road access to bears. Roads do not usually directly effect bears, outside of the occasional bear hit by a motor-vehicle, often in association with an attractant along the road (e.g., carcass or spilled edibles). More importantly roads, as well as major human developments, appear to effect bears through a host of human activities facilitated by improved access (McLellan 1990). In short, increased access precipitates increased frequency of encounters between bears and humans, with usually negative consequences for bears. For these reasons, rather than focusing on proximal causes of death, we chose to look at mortality effects in terms of the overall complex of activities associated with what is ultimately the most important factor: the area impacted by varying degrees of access. Within these strata we then looked at more proximal causes as a diagnostic signature of the types of risks associated with different access.

The presence of fire-arms in association with legal big-game hunting also clearly has implications to the frequency and outcome of human-bear contacts. For this reason we stratified the back-country by areas where hunting and fire-arms were allowed (forest Service lands) and where they were not (Park Service lands).

Implications. - Yellowstone's grizzly bear population is clearly constrained by high densities of humans and human access. Peripheral areas with high road densities apparently correspond to a per annum probability of grizzly bear survival approaching zero. In the larger scale, even moderate levels of human access and resident densities are not compatible with grizzly bears (Mattson 1990).

Our analysis suggests trends over time towards lower unit-area mortality rates, in association with all levels of human access. As an alternate hypothesis, this could be the result of a declining bear population. However this explanation seems very unlikely given that the population appears to be stable (Knight and Eberhardt 1987, Knight et al. 1988), and that major improvements have been made in management of attractants that have been a primary cause of bear deaths in the past (e.g., sheep, garbage, and other unsecured edibles). Greatest improvements in recent years have been associated with primary and secondary roads, primarily by the reduction in sheep-related mortalities around secondary roads.

However we need to ask whether these improvements are sufficient. Recent analyses suggest that because of demographic constraints (Dennis et al. 1991) and uncertainties over future habitat conditions (Mattson and Reid 1991) optimism over long-term viability of the Yellowstone grizzly bear population is not justified. Thus, even though gains have been made, further efforts to reduce mortality rates are apparently required; and it may be that most of the easy gains have already been made.

Yellowstone Park's back-country serves as a standard for the rest of the ecosystem. It exhibits the lowest unit-area mortality rate and most mortality appears to be from natural causes. Whatever the trends associated with road access, areas impacted by secondary roads and major developments still have roughly 5X and 11X the mortality rate, respectively, of Yellowstone Park's back-country, and almost all front-country mortalities are still human-caused. These disparities make a case for preserving or increasing whatever refuge effect is associated with the Park's back-country.

Relative to Yellowstone Park's back-country, conditions in Forest Service back-country areas have improved markedly. The greatest improvement (0.4X the prior rate) was associated with termination of legal grizzly bear hunting in 1974. Since then, improvements have apparently been associated with sanitation of back-country camps and the elimination of baiting-stations for hunting black bears. However during the 1990 hunting season 5 grizzlies where shot in back-country areas, all probably by hunters (Knight et al. 1991). These events raise questions about future trends, and whether other mortality factors such as accidental encounters with hunters may become more important. None-the-less, it is encouraging that the unit-area mortality rate in the Forest Service back-country, where fire-arms are present, is comparable to Yellowstone Park's back-country.

Mortality rates associated with developments appear to have been comparatively unresponsive to management in the last 16 years. Areas near major developments, as well as primary roads, may serve as a temporary refuge for subordinate (typically subadult males) or security-conscious (often females with dependent young) bears from adult males that preferentially use back-country areas (Mattson et al. 1987; Mattson et al., in prep.). High quality foods other than pine seeds also occur around developments (Mattson and Knight 1989; Mattson et al, in prep.). Subadult males and adult females consequently become disproportionally habituated to humans; not as often in recent years by conditioning to human-origin foods, but in the course of using native foods near humans (Mattson et al., in prep.). Given that humans are nearly as likely to kill habituated bears as they are to kill food-conditioned bears (Mattson et al., in prep.), mortality problems associated with Park developments appear to have persisted. Some observations suggest that a portion of bear deaths around major developments may be a consequence of habituation developed along roads. Continued problems around major developments are also attributable to persisting availability of attractants around private residences and towns bordering Yellowstone Park (Servheen 1989).

Our results suggest that we can least afford to increase the area impacted by major developments (e.g., major campgrounds) and secondary road systems. Also, given rote proportions of mortality associated with developments, secondary roads and the Forest Service back-country, greatest improvements are still needed in these areas. Reduction of mortality associated with secondary roads may be relatively difficult, given the recent low involvement of attractants, unless management of fire-arms and human attitudes is considered. Similarly, mortality risk around developments will probably continue to be responsive to removal of remaining attractants, but management also may be stymied by an increasing involvement of human-habituation, without food-conditioning, in bear-human conflicts. In short, we may be reaching a point where relatively easily managed factors are no longer playing a major role in human-caused grizzly bear mortality, and where human presence alone may be a primary causal factor. Thus, even though improvements are evident, there is an argument for minimizing contact between grizzly bears and humans as the best future means of minimizing mortality risk to Yellowstone's grizzly bears.

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YELLOWSTONE GRIZZLY BEAR MORTALITY, HUMAN HABITUATION, AND WHITEBARK PINE SEED CROPS

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Abstract: The Yellowstone grizzly bear (*Ursus arctos horribilis*) population may be extirpated during the next 100–200 years unless mortality rates stabilize and remain at acceptable low levels. Consequently, we analyzed relationships between Yellowstone grizzly bear mortality and frequency of human habituation among bears and size of the whitebark pine (*Pinus albicaulis*) seed crop. During years of large seed crops, bears used areas within 5 km of roads and 8 km of developments half as intensively as during years of small seed crops because whitebark pine's high elevation distribution is typically remote from human facilities. On average, management trappings of bears were 6.2 times higher, mortality of adult females 2.3 times higher, and mortality of subadult males 3.3 times higher during years of small seed crops. We hypothesize that high mortality of adult females and subadult males during small seed crop years was a consequence of their tendency to range closest (of all sex-age cohorts) to human facilities; they also had a higher frequency of human habituation compared with adult males. We also hypothesize that low mortality among subadult females during small seed crop years was a result of fewer energetic stressors compared with adult females and greater familiarity with their range compared with subadult males; mortality was low even though they ranged close to humans and exhibited a high frequency of human habituation. Human-habituated and food-conditioned bears were 2.9 times as likely to range within 4 km of developments and 3.1 times as often killed by humans compared with nonhabituated bears. We argue that destruction of habituated bears that use native foods near humans results in a decline in the overall ability of bears to use available habitat, and that the number and extent of human facilities in occupied grizzly bear habitat needs to be minimized unless habituated bears are preserved and successful ways to manage the associated risks to humans are developed.

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The Yellowstone grizzly bear population will likely survive the next 30 years (Knight and Eberhardt 1985, 1987) but may not survive beyond the next 100–200 years (Dennis et al. 1991, Mattson and Reid 1991). Short- and long-term survival is contingent upon maintaining known average annual mortality at ≤2 adult female and 7 total deaths/year (Knight and Eberhardt 1984, 1985). Thus, management of Yellowstone's grizzly bear population has focused on reducing mortality to acceptable levels, which has in turn been dependent on understanding the causes of mortality.

McArthur Jope (1983), Jope (1985), and Herrero (1985) applied the concepts of human habituation and human food conditioning to the behavior and management of bears. They demonstrated that many management problems with bears arose from food conditioning and habituation, which are characterized by less fear of humans and a predilection towards humans or human facilities as a source of food. Subsequently, management of bears has become increasingly phrased in terms of habituation and food conditioning, and some programs have included a direct assessment of these factors as a basis for managing individual bears (Claar et al. 1986, Dalle-Molle and Van Horn 1989, McCrory et al. 1989, and McLean and Pelton 1990). Therefore, we posed hypotheses concerning distributions and mortality of Yellowstone grizzly bears in terms of human habituation and food conditioning, as follows:

H_{a1}: Frequency of human habituation and food conditioning differs among grizzly bear sex-age cohorts.
H_{a2}: Frequency of human-caused mortality differs between human-habituated and wary bears, and among sex-age cohorts.
H_{a3}: Distributions of human-habituated and wary bears differ with respect to human facilities.

While the last hypothesis appears to be circular, given that frequency of human habituation would predictably increase with nearness to humans (Herrero 1985), it is relevant to determining spatial impacts of human facilities that are

mediated through the habituation of bears to humans.

Whitebark pine seeds and ungulates appear to be the 2 most important foods of Yellowstone grizzly bears, whereas berries are relatively unimportant (Mattson et al. 1991). Consequently, food habits of Yellowstone grizzly bears are relatively unique in North America, and most closely resemble those of central Siberian brown bears (*Ursus arctos jeniseensis*) (Mattson et al. 1991). Whitebark pine seeds are predictably important because of their high fat content and potential abundance during pre-hibernation hyperphagia (Mattson and Jonkel 1990), and when available, Yellowstone grizzly bears consume the seeds almost exclusively, typically by raiding red squirrel (*Tamiasciurus hudsonicus*) middens (Kendall 1983, Mattson and Jonkel 1990). For these reasons we postulated that availability of whitebark pine seeds has the greatest potential of any single food-related factor to impact behavior and demography of the Yellowstone grizzly bear population.

Little specific information is available describing the effects of variation in food supplies on bear mortality, although poor food conditions often result in greater bear movements and mortality (Slobodyan 1976, Garshelis and Pelton 1981, Grenfell and Brody 1983, Garshelis 1989). In Siberia, brown bears apparently range farther, kill domestic livestock more frequently, and are in turn killed more frequently by humans when stone pine (*Pinus sibirica* and *P. pumila*) seed crops are small (Ustinov 1976). Yellowstone grizzly bears also exhibit greater movements and use lower elevations during years of small whitebark pine seed crops (Mattson and Knight 1989, Blanchard and Knight 1991). However, relationships among variation in seed crops, grizzly bear mortality, and nearness of grizzly bears to humans have not been analyzed for the Yellowstone Ecosystem. Thus, we posed the following additional hypotheses:

H_{a4}: Distribution of grizzly bears with respect to human facilities differs between years of large and small seed crops, and among sex-age cohorts.
H_{a5}: Human-caused mortality differs between years of large and small seed crops, and by sex-age cohorts.

Herein, we test the hypotheses posed, and speculate on causal linkages between what we suspect are 2 major factors influencing grizzly bear mortality in the Yellowstone area: whitebark pine seed crop size and frequency of human-habituation among the bears; we also offer interpretations for management.

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STUDY AREA AND METHODS

Our 20,000-km² study area was centered on Yellowstone National Park and included portions of Wyoming, Montana, and Idaho. Study area characteristics have been described by Knight and Eberhardt (1985), Mattson et al. (1991) and Blanchard and Knight (1991).

Transects for monitoring whitebark pine cone production have been maintained since 1980 (Blanchard 1990). Cones were counted on each of 10 permanently marked trees after cone maturation, but before heavy cone use by seed consumers. Although the number of transects increased over the years from 9 to 21 (Blanchard 1990), we used only the 9 transects first established in 1980 to allow systematic comparison of results.

Food habits were estimated by fecal analysis, 1976–90 (Mattson et al. 1991), and included the frequency of whitebark pine seed remains in grizzly bear feces for August–October and for the entire year. An acute sigmoidal relationship was evident between frequency of pine seeds in feces and transect cone counts (Blanchard 1990). Consequently, we classified years as either characterized by widespread use (use) or virtually no use (nonuse), with the cut-off point between the two being 20% frequency of seeds in feces (corresponds to about 220 cones/transect).

We hypothesized that the current year's crop, reflected in August–October use, most influenced autumn behavior, and that the entire year's diet also influenced mortality. Consequently, we used August–October pine seed use to stratify analysis of mortality, movements and behavior, while we also used data for the entire year to stratify the mortality analysis. Stratification of data by August–October use and the entire year's use differed because during June–July bears extensively consumed pine seeds from a large previous year's crop that had survived

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Science and Management of Rocky Mountain Grizzly Bears

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Abstract: *The science and management of grizzly bears (*Ursus arctos horribilis*) in the Rocky Mountains of North America have spawned considerable conflict and controversy. Much of this can be attributed to divergent public values, but the narrow perceptions and incomplete and fragmented problem definitions of those involved have exacerbated an inherently difficult situation. We present a conceptual model that extends the traditional description of the grizzly bear conservation system to include facets of the human domain such as the behavior of managers, elected officials, and the public. The model focuses on human-caused mortality, the key determinant of grizzly bear population growth in this region and the interactions and feedback loops among humans that have a major potential influence on bear mortality. We also briefly evaluate existing information and technical methods relevant to understanding this complex human-biophysical system. We observe not only that the extant knowledge is insufficient for prediction (and in some cases for description), but also that traditional positivistic science alone is not adequate for dealing with the problems of grizzly bear conservation. We recommend changes in science and management that could improve learning and responsiveness among the involved individuals and organizations, clarify some existing uncertainty, and thereby increase the effectiveness of grizzly bear conservation and management. Although adaptive management is a promising approach, we point out some key—as yet unfulfilled—contingencies for implementation of a method such as this one that relies upon social processes and structures that promote open learning and flexibility in all facets of the policy process.*

Ciencia y Manejo de los Osos Pardos de las Montañas Rocallossas

Resumen: *La ciencia y manejo de los osos pardos (*Ursus arctos horribilis*) en las montañas rocallosas de Norte América han producido considerables conflictos y controversias. Mucho de esto puede ser atribuido a los divergentes valores públicos, así como a reducidas percepciones e incompletas y fragmentadas definiciones de los involucrados, lo cual ha exacerbado la ya difícil situación. Presentamos un modelo conceptual que expande la descripción tradicional del sistema de conservación de los osos pardos para incluir facetas del dominio humano como son la conducta de los manejadores, los oficiales elegidos y en publico. El modelo se enfoca en la mortalidad causada por humanos, clave determinante del crecimiento de las poblaciones de osos pardos en esta región y las interacciones y retroalimentación entre los humanos que tienen un mayor potencial para influir en la mortalidad de los osos. Brevemente evaluamos la información existente y los métodos técnicos relevantes para entender este complejo sistema humano-biofísico y observamos que no solo el conocimiento actual es insuficiente para predecir (y en algunos casos para describir), sino también que la ciencia positivista por si sola no es adecuada para enfrentar los problemas de la conservación del oso pardo. Recomendamos cambios en la ciencia y manejo que pueden mejorar el aprendizaje y responsabilidades entre los individuos y las organizaciones involucradas, clarificar algunas incertidumbres existentes y por lo*

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and behavior of people, as well as dynamic biophysical attributes such as grizzly bear food and shelter. Continued research on trends will probably be easy because of historical emphasis on this topic, whereas systems to monitor humans will likely be complicated by uncertainty over good quantitative metrics and because of traditional antipathy to keeping records on certain types of public activity.

Finally, grizzly bears could benefit by the widespread adoption of management strategies known to be effective but not always implemented. This program would emphasize: (1) sanitation of human facilities wherever humans and grizzly bears come in contact so that conditioning of grizzlies to human foods is minimized (Herrero 1985; Herrero & Fleck 1990); (2) location or relocation of human facilities in or to areas that are likely to receive little grizzly bear use, either for travel, bedding, foraging, or security from other bears, to minimize conflict and habituation of grizzly bears to humans (Herrero et al. 1986); (3) limitation of human activity and numbers in occupied grizzly bear habitat, again to minimize conflict and habituation; (4) limitation of human access to grizzly bear habitat by road and trail; (5) reduction in number of armed people in grizzly bear habitat (other than during legal hunting seasons), especially in combination with foods or odors that attract grizzly bears (Herrero & Fleck 1990); (6) a balanced management of mortality that favors the survival of females (e.g., the sex-weighted point scheme used in the Yukon [Smith 1990]), but at the same time does not result in excessive mortality of adult males; and (7) education of back-country users and other local residents to minimize undesired conflicts with grizzly bears. We do not identify explicit thresholds or standards for these recommendations because the specifics need to await more rigorous analysis of data from each grizzly bear population. The standards will also be contingent upon the degree to which recommendations one through six are implemented.

We have not explicitly considered two factors that are perhaps as important as any to the ultimate survival of grizzly bears in the Rocky Mountains: (1) the degree to which politicians and managers involve the public in developing conservation strategies and corresponding ownership of the process by affected citizens (Gregory & Keeney 1994; Kellert 1994*b*; Wondolleck et al. 1994; Primm, this issue), and (2) the life-styles and values of humans in Canada and the United States. If grizzly bears are resented and consistently held in lower regard than other resources that we demand from their remaining habitat, then wild grizzly bears in the southern Rocky Mountains will almost certainly disappear, and their descendants will survive only as penned and catered relics. The survival of grizzly bears and other wild things in the Rocky Mountains might simply follow from the extent to which we can peacefully resolve conflicts among ourselves and adopt more tolerant and less acquisitive life-styles (McDougal et al. 1988; Daly & Cobb 1989).

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THE EFFECTS OF DEVELOPMENTS AND PRIMARY ROADS ON GRIZZLY BEAR HABITAT USE IN YELLOWSTONE NATIONAL PARK, WYOMING

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Abstract: Aerial locations of radio-instrumented grizzly bears (*Ursus arctos*) were used to analyze effects of human activity associated with developments and primary roads on grizzly bear habitat use in Yellowstone National Park. Grizzly bear occupancy of habitat near human facilities was reduced, efficient foraging strategies were disrupted, and cohorts tending to be subordinate or security-conscious were displaced into habitat nearer developments by more dominant cohorts, particularly during summer and fall. Adult females and subadult males residing closer to developments were management-trapped at a higher rate than animals of the same class residing farther away. Adult females and subadults bore a disproportionate part of costs associated with avoiding roads and developments. For this reason and because adult females are generally thought to operate under considerable energetic duress in the Yellowstone area, avoidance of developments and roads may have resulted in higher mortality and lower productivity among the adult female cohort.

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Grizzly bear populations have typically been reduced or eliminated after sustained contact with Western civilizations. This has primarily been a result of human-caused mortalities; habitat loss has been a secondary factor (Storer and Trevis 1955, Brown 1985). Therefore, management and research have been concerned with defining how much mortality and habitat loss a bear population can tolerate and remain viable. Key questions have been (1) how do bears respond to humans, and (2) how does a given response influence risk for, and habitat use by, grizzly bears?

The consequences of bear-human encounters to humans have been described and analyzed (e.g., Herrero 1976, Merrill 1978, Chester 1980, Herrero 1985, Jope 1985). Other research has attempted to determine encounter effects on bears as a function of individual bear history, site, and season (Schleyer et al. 1984, Haroldson and Mattson 1985). Still other studies have investigated more general impacts of human activities, primarily in association with logging and hydrocarbon exploration and development (Elgmork 1978, Harding and Nagy 1980, Schallenberger 1980, Zager 1980, Aune et al. 1984, McLellan and Mace 1985).

The effect of human activities on bears is an important issue in Yellowstone National Park; most human activities are concentrated at roads and developments. More than 2 million people visit the park each year during the period that grizzly bears are active. Fifty percent of the park is within 8 km of a primary road and within 11.5 km of a village or front-country campground. Furthermore, the Yellowstone grizzly bear population appears to be marginally viable (Knight and Eberhardt 1984, 1985). Therefore, the Interagency Grizzly Bear Study Team (IGBST) used existing data to analyze the effects of roads and human developments on grizzly bear habitat use in Yellowstone Park.

Our objectives were to (1) determine if observed levels of bear use were equal to that expected along roads and around developments; (2) determine if productivity of habitat occupied by bears was equal to that expected with nonselective use along roads and around developments; (3) quantify any evident avoidance by bears of roads and developments and; (4) determine if representation of different sex and age bear classes differed between areas close to and more remote from human facilities.

STUDY AREA

Yellowstone National Park (Fig. 1) comprised the analysis area. Most elevations in the park are from 2,100 to 2,450 m. Topography is dominated by an extensive central plateau and encircling higher relief mountains. Bedrock in many areas is of recent volcanic origin. Other areas are underlain by older volcanic and uplifted sedimentary strata (Keefer 1976).

The analysis area lies principally in the subalpine zone. Closed-canopy forest covered approximately 75% of the area. Most of this forest consisted of lodgepole pine (*Pinus contorta*) dominated stands in sapling to over-mature stages. Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and whitebark pine (*Pinus albicaulis*) dominated stands were more common on high-relief topography underlain by andesitic bedrock. Extensive nonforest areas occurred primarily below 2,125 m and generally reflected warmer, drier conditions. Further details of the study area are available in Knight and Eberhardt (1985).

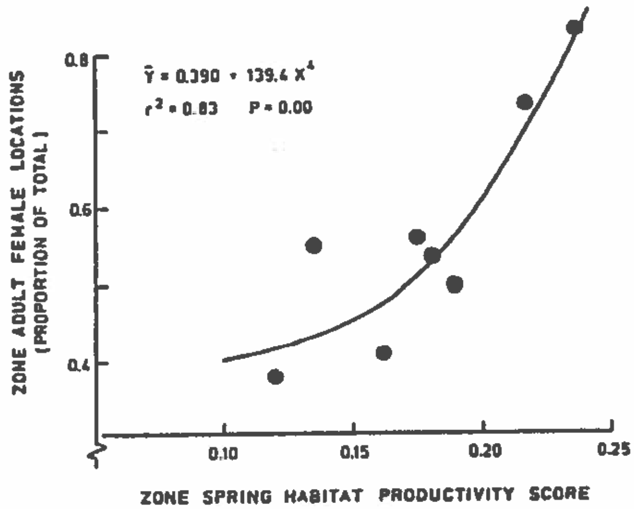

Fig. 10. Relationship of adult female locations to average habitat productivity score during spring for 15-km analysis zones; locations are expressed as a proportion of the zone total.

(Knight and Eberhardt 1984), that near 30 of these animals resided predominantly within the park, and that Yellowstone Park was near carrying capacity (Picton et al. 1986, Mattson 1987), then this effect translates into loss of habitat sufficient to support 4 or 5 adult females during summer.

DISCUSSION

Error and Bias

Some potential complications are associated \ using zone widths of 100–300 m, as we did for 1,500-m analysis. Aerial locations of telemet bears may have errors greater than 100 m. Gro analysis of aerial locations by IGBST personnel gested that a majority of our locations had errors than 200 m. Many locations were by sighting an were very accurate; a few locations were know be as much as 1 km in error.

The consequences of this error to our analysis v probably minor even though a substantial numbe bear locations undoubtedly occurred in zones o than indicated by aerial telemetry. However, mo the trade-off due to this error would be with adja zones. Because our primary objective was to ana broad patterns, as much as 600 m in the 1,50 analysis, we concluded that location error did compromise interpretation of results.

Simple interpretation of results was more li complicated by biases inherent in aerial locatio telemetered animals. Most of our locations occu during morning hours and grizzly bear are ni active in the Yellowstone area, especially during s mer (Schleyer 1983, Harting 1985). Because of

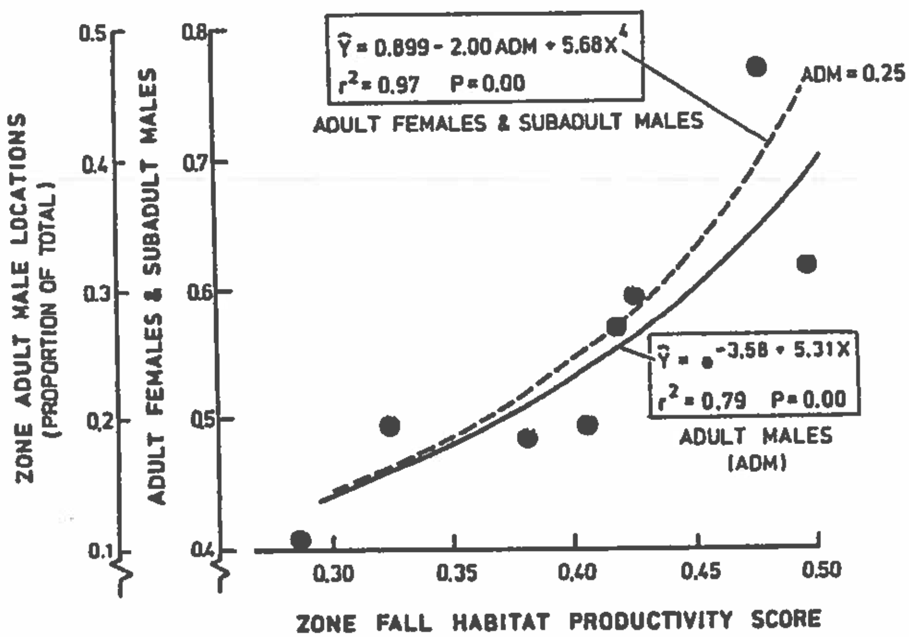

Fig. 11. Relationship of adult male, adult female, and subadult male locations to average habitat productivity score during spring for 15-km analysis locations are expressed as a proportion of the zone total.

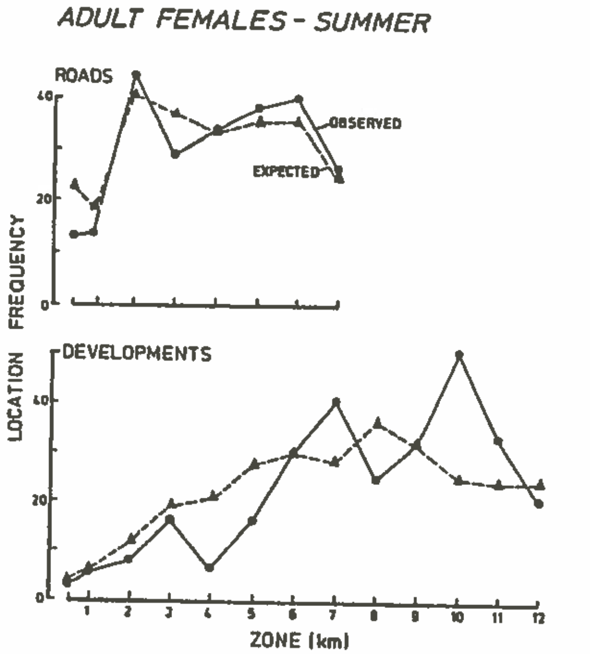

Fig. 12. Observed (adult female bear location) and expected (weighted grid-point) summer frequencies for road and development 15-km analysis zones.

diel bias, observed habitat use close to roads and developments may not reflect actual habitat use. Bears could have made additional night-time use of adjoining areas. This does not discredit the fact that bears were apparently avoiding humans during the day; however, actual was probably greater than calculated summer habitat use for adult females within road and development zones of influence.

Bear Behavior

Avoidance of humans by bears was interpreted as taking 2 forms: (1) disruption of foraging activities that tend to maximize use of the most productive habitat within a zone; and (2) outright avoidance of areas near front-country human facilities. Disruption of otherwise efficient foraging strategies was inferred primarily from bear location habitat productivity scores less than or nearly equal to zone averages, and outright avoidance from observed bear use less than expected in zones adjoining or near by human facilities.

We assumed that the costs of avoidance evident by aerial telemetry locations were greater during spring and fall compared to summer. This assumption resulted from the tendency for grizzly bears to be more day-active during spring and fall compared to summer in the Yellowstone area (Schleyer 1983, Harting 1985). Thus, daytime avoidance attributed to human facilities during spring and fall probably reflected a greater behavioral response and associated stress or energy related costs compared to summer. Spring and fall also corresponded to potentially critical periods of post-den emergence and prehibernation hyperphagia. The post-den emergence period is thought to be especially important to adult females in the Yellowstone area (Mattson 1987); prehibernation hyperphagia was probably important to all cohorts (Nelson et al. 1983, Nelson et al. 1984, Mattson 1987).

Spring.—Adult females occupied the most productive spring habitat; proportionate zone distribution of this cohort was positively related to zone distribution of spring productivity scores. Thus, because spring productivity was highest near roads and developments, adult females tended to occupy habitat near these facilities.

Adult males tended to be proportionately distributed farther from developments during spring. This distribution probably did not reflect avoidance of developments because spring distribution of adult males was more likely an artifact of previous fall distribution. Spring and fall proportionate representation of adult males was strongly correlated ($r = 0.95$, $P = 0.000$).

Bears also apparently avoided humans during spring. Our data suggest that during daylight hours bears tended to avoid an area averaging 500 m along

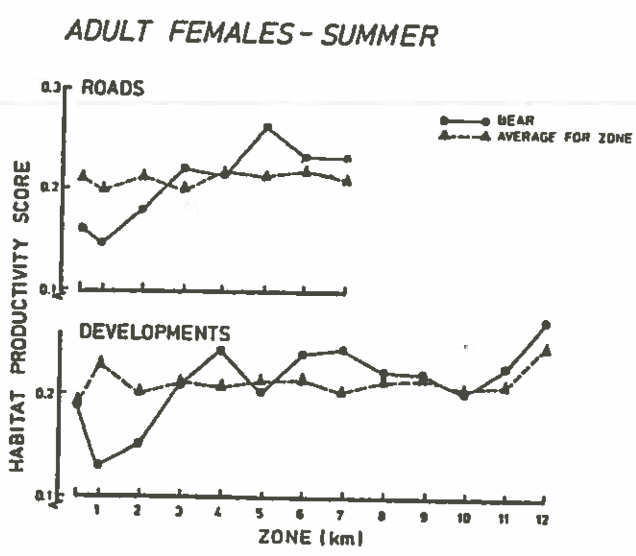

Fig. 13. Average summer habitat productivity score for adult female bear location and grid-point scan areas, for development and road 15-km analysis zones.

roads. Spring response to developments was evidenced by disruption of foraging out to 3 km. Other data collected while surveying spring bear use of ungulate carcasses in the Old Faithfull area (Mattson and Henry 1987) showed that only 6%–7% of carcasses within 5 km of the development were used by bears; 50%–100% of carcasses beyond 5 km had been used by bears. These observations were consistent in 1985 and 1986. Taken together, this analysis and the work of Mattson and Henry (1987) suggest a potentially strong avoidance of developments by grizzly bears during spring.

Summer.—Grizzly bears tended to avoid an area averaging 500 m along roads during summer. As during spring, the avoidance more likely occurred during daylight hours. Unlike spring, daytime disruption of foraging out to 2 km of roads was also evident. These 2 phenomena suggest a slightly stronger daytime bear response to roads during summer compared to spring. This is consistent with much higher vehicle traffic levels during summer.

During summer no spatial avoidance of developments was apparent for zones out to 2 km. Bear use was less than expected for zones 2–5 km and 7–9 km from developments; disruption of foraging was also apparent out to 3 km. This relatively complex pattern can be understood by looking at zone distribution of telemetry locations for individual bears. The 3 peaks in observed vs. expected use could be explained by a greater number of bears concentrating their activity in corresponding zones. Although most bears ranged across all zones, individuals could be distinguished by a greater tendency to range nearby (<5 km), at intermediate distances (5–7 km), and far from (>7 km) developments during summer.

Several interpretations of summer bear distribution with respect to developments were possible. However, we favored the following: bears tending to range closest to developments (<5 km) were very likely habituated to humans and human facilities. Further, the apparent greater number of management trappings among adult females and subadult males suggests that many of these bears were food conditioned. Bears tending to range beyond 7 km of developments were probably less often habituated to humans or conditioned to human foods located at developments. Significantly, 30% of Yellowstone Park was within 7 km of a front-country campground or development.

The summer pattern of bear habitat use around developments could have resulted from bear response to humans and human foods. Habitat productivity was more evenly distributed across zones during summer compared to spring and fall and grizzly bears did not key as strongly on the most productive habitat across or within zones. Thus, the tendency for individual bears to be segregated by distance from developments suggests differential response to humans rather than differential productivity-based habitat selection. This is even more probable given that zones of "under-utilized" habitat alternated with zones of peak occupancy progressively outward from developments. A likely inference is that bears ranging farther from developments tended to be wary of humans and purposely avoided developments as well as the more habituated bears ranging near developments.

Individual cohort patterns underlay the hypothesized general response of bears to developments during summer. Females with cubs-of-the-year apparently avoided developments more than other bear cohorts. Females with cubs appear to have been in a double-bind during summer, avoiding humans and other adult bears. Subadults also apparently avoided adult females during summer. Furthermore, subadult locations comprised a larger portion of total locations within vs. beyond 7 km of developments. Thus, subadults appear to have ranged closer to developments during summer in part because they tended to avoid adult females. The response of typically low status (subadults) or security-consciou[s] (females with cubs) cohorts to adult females durin[g] summer may have partly reflected a response to adul[t] males; adult males would have been seeking out estru[s] females and would, consequently, be associated wit[h] them (Craighead and Mitchell 1982, Schleyer 1983).

Fall.—Adult males tended to occupy the most pro[-]ductive fall habitat; proportionate zone locations [of] adult males were related to zone fall productivit[y] scores. Adult females and subadult males, when a[l]lowed access, also tended to occupy productive fa[ll] habitat. However, avoidance of or displacement b[y] adult males apparently outweighed habitat preferen[ce] among these 2 cohorts during fall. These relationshi[ps] would be expected with hyperphagia (Nelson et a[l.] 1983, Nelson et al. 1984) and from previous obse[r]vations of bear cohort interactions at garbage dispo[sal] sites and spawning streams (Hornocker 1962, Egb[ert] and Stokes 1976).

Our data suggested that grizzly bears tended [to] avoid an area averaging 3 km along roads during f[all] and that foraging tended to be disrupted out to 4 k[m.] This response of bears to humans on roads duri[ng] fall is problematic, given that vehicle traffic dropp[ed] markedly in Yellowstone Park around the 1st week of September (Yellowstone Natl. Park, unpubl. data). Fall zone productivity scores were lowest within 5 km of roads and average forest cover was comparatively low out to 4 km. Lack of cover combined with comparatively unproductive habitat may have caused the observed comparatively low levels of daytime bear use along roads during fall.

During fall a pattern of daytime bear use similar to that of summer was evident around developments. Our interpretation of this pattern was similar to that of summer: habituated bears tended to occupy zones within 3 km and especially within 1 km of developments. Use greater than expected within 1 km likely reflected the presence of food-conditioned habituated bears. If the presence of habituated bears accounts for bear use greater than or nearly equal to that expected out to 1 km, then bear use less than expected in the broader area out to 4 km could be attributed to avoidance of developments by other bears and lack of human-related foods so far distant from developments. The area out to 4 km also coincided with low average productivity scores and percent forest area. These habitat factors would have probably contributed to, rather than mitigated, a daytime avoidance response by grizzly bears.

CONCLUSIONS

Three phenomena were evident from our analysis: (1) bears selecting more productive habitat, (2) bears avoiding bears, and (3) bears avoiding humans. Our analysis further suggested that the relative strength of these phenomena varied with season and cohorts. During spring females apparently selected highly productive habitat and secondarily, responded to the human presence. Adult males were apparently more indifferent to habitat conditions and further removed from humans. During summer strong selection for highly productive habitat was not evident by any cohort; and avoidance of humans and other bears more evident. Subadults and females with cubs were apparently most likely to avoid other bears, and females with cubs most likely to avoid humans. During fall all cohorts were probably strongly motivated toward selection of highly productive habitat. Even so, adult males apparently displaced other cohorts from the most productive habitat. Secondarily, bears also avoided humans, but in areas inherently less productive. Because adult females and subadults tended to be distributed closer to roads and developments and accounted for a large portion of locations especially during spring and fall, these cohorts were likely responsible for a large part of observed avoidance of humans.

Avoidance of humans using roads and developments in Yellowstone Park probably exacted a cost on the grizzly bear population. Adult females and subadults apparently bore a disproportionate part of this cost. Knight and Eberhardt (1984, 1985) have suggested that viability of the Yellowstone grizzly bear population is in large part contingent on survivorship of adult females. Mattson (1987) has also suggested that adult females, unlike adult males, experienced an ongoing energetics crisis; weights, mortality, and fecundity of adult females were strongly related to year-to-year and geographic variation in habitat productivity. Avoidance primarily of developments during spring and roads and developments during fall aggravated what was already an apparently marginal energetic situation for adult females. Thus, we conclude that avoidance of roads and developments by grizzly bears in Yellowstone Park probably resulted in poorer condition adult females and, consequently, higher mortality rates and lower fecundity for the cohort. However, we did not determine the extent of this effect.

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GRIZZLY BEARS AND RESOURCE-EXTRACTION INDUSTRIES: EFFECTS OF ROADS ON BEHAVIOUR, HABITAT USE AND DEMOGRAPHY

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SUMMARY

(1) Roads are an integral part of the development of resource-extraction industries. We wanted to know whether grizzly bears were displaced by these roads from adjacent habitats. Over 7 years, twenty-seven grizzly bears were captured and radio-collared in 264 km^2 of the Rocky Mountains, containing active tree-felling and petrocarbon developments.

(2) Most bears used habitats within 100 m of roads less than expected. This is equivalent to a habitat loss of 8·7%. This is significant because many habitats close to roads contain important bear foods. Avoidance of roads was independent of traffic volume, suggesting that even a few vehicles can displace bears.

(3) Roads and nearby areas were used at night but avoided in the day. Yearlings and females with cubs used habitats near roads more than other bears. These areas may have been relatively secure because they were avoided by potentially aggressive adult males.

(4) Limited data indicated minimal demographic effects during our study, but roads increased access for legal and illegal hunters, the major source of adult grizzly mortality.

(5) When roads are developed for resource industries in grizzly bear habitat, the bear population becomes highly vulnerable unless vehicle access and people with firearms are controlled.

INTRODUCTION

Grizzly bears (*Ursus arctos* Ord) are considered to require wilderness and seclusion from man (Hamer 1974; Craighead 1976), but much of their habitat is being explored and developed by resource-extraction industries (forestry, mining, petrocarbons). Previously ranging throughout western North America, grizzly bears are now classified as a threatened species in the contiguous U.S.A., and there is concern that their requirements are largely incompatible with most resource development. Most published information concerns grizzly bears in areas without resource-extraction industries, such as national parks (see review in LeFranc *et al.* 1987).

There are many levels of bear–industry interaction, but the most immediate concerns the extensive network of roads upon which the industries depend. Roads increase access for hunters and poachers, the probability of vehicle–bear collisions, and the frequency of energy costly flight responses by the bears. Indirect population constraints can result from long-term displacement of bears from areas adjacent to roads. Roads often follow valley bottoms and pass through riparian areas which are frequently used by grizzly bears. If roads do displace bears, it leads either to increased pressure on similar habitats in undisturbed regions, or to the 'loss' of these essential but limited habitats. Some variation in bears' responses to roads has been predicted; adult females with young cubs may avoid

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HABITATS SELECTED BY GRIZZLY BEARS IN A MULTIPLE USE LANDSCAPE

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Abstract: The effects of sex, ageclass, and season on habitats and elevations selected by 56 radiocollared grizzly between 1979 and 1995 in the Flathead River drainage of southeastern British Columbia and the adjacent portion of Montana were evaluated using compositional analyses. Two habitat selection strategies were apparent in the population: mountain resident bears selected avalanche chutes at higher elevations during spring, while elevational migrating bears moved to low elevations and selected riparian habitats. During summer, both groups of bears showed selection for areas that had been burned by wildfire 50–70 yr previously. In autumn, riparian was the highest ranked habitat followed by forest and open forest. Regenerating cut-blocks and rock outcrops consistently ranked lowest. Results of this southern grizzly bear study differ from others in that bears were free to select habitats in both mountains and the wide valley and they showed strong selection for some low elevation habitats.

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Key words: British Columbia, forestry, grizzly bears, habitat selection, Montana, *Ursus arctos*.

Humans have had a tremendous effect on the distribution and abundance of grizzly bears in southern Canada and the United States. Within a century, the southern and eastern distribution of these bears contracted to rugged mountains and high plateaus where few people settled (McLellan 1998). Today, maintaining grizzly bears in southern areas is a major conservation challenge (Servheen 1990, Banci et al. 1994).

The remaining grizzly bears in Alberta and the lower 48 states of the United States are largely confined to parks and designated wilderness areas plus adjacent multiple-use lands of the interior mountain ranges. In contrast, only about 10% of the grizzly bears in British Columbia are confined to protected areas; the vast majority live on multiple-use lands (McCrory et. al. 1990, Herrero 1994). Yet, because most grizzly bears in the interior mountains live in British Columbia and it is through this province that bears in the United States and Alberta are connected to larger populations in the North, conservation efforts on British Columbia multiple-use lands are critical to all southern grizzly bears.

In an attempt to address conservation issues including the maintenance of grizzly bear populations, British Columbia has developed a grizzly bear conservation strategy, a series of land-use planning processes, and the Forest Practic-

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WEDNESDAY, AUGUST 19, 2015

Grizzly bears kill more livestock in Montana than in all of 2014

ALISON NOON
Associated Press

HELENA — Growing numbers of grizzly bears venturing east from the Rocky Mountains are attacking more domestic cattle and sheep.

Montana's livestock-loss program has reimbursed ranchers for 42 animals killed by grizzlies so far this year — eight more than in all of 2014, not counting the 22 cattle lost this year to bears that have not yet been claimed.

One report came from as far east as Floweree, Montana, about 100 miles northeast of Helena, George Edwards of the Montana Livestock Loss Board said Tuesday.

Wyoming officials expect a less drastic increase in livestock attacks and the range of roaming by grizzly bears this year. "We're having what I guess you would call a steady increase in livestock depredation as grizzly population and area expand," said Brian DeBolt, Wyoming's large carnivore conflict coordinator.

This is only the third year Montana has offered financial relief to ranchers who lose livestock to grizzlies, but Edwards said the state has long been encouraging people to report bears' interactions with livestock.

The number of animals killed this year amounts to a spike amid a long-term downward trend of grizzly attacks on livestock along the Northern Continental Divide, state and federal officials said.

"These numbers vary from year to year anyway, and more reporting may be happening now because there's reimbursement," federal grizzly recovery coordinator Chris Servheen said. "But the big picture is that we try to mitigate conflicts."

Montana's Northern Rockies Wildlife Manager Graham Taylor said measures taken during the last few years to electrify fences and fortify food storage have helped to reduce the number of bear-livestock conflicts in parts of Montana despite a growing number of grizzlies.

90 ft/ac = threshold

RED SQUIRRELS IN THE WHITEBARK ZONE

Daniel P. Reinhart
David J. Mattson

ABSTRACT

Reports results of a study of interactions among red squirrels (Tamiasciurus hudsonicus), *bears* (Ursus *spp.*), *and whitebark pine* (Pinus albicaulis) *from 1984 through 1987 in north-central Yellowstone National Park and in the vicinity of Cooke City, MT. This paper deals with results that pertain to habitat relationships of red squirrels in the whitebark pine zone. Indices of red squirrel activity and abundance were highest in the mesic and wet habitat types. Pure whitebark pine stands were apparently not favorable habitat for red squirrels. In the whitebark pine zone, cones of other conifer species were needed to offset yearly variations in whitebark pine cone production. Optimal red squirrel habitat in this zone consisted of stands with high tree species diversity, basal area, and environmental favorability. Annual fluctuations in red squirrel densities reflected yearly whitebark pine cone production in stands with a high whitebark pine component. Bears may play a role in regulating red squirrel abundance in whitebark pine stands.*

INTRODUCTION

Red squirrels (*Tamiasciurus hudsonicus*) are commonly associated with coniferous forests. They range extensively in the boreal regions of North America from Alaska to Arizona and from northern Quebec to the Appalachian Mountains (Smith 1970). Red squirrels are typically diurnal, solitary, and active throughout the year. Their diet consists primarily of the reproductive products of trees, fungi, and shrubs within the forests they occupy (C. Smith 1968). Although red squirrels are well adapted to live on a variety of foods available during the growing season (Ferron and others 1986), in the Rocky Mountains they must rely on stored conifer seeds for half the year (Finley 1969; Rusch and Reeder 1978). Conifer seed cones represent storable, high-energy packages that are relatively resistant to spoilage (Weigl and Hanson 1980).

Red squirrels subsist on a seasonal food supply on a year-round basis by caching and storing conifer seed cones gathered within established, defended territories. Gathering and storing cones occupy up to 80 percent of their daily activity from August through November (C. Smith 1968). Individual territories are nonoverlapping and contiguous within forest habitats and are defended from other red squirrels regardless of sex by vocalizations and by chasing intruder squirrels (Rusch and Reeder 1978; C. Smith 1968).

A large, centralized midden is a major feature of a red squirrel territory. Middens are sites traditionally used to cache and feed on cones and consist of large amounts of cone clippings. They occasionally extend into springs, bogs, and creek bottoms where added moisture helps preserve cones in a closed, more storable condition (Finley 1969).

In high-elevation mountain forests of western North America, whitebark pine (*Pinus albicaulis*) trees produce annually fluctuating crops of large, edible seeds (Forcella and Weaver 1986). These seeds are extensively used by wildlife such as Clark's nutcracker (*Nucifraga columbiana*), bears (*Ursus* spp.), and red squirrels (Kendall 1981; Tomback 1982). The large, edible seeds of whitebark pine are apparently preferred over other conifers by red squirrels and are readily cached when available (Hutchins and Lanner 1982). Whitebark pine seeds are also an important fall and spring food for grizzly bears (*Ursus arctos*) within the Yellowstone ecosystem and are obtained almost exclusively by raiding squirrel caches (Kendall 1981). During 1984 through 1987 the Interagency Grizzly Bear Study Team (IGBST) studied the interrelationships of grizzly bears, red squirrels, and whitebark pine. Habitat relationships of red squirrels within the whitebark pine zone are presented here.

STUDY AREA

Our study area consisted of the Mount Washburn massif in north-central Yellowstone National Park, and an area in the Gallatin National Forest near Cooke City, MT (fig. 1). Both areas were located in higher elevations of the subalpine zone on moderately steep topography. Elevations ranged from 2,360 m (7,800 ft), just below the lower elevational limits of whitebark pine distribution, to 2,865 m (9,400 ft) at the upper limits of erect tree growth.

Most study area timber cover was mature to overmature with some stands of pole-sized, even-aged trees. Whitebark pine occurred throughout the study area and was variously represented from dominant to scattered individuals. Whitebark pine was more prevalent in the Mount Washburn area than in the Cooke City area, where lodgepole pine (*Pinus contorta*) was a more common dominant.

Paper presented at the Symposium on Whitebark Pine Ecosystems: Ecology and Management of a High-Mountain Resource, Bozeman, MT, March 29-31, 1989.

Daniel P. Reinhart is Wildlife Technician and David J. Mattson is Wildlife Biologist, Interagency Grizzly Bear Study Team, Forestry Sciences Laboratory, Bozeman, MT.

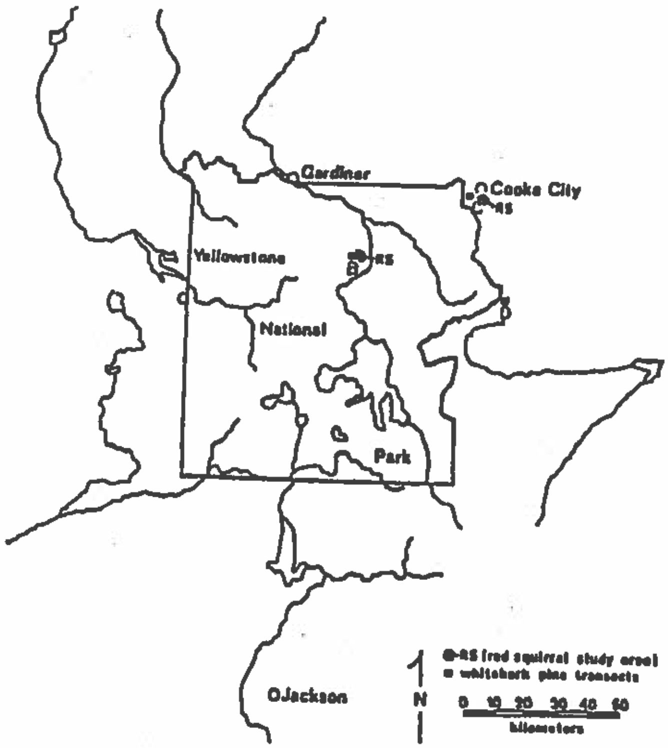

Figure 1—Location of red squirrel study areas (RS) and whitebark pine transects: Mount Washburn (B) and Cooke City (C).

The study area included five major habitat types described by Steele and others (1983). The *Pinus albicaulis* (PIAL) series habitat types prevailed at high elevations on west and south aspects. The *Abies lasiocarpa/Vaccinium scoparium-Pinus albicaulis* (ABLA/VASC-PIAL) and *Abies lasiocarpa/Vaccinium globulare-Vaccinium scoparium* (ABLA/VAGL-VASC) habitat type phases were the most common habitat types in our study area. The *Abies lasiocarpa/Vaccinium scoparium-Vaccinium scoparium* (ABLA/VASC-VASC) phase, *Abies lasiocarpa/Thalictrum occidentale* (ABLA/THOC), and *Abies lasiocarpa/Spiraea betulifolia* (ABLA/SPBE) habitat types occurred at low elevations. The wet site *Abies lasiocarpa/Calamagrostis canadensis* (ABLA/CACA) type was found near creek bottoms and seeps.

METHODS

We delineated homogeneous timber stands on USGS 15-ft topographic maps and 1:20,000 and 1:30,000 color aerial photographs. Line transects were laid out to intercept all stands so that no transects intersected and stand edge effect was minimized. Transects were laid out without bias toward timber stands or toward the monitored squirrel population. Transect lengths were determined from airphotos and corrected for slope.

Field work was conducted from mid-August to mid-September from 1984 through 1987. Beginning and end points were located using airphoto interpretation and marked with stakes. Two people walked all transects each year during daylight hours; one person maintained compass bearing and distance pacing, while the other person was responsible for observing and recording squirrel sign. Regular pauses were observed every 100 to 200 m in each stand for habitat evaluation.

All stands were identified by forest habitat type (Steele and others 1983) and forest cover type (Despain 1977; Mattson and Reinhart, this proceedings). In addition, between 5 and 26 systematically placed variable-radius overstory plots were taken in each stand (Mattson and Reinhart, this proceedings).

Red squirrel data were collected annually while walking line transects (Eberhardt 1978). Squirrel sign was referenced to transect locus and perpendicular distance from transect. All unduplicated sightings or vocalizations discerned from the transects and estimated to be within stand bounds were recorded. All individual squirrel middens observed from transects were noted and described as active or inactive based on the presence of cached cones, fresh cone clippings, or squirrels. Red squirrel activity was recorded between 0 to 60 m from transect lines. Bear activity and bear-excavated red squirrel middens were also noted.

We calculated two indices of relative squirrel abundance for habitat types and for habitat type-cover type combinations. We summed sightings and vocalizations and divided by total transect length to derive linear frequency of occurrence. Similarly, we divided total middens by transect length to derive linear frequency of middens.

Annual whitebark pine cone production for Cooke City and Mount Washburn study areas was obtained by counting cones on marked trees along predetermined whitebark pine cone transects (Blanchard, this proceedings).

RESULTS

Data were collected on up to 50 km of line transects per study year. Between 41 and 57 transects that sampled between 40 and 74 stands were walked annually on Mount Washburn. Between 15 and 22 transects surveyed between 51 and 65 stands near Cooke City.

Annual whitebark pine cone production varied widely in the study areas (fig. 2). Whitebark pine cone production was highest in 1985 and lowest in 1986. Cone crops in 1984 and 1987 were intermediate. Cooke City cone data were missing in 1984 and therefore extrapolated using simple linear-regression. Actual cone production in 1987 was believed to be higher than the cone counts indicated because of earlier than normal cone maturation and harvest and late cone surveys (Blanchard, this proceedings).

Several patterns were evident by linear counts of vocalizations plus sightings and active middens (table 1, fig. 3):

1. Relatively little squirrel activity occurred in PIAL series habitats on Mount Washburn. These were mostly pure near-climax whitebark pine stands.

2. Moderate amounts of squirrel sign were found on the drier ABLA/SPBE type and in the ABLA/VASC-PIAL phase.

3. A higher incidence of red squirrel activity occurred in more mesic habitats represented by the ABLA-THOC habitat type and the ABLA/VAGL-VASC and ABLA/VASC-VASC phases and in the wetter sites of the ABLA/CACA habitat type.

We calculated annual variation of squirrel density indices for the major study area habitat types (table 1). On Mount Washburn (fig. 3A), annual variation in squirrel abundance generally reflected annual variation in whitebark pine cone production. This pattern was most evident in the ABLA/VASC-PIAL phase but was also apparent in the other more mesic habitat types. At Cooke City (fig. 3B), sequential years' variation of squirrel densities was not as pronounced as on Mount Washburn with the exception of the ABLA/VASC-PIAL phase where variation did reflect the whitebark pine cone crop.

There were differences in the extent of variation among years between the two indices used to measure squirrel abundance (fig. 3). Linear densities of vocalizations and sightings varied more than linear densities of active middens. There was also an exponential increase in the density of vocalizations plus sightings relative to the increase in the density of active middens ($r^2 = 0.959$, $P < 0.001$) (fig. 4).

Table 1—Mean densities (n/km) and coefficients of yearly variation of active red squirrel middens for habitat types of the two study areas

Habitat type	Midden density: Mount Washburn $\bar{X}$	Mount Washburn C.V.	Cooke City $\bar{X}$	Cooke City C.V.
ABLA/CACA	3.64	0.506	2.35	0.719
ABLA/THOC	3.20	0.233	1.63	0.355
ALBA/VAGL-VASC	2.60	0.079	1.92	0.250
ABLA/VASC-VASC	2.78	0.243	—	—
ABLA/VASC-PIAL, LP cover type	3.80	0.389	4.34	0.737
ABLA/VASC-PIAL, WB cover type	1.15	0.548	1.38	0.188
ABLA/SPBE	1.53	0.580	—	—
PIAL series	0.11	0.200	—	—

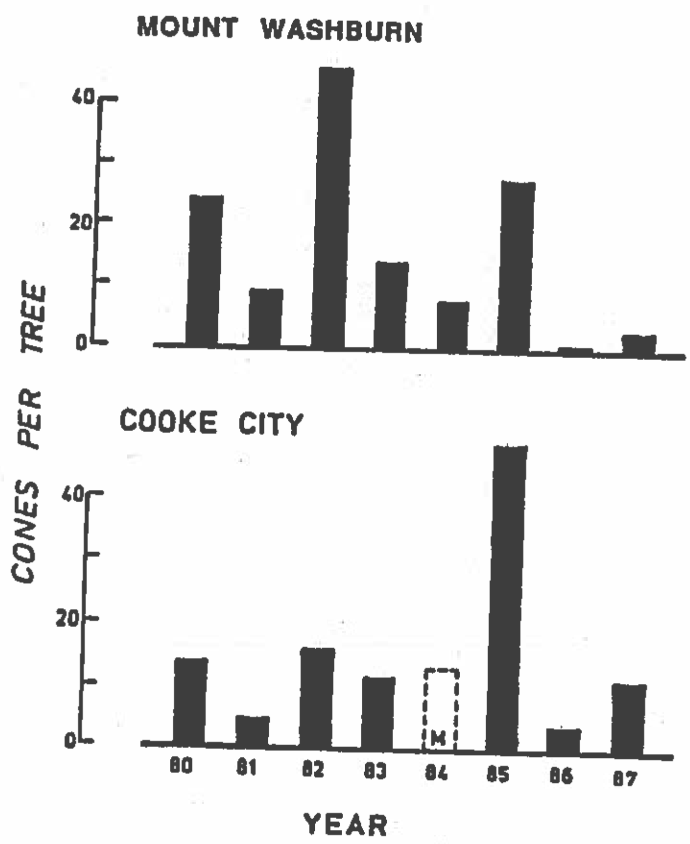

Figure 2—Whitebark pine cone production, 1980-1987, for the Mount Washburn and Cooke City study areas. Cone production for Cooke City in 1984 was extrapolated.

Average linear frequency of middens for different habitat types was positively related to average timber basal area ($r^2 = 0.675$, $P < 0.001$) (fig. 5). The ABLA/VASC-PIAL habitat type-whitebark pine cover type deviated the most from this relationship. Lodgepole pine cover types of the ABLA/VASC-PIAL phase fit the general relationship of basal area and squirrel density. At an average basal area of less than 67.7 m²/ha (90 ft²/acre), no resident squirrels occurred. Mean basal area for the PIAL series defined this extreme end point.

We also related a synthetic environmental variable, "site favorability," to mean squirrel midden abundance (fig. 6). Site favorability was an index that positively weighted direct solar radiation and negatively weighted wind exposure and elevation. Mattson and Reinhart (this proceedings) more fully described this variable. Squirrel abundance was lowest on the coldest, highest, and most wind-exposed habitat types ($r^2 = 0.792$, $P < 0.001$). Variation from this relationship was associated with overstory species diversity and higher basal areas of whitebark pine and Douglas-fir (*Pseudotsuga menziesii*). Habitat types with less squirrel densities included the PIAL series, which consisted of almost pure whitebark pine stands, and the ABLA/VASC-VASC phase, which consisted of predominantly pure lodgepole pine stands. The lodgepole pine cover type of the ABLA/VASC-PIAL phase and the ABLA/SPBE habitat type showed higher squirrel densities than expected by site favorability index. Higher levels were associated with moderate overstory diversity and relatively high basal areas of whitebark pine and Douglas-fir, respectively.

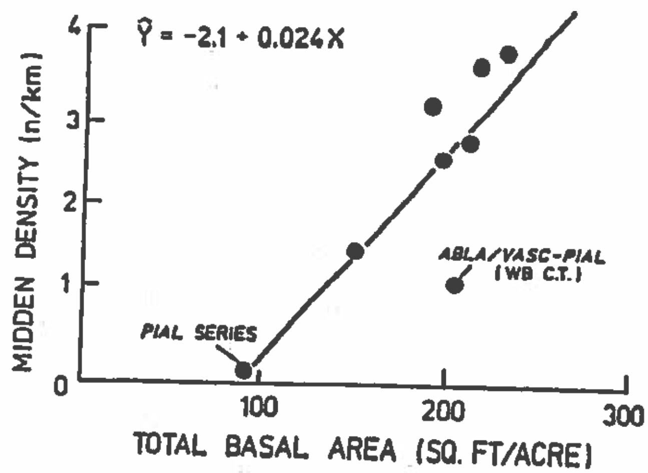

Figure 5—Relationship of active midden density and total timber basal area for the Mount Washburn study area.

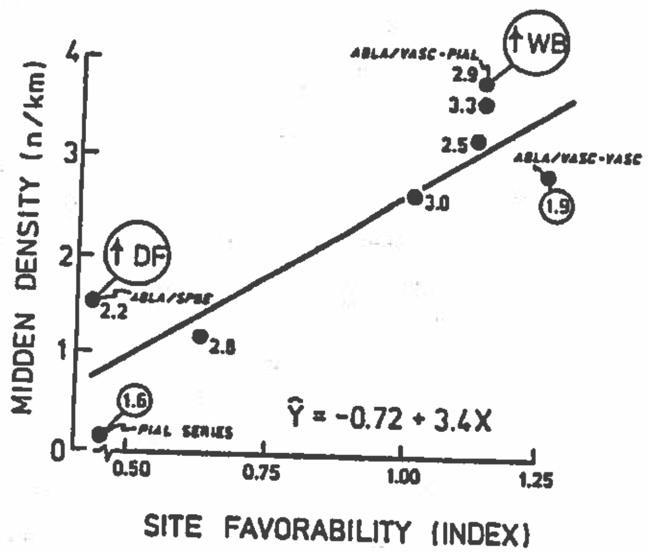

Figure 6—Relationship of active squirrel midden density and site favorability index for the Mount Washburn study area. Numbers at each datum are overstory diversity ($e^{H'}$; Shannon and Weaver 1963) for the corresponding type.

DISCUSSION

Line transects have been used in previous studies to describe the relative abundance of wild populations (Burnham and others 1980; Eberhardt and others 1979; Hayne 1949). Indirect evaluation techniques have been useful measures of animal abundance when used to compare data between areas and time periods, or to associate habitat parameters with wildlife populations (Halvorson 1984). The following criteria should be met to reduce bias and variability in auditory and visual line transects of red squirrels (Eberhardt 1978; Halvorson 1984; Hayne 1949):

1. Sample design includes standardized methods that are repeatable.
2. Transects are laid out without bias toward the monitored population.
3. Time of day or season in relation to animal activity patterns does not vary over the course of the sampling period.
4. The effects of topography and cover on animal response to the observer are known.
5. Monitoring of a population is undertaken for a time period long enough to cover full cycles of population abundance.

This study of red squirrel populations appeared to have met these criteria. Red squirrel vocalizations could be heard between 0 to 60 m from transect lines, and usually occurred when the observer entered a red squirrel territory (C. Smith 1968). Red squirrels and middens were sighted between 0 to 40 m from the transect lines. There were no apparent differences in the frequency of squirrel calls or sightings related to time during daylight hours; stand boundaries and red squirrel territories were discrete so that topography changes were not critical to our evaluation. This study encompassed 4 years that included high, low, and intermediate whitebark pine cone crops. Although more years are needed to fully monitor red squirrel population trends (Halvorson 1984), some aspects of red squirrel habitat relationships can be addressed.

The high correlation of vocalization plus sighting densities with midden densities suggests that these two indices reflected the same phenomenon, and tends to corroborate the validity of each as a measure of squirrel abundance. The greater frequency of vocalization plus sighting densities relative to midden densities could have been a reflection of our greater sensitivity to red squirrel activity because of the greater detection range of vocalizations relative to middens. The exponential increase and greater variation of vocalizations and sightings with respect to middens could also reflect positive acoustical feedback similar to ruffed grouse (*Bonasa umbrellus*) behavior (Rogers 1981). With increasing squirrel densities (midden densities), there could have been an exponential increase in vocalizations triggered as a positive response to one squirrel's initial call. We suspect that this second explanation holds, and so considered squirrel midden abundance to be a more reliable indicator of squirrel density in our study area.

The whitebark pine zone apparently constitutes an extreme of the red squirrel niche. Pure whitebark pine stands, represented by the PIAL series habitat types, were not hospitable habitats for red squirrels. Factors that may contribute to the lack of red squirrels in pure whitebark pine stands include less total overstory basal area and species diversity, highly variable cone crops characteristic of whitebark pine, and the high, cold, harsh environments associated with these stands. The more mesic and wetter habitat types supported more red squirrels. These habitats had more overstory diversity, which in turn offered red squirrels other species' cone crops when whitebark pine seeds were not available. Lodgepole pine was an important conifer species to red squirrels. Although less preferred by red squirrels compared to some other tree species (Finley 1969), lodgepole pine played an important role in red squirrel habitat by providing a more consistent source of serotinous and thus more storable cones (C. Smith 1968).

Annual variation in red squirrel densities apparently reflected general whitebark pine cone crops in stands with a moderate to high proportion of whitebark pine. This was most evident in the ABLA/VASC-PIAL phase of both the Cooke City and Mount Washburn study areas. Although cone crops of other conifer species in mixed stands were not measured in this study, they apparently played an important role in the red squirrels' food supply, especially in years of poor whitebark pine cone mast (Finley 1969). In general, squirrel densities in all habitat types were more sensitive to whitebark pine crops in the Mount Washburn study area where whitebark pine was more prevalent than in the Cooke City study area. Two factors may explain greater yearly fluctuations in red squirrel densities in stands with a substantial amount of whitebark pine:

1. The food supply associated with large whitebark pine cone crops may allow the temporary establishment of more territories and squirrels in areas that did not previously support red squirrels.

2. Bear depredation of red squirrel caches may compound the effects of variable whitebark pine crops by further disrupting the squirrel population social status, by competing for food, and by occasionally eating red squirrels outright. Squirrel remains show up in grizzly bear scats containing whitebark pine seeds (Knight and others 1987).

Regulatory factors have been identified for red squirrel populations in other study areas. C. Smith (1968) suggested that territoriality allowed individual red squirrels the optimum conditions for harvesting, storing, and defending a seasonal food supply throughout the year. He further demonstrated that territory size was related to food supply, or was inversely proportional to habitat quality. Kemp and Keith (1970) found a strong correlation between white spruce (*Picea glauca*) cone crops and red squirrel population levels. However, M. Smith (1968) showed that red squirrel populations could survive a white spruce cone crop failure by caching surplus cones during good mast years.

Red squirrel populations in our study areas may be influenced by bear use and flexible habitat requirements of squirrels. Our study area included the edge of occupied red squirrel habitat. In the whitebark pine zone this edge varied with whitebark pine cone production. In years of unusually large whitebark pine crops, red squirrels occupied pure whitebark pine stands (Kendall 1981). However, this occupancy was probably shortlived. We found little sign of permanent red squirrel occupancy in stands with a high percentage of whitebark pine. Generally, with increased site favorability and species diversity, middens were characterized by increasing amounts of cone debris that indicated a longer history of occupancy. Red squirrels apparently established transient territories in whitebark stands during years of large cone crops because of the high forage quality of whitebark pine seeds. We are not sure how this was realized, but it was probably by the immigration of juveniles or extension of ranges by established squirrels into adjacent whitebark pine stands. Squirrels probably do not survive poor mast years in nearby pure whitebark pine stands because of frequent poor crops, the lack of alternative foods, and depredations by bears that possibly deprive them of an additional year's food. Ognev (1940) described a similarly dynamic situation for the European squirrel (*Sciurus vulgaris*) in the range of Asian stone pines (subsection Cembrae). He described transient territories and even mass "migrations" following years of crop failures.

More research is needed to better understand the relationships among whitebark pine, red squirrels, and bears, as well as how specific silvicultural treatments affect this system. Longer term study is required to assess red squirrel population responses to variable whitebark pine cone crops. In mixed and pure whitebark pine stands, red squirrel densities should be monitored, as should cone mast of all conifer species stratified by age and size classes. Study of red squirrel territory sizes with respect to different habitats or whitebark pine crops, as well as territory stability with respect to site favorability would provide valuable insight into red squirrel population regulation in this zone. More data are needed to assess the interaction between bears and red squirrel populations in the whitebark pine zone. This may be approached by relating levels of midden use by bears to annual variations in red squirrel densities and whitebark pine cone crops.

MANAGEMENT IMPLICATIONS

Timber management can potentially affect red squirrel population densities in the whitebark pine zone. Whitebark pine is not considered to be a valued commercial timber species (Arno and Hoff 1989). However, timber harvests do occur in stands that contain whitebark pine, primarily in stands of higher commercial value in the lower part of whitebark pine's elevational distribution. Basal area reduction by timber harvest in the whitebark pine zone will almost certainly reduce squirrel densities. Our results suggest this effect. Other studies in Alaska (Wolf and Zasada 1975) and Ohio (Nixon and others 1980) have also documented reduction in squirrel densities following reduction in basal area of seed-producing trees.

The strong link between red squirrels and grizzly bears (Kendall 1981; Mattson and Jonkel, this proceedings) in the whitebark pine zone merits the attention of resource managers. Management of grizzly bear habitat in the whitebark pine zone is partly contingent on management of red squirrel habitat and populations. Because of squirrel habitat requirements, management for both bears and squirrels logically revolves around maintenance of diverse-species, high-basal-area stands on favorable, more mesic sites of the zone. Forest managers should be cautious when applying silvicultural practices in whitebark pine forests to "enhance" grizzly bear habitat. Leaving seed-bearing whitebark pine trees in shelterwood cuts would reduce red squirrel densities by reducing overstory diversity and basal area. Planting whitebark pine seedlings following clearcutting may benefit long-term management of these stands, but will have little positive effect until these slow growing trees are mature enough to bear cones. Both practices would increase human access and activity. Increased risk of bear displacement and mortality would outweigh any gains achieved by overt forest manipulation.

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Mattson

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Management and Conservation Article

Hazards Affecting Grizzly Bear Survival in the Greater Yellowstone Ecosystem

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ABSTRACT During the past 2 decades, the grizzly bear (*Ursus arctos*) population in the Greater Yellowstone Ecosystem (GYE) has increased in numbers and expanded its range. Early efforts to model grizzly bear mortality were principally focused within the United States Fish and Wildlife Service Grizzly Bear Recovery Zone, which currently represents only about 61% of known bear distribution in the GYE. A more recent analysis that explored one spatial covariate that encompassed the entire GYE suggested that grizzly bear survival was highest in Yellowstone National Park, followed by areas in the grizzly bear Recovery Zone outside the park, and lowest outside the Recovery Zone. Although management differences within these areas partially explained differences in grizzly bear survival, these simple spatial covariates did not capture site-specific reasons why bears die at higher rates outside the Recovery Zone. Here, we model annual survival of grizzly bears in the GYE to 1) identify landscape features (i.e., foods, land management policies, or human disturbances factors) that best describe spatial heterogeneity among bear mortalities, 2) spatially depict the differences in grizzly bear survival across the GYE, and 3) demonstrate how our spatially explicit model of survival can be linked with demographic parameters to identify source and sink habitats. We used recent data from radiomarked bears to estimate survival (1983–2003) using the known-fate data type in Program MARK. Our top models suggested that survival of independent (age ≥2 yr) grizzly bears was best explained by the level of human development of the landscape within the home ranges of bears. Survival improved as secure habitat and elevation increased but declined as road density, number of homes, and site developments increased. Bears living in areas open to fall ungulate hunting suffered higher rates of mortality than bears living in areas closed to hunting. Our top model strongly supported previous research that identified roads and developed sites as hazards to grizzly bear survival. We also demonstrated that rural homes and ungulate hunting negatively affected survival, both new findings. We illustrate how our survival model, when linked with estimates of reproduction and survival of dependent young, can be used to identify demographically the source and sink habitats in the GYE. Finally, we discuss how this demographic model constitutes one component of a habitat-based framework for grizzly bear conservation. Such a framework can spatially depict the areas of risk in otherwise good habitat, providing a focus for resource management in the GYE.

KEY WORDS Demography, Greater Yellowstone Ecosystem, grizzly bear, hazard models, known-fate analysis, road density, secure habitat, source–sink dynamics, survival, *Ursus arctos*.

The Greater Yellowstone Ecosystem (GYE) grizzly bear (*Ursus arctos*), listed as a threatened species in 1975, was formally delisted by the United States Fish and Wildlife Service (USFWS) in 2007 (USFWS 2007). The bear was relisted by court order in November 2009. Today, this population of grizzly bears lives in close proximity to humans and is what Scott et al. (2005:384) refer to as a "conservation-reliant species," that is, a species that is at risk from threats so persistent that it requires continuous management to maintain population levels.

Humans are the primary agent of death in grizzly bears. Indeed, rates of human-caused mortality determine the trajectories of most grizzly bear populations (Eberhardt et al. 1994, McLellan et al. 1999, Harris et al. 2006). Accordingly, understanding bear–human relationships and modeling the mortality risk in human-dominated landscapes have received recent attention, leading to development of increasingly comprehensive, spatially explicit hazard models. For example, building on early studies that emphasized the effects of roads on grizzly bear survival (Archibald et al. 1987, McLellan and Shackleton 1988, Mattson and Knight 1991, Mace et al. 1996, Mace and Waller 1997), recent hazard models also consider differences in land management policy, proximity to humans and human developments, terrain features, and vegetation cover, as well as sex, age, and management history of individual bears (Boyce et al. 2001, Merrill and Mattson 2003, Johnson et al. 2004, Nielsen et al. 2004, Haroldson et al. 2006). Moreover, these models have the potential to provide managers with spatially explicit assessments of risks, thereby focusing management activities (Nielsen et al. 2006).

Risk assessments are typically constructed using data from histories of radiomarked individuals or the locations of dead bears (Boyce et al. 2001, Merrill and Mattson 2003, Johnson et al. 2004, Nielsen et al. 2004, Haroldson et al. 2006). Methods to model survival from marked individuals are well established, allow for direct comparisons among habitats where bears survive and where they die, and constitute one component necessary to parameterize demographic models (White and Garrott 1990, White and Burnham 1999). Models using known mortality locations allow for an alternative approach when telemetry data are unavailable. These models compare mortality sites to random or telemetry locations but require assumptions about reporting rates and the spatial accuracy of the death sites (Merrill and Mattson 2003, Nielsen et al. 2004).

Despite progress in modeling grizzly bear mortality risk, important challenges remain. Most notably, in the GYE, a

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Grizzly

grizzly deaths 59 in GYE — Tuesday, December 22, 2015 10:00 PM

From: "George Wuerthner" <gwuerthner@gmail.com>

To: "Ann Harvey" <aharvey@wyom.net>

Bcc: sjjohnsonkos@yahoo.com

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A grizzly bear swims across the outlet of Shoshone Lake in Yellowstone National Park where the number of ecosystem-wide bear deaths hit a record in 2015. Wildlife managers say more mortalities are expected with a larger population, but some activists are unsettled by the loss of 59 grizzlies. (Angus M. Thuermer Jr./WyoFile)

A record 59 grizzlies died in the Yellowstone ecosystem in 2015

by Angus M. Thuermer Jr. | DECEMBER 22, 2015

265 SHARES

Conflicts with hunters and livestock were among the reasons a record 59 grizzly bears died in the Yellowstone ecosystem in 2015, the federal government's grizzly coordinator said last week.

In addition to running into hunters and being removed for killing stock, grizzlies also faced a dry year and were seen more often in developed areas, said Chris Servheen, grizzly bear recovery coordinator for the U.S. Fish and Wildlife Service. He leads the effort to establish an enduring population in the Yellowstone region.

The number of deaths "was the highest number of grizzly mortalities in the Yellowstone Ecosystem since 1970," Servheen said in an email. He put the number in perspective, writing that the losses are "not a big deal in terms of population-level impacts.

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"Remember," he wrote, "that there are three times as many bears in the ecosystem today as in 1970." An estimated 717 grizzlies live in the ecosystem today, according to the Interagency Grizzly Bear Study Team, but some question the accuracy of that figure.

Grizzly deaths are recorded according to sex and age. The number of females older than two years is an important component of the population. Consequently, managers have set an annual limit for adult female mortalities at 7.6 percent of the population.

In 2015 adult female grizzly deaths exceeded that figure by 0.1 percent, Servheen wrote. Adult males died at 11.7 percent, well below their 15 percent limit.

"Bottom line is that annual mortalities fluctuate in natural systems and individual years will vary," Servheen wrote.

Numbers are key part of Endangered Species Act delisting

The health and size of the population are critical factors as the federal government begins to remove Endangered Species Act protection from the Yellowstone-area population. Wyoming, Idaho and Montana could subsequently institute a grizzly hunting season.

Fifty-five of the deaths in 2015 were human-caused. Investigators are probing the death of 19 Yellowstone-area grizzly bears, according to the mortality table. "Investigation" is a label applied to probes of grizzlies believed killed by hunters, poachers or nefarious actors.

14 livestock
12 food

Fourteen bears were killed or otherwise removed from the population for conflicts with livestock and 12 for getting human food or for property damage, the 2015 mortality table shows. Five bears were euthanized through management actions, four died as a result of collisions with vehicles, two were natural deaths and three bears died of unknown causes.

The 2015 mortality figure of "known and probable" deaths exceeds the previous annual high of 55 that was set in 2012, grizzly bear advocate and watchdog Louisa Willcox wrote WyoFile in an email. There also are unrecorded bear deaths, she said, and they could bring the 2015 tally up to 90 bears.

Although the federal population estimate was set at 717, it covers a range that could be as low as 642, Willcox said. That led to her worst-case estimate.

"Bottom line: there could be as few as 552 bears in the ecosystem," she wrote. If 90 bears out of 642 were killed, that amounts to 12 percent of the official population number and would bring the ecosystem count to "below the basement level of 600."

Six hundred is the fewest bears that the U.S. Fish and Wildlife Service would allow — after delisting — before it would prohibit "discretionary mortality." U.S. Fish and Wildlife director Dan Ashe referenced that limit in a letter he sent to state game directors in September.

An agency spokeswoman said the 600-bear minimum likely would never be reached after Endangered Species Act protections are removed. "The goal would be to manage for approximately 674 grizzly bears to ensure a sustainable and resilient population that utilizes the entire available habitat in the Greater Yellowstone Ecosystem," Serena Baker wrote in an email. "We do not anticipate population numbers to dip down to 600 bears."

Members of the Interagency Grizzly Bear Study Team also say the population survey could under-estimate bears by 40 percent. That wide range perplexes some, including Wyoming Wildlife Advocates. That nonprofit advocacy group asked Ashe in November for a "definitive GYE grizzly bear survey."

Federal estimates spread over a range of plus or minus 472 bears, wrote Kent Nelson, director of the group. "At this point IGBST's 'best available science' starts looking more like a wild-ass guess," Nelson wrote Ashe.

"There is a far better alternative to the chaotic situation," he wrote. That would constitute "a survey of the GYE grizzly population using DNA hair analysis."

The current estimates are based on mathematical modeling, following observations, including those made from aerial surveys.

Clarification: The official 717 count is for the "Demographic Monitoring Area," that covers about 20,000 square miles across most, but not all, of the Yellowstone ecosystem. The IGBC mortality chart includes bears killed throughout the ecosystem. Officials have said 10 Yellowstone ecosystem grizzlies died in 2015 outside the DMA — Ed.

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SECTION 3.3

GRIZZLY BEARS AND TIMBER HARVEST

J. S. Waller and R. D. Mace

Two events that probably had a large impact on the South Fork grizzly bear population were the construction of Hungry Horse reservoir and timber harvest. Hungry Horse dam, constructed between 1948 and 1953, flooded 9,712 ha of riparian and upland habitat. Accelerated timber harvest began during the early 1950's with the removal of approximately 90 million board feet (mbf) of timber that would soon be flooded by Hungry Horse reservoir. In 1947 the maximum allowable cut (MAC) on the Flathead National Forest (FNF) was 65 mbf. New silvicultural technologies, and the increasing post-war demand for timber, increased the FNF's MAC to 127 mbf. In 1963 144 mbf was harvested on the FNF, nearly double the 1953 harvest of 75 mbf. In 1898 only 3 sawmills operated in the area with timber harvested primarily from private lands. Private timber reserves supplied local mills until the second world war. By 1953 20 mills operated in the area, and increased to 36 mills and 4 plywood plants by 1965. The forest road system expanded with the increased timber harvest. In 1939 there were 458 km of roads in the FNF, and by 1965 there were over 2,763 km of road. After the completion of the west-side reservoir road in 1953, roads were built to the heads of every major drainage in the study area from Doris Mountain near the northern terminus of the Swan Mountains to the northern boundary of the Bob Marshall Wilderness. Expansion of the road system into the Bunker Cr. drainage on the northern boundary of the Bob Marshall was controversial and hotly contested during the mid 1950's (Shaw 1967).

From the inception of the South Fork Grizzly Project, the effects of roads on grizzly bears were recognized as being an important area of research. By 1990 it was apparent that timber harvest units were a large component of the grizzly bears' environment, and thus a suitable subject for research as well. In September 1990 a graduate student was employed to document the nature and extent of cutting unit use by grizzly bears. This work culminated in 1992 with a thesis entitled "Grizzly bear use of habitats modified by timber management" (Waller 1992).

This study employed a sample of 22 radio-collared grizzly bears to document the extent to which grizzly bears used harvested habitats on a seasonal and annual basis, and how this use compared to the availability of harvested habitats. Use sites within harvested stands were sampled and compared to random sites within the same stand to determine if grizzly bears were selecting unique microsites within stands or if use sites were representative of the stand as a whole.

Thesis results indicated that grizzly bears significantly avoided cutting units, during all seasons, at the study unit level of selection. However, study animals used cutting units in proportion to their availability within their seasonal 95% minimum convex polygon home ranges. No differences in use of cutting units by age or sex class were observed. Use of cutting units increased during the summer, and clearcuts were used less than other harvest types. Grizzly bears were more likely to use cutting units harvested 30-40 years ago than older or newer cutting units. Also cutting units at higher elevations were more likely to be used than those at lower elevations.

Also in 1992 the SFGP released it's Progress Report for 1992 which addressed annual patterns of grizzly bear selection for or against cutting units by elevation class. Again, only univariate tests were conducted (Mace and Manley 1993). Results of this analysis differed only slightly from those in Waller's thesis. No preference or avoidance of specific cutting unit types was observed. Females were found to avoid cutting units at lower elevations. Cutting units less than 12 years old were used less than expected.

In 1996, we published the results of our research concerning the interaction between grizzly bears and roads (Mace et al. 1996). This multivariate analysis incorporated habitat and elevation to assess the seasonal interactions between grizzly bears and roads at 3 levels of selection. One of the habitat classes in the analysis was cutting units. This analysis found that cutting units were avoided at the 2nd order of selection (within a composite home range). However, we observed stronger selection for cutting units within seasonal home range polygons; logistic regression coefficients were positive for cutting units for 67%, 79%, and 54% of radio collared bears during spring, summer, and fall respectively.

In 1997 we published a paper addressing univariate habitat selection, and again, cutting units were one of the habitat types in the analysis (Waller and Mace In Press). Cutting units were found to be among the least preferred habitat types for both sexes during spring and fall within 95% home ranges. Conversely cutting units were among the most preferred habitat types for both sexes, within 95% home ranges, during summer.

During 1996, we attempted to publish a paper describing in greater detail the factors affecting how grizzly bears select cutting units. This publication failed the peer review process due to shortcomings in the data. Specifically, reviewers questioned the accuracy of the U.S. Forest Service records used to classify cutting units by harvest method and scarification type. No field verification of this database was performed, or was possible due to the ages of the cutting units involved. Further, the functional relationship between U.S.F.S. classification and actual ground condition was not clear. Several silvicultural systems were used on the FNF, such as clearcutting, seed tree cutting, and shelterwood cutting. Although these cutting units were classed differently, the actual condition may have been functionally the same. We made an attempt to classify cutting units by current condition using satellite imagery, but we were forced to pick one dominant cover type to represent the cutting unit. In reality, cutting units could be mosaics of several cover types, and thus have different values to grizzly bears. No relationship was found between current dominant overstory and bear use.

Another serious shortcoming that has affected other analysis efforts is the small telemetry sample sizes involved. By 1994 we had amassed 2,248 useable aerial telemetry locations on 20 individual grizzly bears, but only 254 (11%) occurred within cutting units, an average of 2 locations per bear per year. There were 1,503 cutting units within the study area, but bears were relocated in only 188 of these units (12%). One may perceive this as avoidance of cutting units, however cutting units comprise only 15% of the study area. Given these figures, it is clear that bi-weekly aerial telemetry flights were insufficient to accumulate the telemetry sample sizes necessary to analyze fine scale patterns of habitat selection.

The error associated with aerial telemetry locations further compounds the problem. About 50% of the locations in cutting units were within 75 m of the edge of that unit. Our telemetry was accurate to 75 m, thus for 127 locations classed as being in a cutting unit, we were uncertain as to whether or not the bear was actually in the cutting unit or not. In these cases the resolution of our habitat mapping exceeds the resolution of our telemetry. However, it appeared that grizzly bear distance from, or into, a cuting unit is as expected relative to the availability of distances (Fig. 3.3.1).

Despite these problems, certain aspects of this database appeared robust, and recurred in the analyses described above. The first of these is the apparent avoidance of cutting units at large scales or lower orders of selection. As selection order increased, from landscape or geographic levels to seasonal selection within home ranges, avoidance of cutting units decreased. This probably reflects the selection that occurred at lower orders and not high Type II error rates. Although the number of telemetry points was low, the number of individuals was high enough to minimize Type II errors (Alldredge and Ratti 1986).

The data indicated, and personal observations confirmed, that use of cutting units increased during the summer when huckleberries (*Vaccinium globulare*) became available. Some cutting units supported large patches of huckleberry, but there is no research that explained or predicted the spatial distribution or productivity of these patches. We have also found a consistent negative relationship between the age of cutting units and the amount of use they received. Cutting units less than 12 years old were much less likely to be used than older units.

We found that certain cutting units seemed to have seasonal concentrated use by grizzly bears. To date we have been unable to attribute this use to any factors within our databases. We suspected that concentrated use was a function of abundant food resources (these cutting units seemed to have lots of huckleberries), security (not necessarily related to proximity to open road, rather freedom from human disturbance), and the cutting units' spatial location within the study area. This last factor deserves some discussion. We believe that use was also related to a cutting units topographic position. Cutting units that had high security, abundant food, and occurred along major drainages or ridgetops received more use from resident females and males that traveled through the corridor. Also units that occurred at the intersection of several home ranges could be expected to be used by more bears than those within the core home range of a resident female.

Grizzly bears have survived and successfully reproduced within the study area despite 50 years of timber harvest (Mace and Waller 1997b). However our studies of timber harvest/grizzly bear interactions are observational and no companion study in adjacent wilderness is available to compare survival and reproductive parameters. No empirical studies of the response of bear foods to timber harvest have been conducted. Observational studies (Zager 1980, Waller 1992, Anderson 1993) suggest wide variation in responses exist. Timber harvest in other ecosystems may have a more severe effect on bear food abundance than in our study area (Anderson 1993). Ecosystem specific food studies, combined with baseline population data, would help managers deduce the effects of various land management strategies on resident grizzly bear populations.

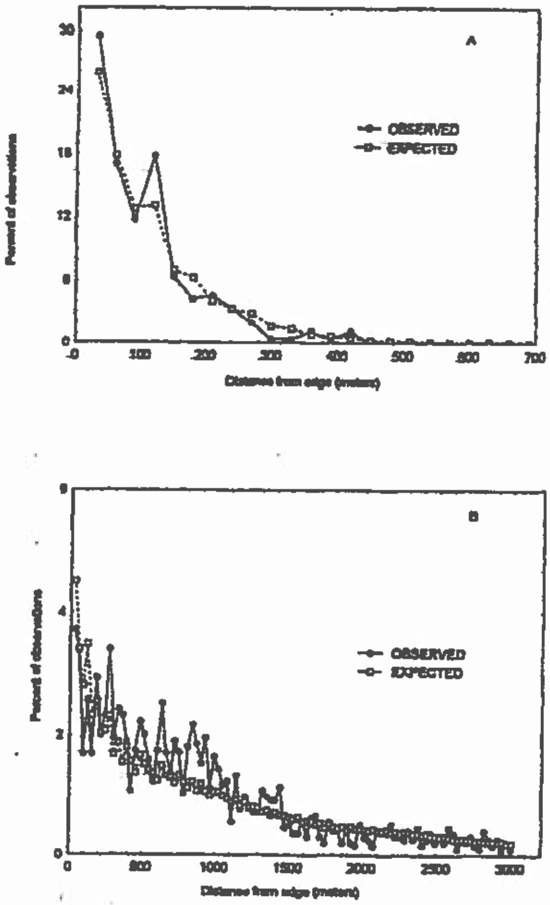

Figure 3.3.1. Distribution of observed and expected (available) distances to edge of cutting units from; A) within cutting units, and B) outside cutting units, Swan Mountains, Montana.

FWS_Pub CMT_006268

Grizzly bear use of open, closed, and restricted forestry roads

Robert B. Wielgus, Pierre R. Vernier, and Tina Schivatcheva

Abstract: We investigated grizzly bear (*Ursus arctos*) selection of three road types in the northern United States and southern British Columbia from 1986 to 1991. We hypothesized that grizzly bears select against open (public use allowed), restricted (forestry use only), and closed roads (no public use allowed) in that order. We analyzed use of roads for 11 bears (five females and six males) in an area containing open and closed roads and 11 bears (seven females and four males) in an adjacent area containing restricted roads. We used χ^2 and log–linear models to test for selection of habitat type and distance to road categories. Ten of 12 females and 5 of 10 males (15 of 22 bears) selected against ($P < 0.05$) low-elevation interior cedar–hemlock and for ($P < 0.05$) high-elevation Englemann spruce (*Picea engelmannii* Parry ex Engelm.) – subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.). After accounting for habitat, 4 of 5 females and 3 of 6 males (7 of 11 bears) selected against open roads and 3 of 5 females and 0 of 6 males (3 of 11 bears) selected against closed roads. No females ($n = 7$) or males ($n = 4$) (0 of 11 bears) selected against restricted roads. Our results are inconsistent with the hypothesis that bears select against open, restricted, and closed roads in that order. Most females and males selected against open roads, most females selected against closed roads, and no bears selected against restricted roads. The type of human activity along roads plays a role in bear responses to roads, and this aspect should be incorporated into future bear–road studies.

Résumé : Nous avons étudié l'utilisation par l'ours grizzly (*Ursus arctos*) de trois types de chemins dans le Nord des États-Unis et le Sud de la Colombie-Britannique de 1986 à 1991. Notre hypothèse était que les ours grizzly évitent, dans l'ordre, les chemins ouverts (au public), les chemins à accès restreint (limités aux forestiers) et les chemins fermés (au public). Nous avons analysé l'utilisation des chemins par 11 ours (cinq femelles, six mâles) dans un territoire incluant des chemins ouverts et fermés et par 11 ours (sept femelles, quatre mâle) dans un territoire adjacent avec des chemins à accès restreint. Nous avons utilisé le test du χ^2 et des modèles log–linéaires pour les tests de sélection du type d'habitat et de distance par rapport aux routes des différentes catégories. Dix des 12 femelles et 5 des 10 mâles (15 des 22 ours) utilisaient moins les peuplements de pruche et thuya de l'intérieur et à basse élévation ($P < 0,05$) et plus les peuplements d'épinette d'Engelmann (*Picea engelmannii* Parry ex Engelm.) et de sapin subalpin à haute élévation (*Abies lasiocarpa* (Hook.) Nutt.) ($P < 0,05$). En tenant compte de l'habitat, 4 des 5 femelles et 3 des 6 mâles (7 des 11 ours) ont évité les chemins ouverts et 3 des 5 femelles et aucun des 6 mâles (3 des 11 ours) ont évité les chemins fermés. Aucune femelle ($n = 7$) ni aucun mâle ($n = 4$) (0 des 11 ours) a évité les chemins à accès restreint. Nous résultats réfutent l'hypothèse que les ours évitent, dans l'ordre, les chemins ouverts, à accès restreint et fermés. La plupart des femelles et des mâles ont évité les chemins ouverts, la plupart des femelles ont évité les chemins fermés et aucun ours a évité les chemins à accès restreint. Comme le type d'activité humaine le long des chemins influence le comportement des ours, il faudrait en tenir compte lors de nouvelles études sur le comportement des ours en relation avec les chemins.

[Traduit par la Rédaction]

Introduction

The Selkirk Mountains Grizzly Bear Ecosystem (SMGBE) includes parts of southeastern British Columbia, northern Idaho, and northeastern Washington. Grizzly bears within the U.S. SMGBE are classified as threatened by the U.S. Fish and Wildlife Service (Servheen 1990). Bears within the B.C. SMGBE are classified as vulnerable by the Committee on the Status of Endangered Wildlife in Canada (Banci 1991) and threatened by the Grizzly Bear Conservation Strategy of British Columbia (B.C. Ministry of Environment, Lands, and Parks 1995*a*, 1995*b*; Wielgus 2002). Forestry activities are the major anthropogenic activity in the area. Wielgus et al. (1994, 2001) and Wielgus and Bunnell (1995, 2000) studied population dynamics and habitat use of grizzly bears in the SMGBE from 1985 through 1991 and found that population growth rate was marginal because of human caused mortalities near open roads (for a brief review of road – carnivore mortality relationships see Introduction in Gloyne and Clevenger 2001). Forestry roads were also cited as one of the biggest impacts on bear habitat use in the Grizzly Bear Conservation Strategy (B.C. Ministry of Environment, Lands, and Parks 1995*a*, 1995*b*). The

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 DOI: 10.1139/X02-084

Bears - decline since 2007

50% unreport - 90 bears 158

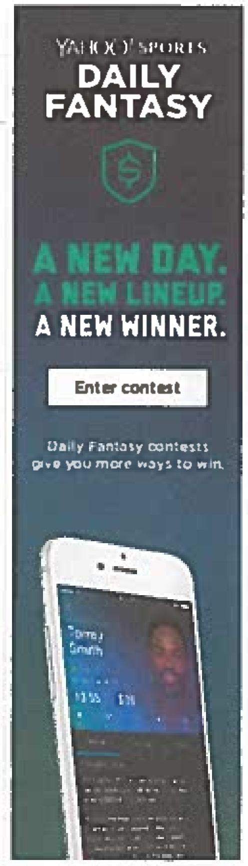
Fwd: Grizzly Times: Heavenly Bears, Grizzly Deaths, Louisa Willcox, 12.24.2015 Thursday, December 24, 2015 12:31 PM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View



Happy Solstice, friends of grizzly bears,

Reply | Reply All | Forward | Actions

Here is my latest blog, along with a link to a background piece (that has a lot of links in it) that tries to -breaking number of Yellowstone grizzly bear deaths this year. I also respond to the spinning and the bullshit coming from Servheen and van Manen of the IGBST in the last few days. David had a hand in the backgrounder as well.

http://www.grizzlytimes.org/#!blank/icili

Many thanks to Sara/Raen at GOAL, Bonnie and Kiersten at SC, Kent and Roger at WWA, Kelly and Bethany at WEG, Tim et al. at EJ, Andrea at CBD, Jonathan at WWP, Tom Mangelson and Penny at Cougar Fund, and the many others swinging for the Bear! They need you more than ever!

May you have peace this holiday season,

Louisa

http://www.grizzlytimes.org/#!Heavenly-Bears-Grizzly-Deaths/c1ou2/567be8270cf2ee60dd7494e1

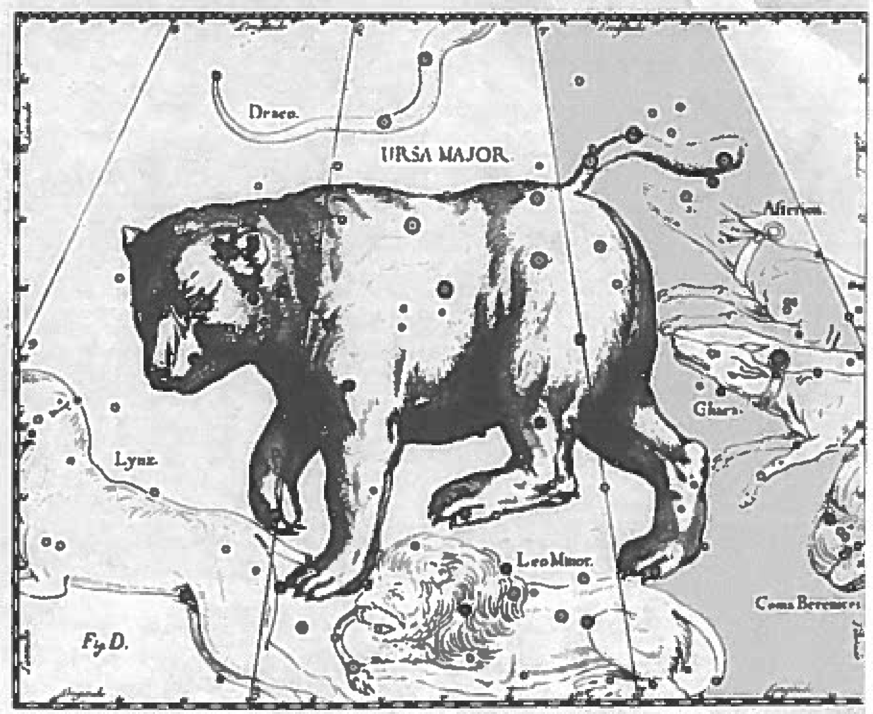
Heavenly Bears, Grizzly Deaths

December 24, 2015

|

Louisa Willcox

FWS_Pub CMT_006270



Stars and the heavens capture our imagination this season. No constellation is more famous than the Big Dipper, which is also known as Ursa Major, the Great Bear. In French, Grande Ourse. Italian, Ursa Maggiore. German, Grosse Bar. Ursa Major and its neighbor Ursa Minor, the Lesser or Little Bear, are the first two constellations listed in the earliest star catalogues.

Ancient peoples saw bears in these constellations, creating stories that varied widely throughout the Northern Hemisphere – the result of long nights of star gazing. The Big Dipper points to the North Star in Ursa Minor, and never sinks below the horizon at night.

Like bears that have long been seen as guides and teachers, these constellations provide literal direction.

Some Native American people saw the bowl of the Big Dipper as the body of a bear, and the three stars of the handle as her cubs. The Big Dipper has been interpreted as a bear lying on its back in winter. Crawling from its den in spring. Standing on its hind legs in summer. Tracking the seasons in its changing position in the night sky.

Stories of these constellations share a common theme: the richness of our connection with bears and nature. The Mother Bear has long been a symbol of care and nurturing, and her stories are full of generosity of spirit.

One of my favorites is the Greek myth about Ursa Major and Ursa Minor that centers on Callisto, one of the maidens of Artemis, goddess of the forest and the hunt. (Her name shares the same root word as the Latin name for bear, Arctos). Callisto was seduced by Zeus and bore a son, Arcas, who grew up to be a hunter. In revenge, Zeus' jealous wife Hera turned Callisto into a bear. Coming upon her son one day in the forest, Callisto rushed to greet him. Not recognizing his mother, Arcas took aim and was about to shoot her, when Zeus saw what was happening. He turned Arcas into a bear and, to save them both, flung them into the heavens where they were transformed into stars. She became Ursa Major, he Ursa Minor.

I wish I had the power of the Greek gods to spare bears from killing born of ignorance. This year, 54 Yellowstone grizzlies were killed by humans, shattering previous records. The leading cause was big game hunters, which is especially disturbing because there is not yet a legal hunt on grizzly bears. That happens next year if the federal government removes endangered species protections for grizzly bears. A proposed rule to delist grizzly bears is expected in January.

What will happen to Yellowstone's magnificent grizzly bears if hunting is legalized when there are already too many human-caused deaths?

The Grizzly Dead

FWS_Pub CMT_006271

According to the federal government, 54 of the 59 Yellowstone grizzly bears reported dead th year were killed by humans (link). This breaks the record for annual grizzly bear deaths by an cause since data started to be assembled in 1959. And it breaks my heart.

Applying a federal estimator of unknown but probable bear deaths, there most likely are another 30 plus dead bears in Greater Yellowstone. This yields a total of roughly 90 dead, or over 12% of the estimated population of 717 grizzly bears -- and a 30% increase above the next-highest year, 2010, when 43 bears were killed. A full rundown of the body count and wha it means can be found here (link).

The numbers of this year's dead are overwhelming and under-reported in the media. I know I am not alone in wishing for the power of a god to shield innocent bears from bullets.

Of Foul Play and Thuggishness
Of the bears killed this year, 19 are being investigated as possible poaching incidents (link). This is almost three times the next highest number of potential poaching incidents recorded ir 2012, when 7 deaths were under investigation.

It is almost certain that these deaths were caused by hunters (or by poachers, although the line between hunters and poachers is often blurred). In the past, deaths under investigation fe into the categories of hunter-related incidents, self-defense kills, and black bear hunters mistaking a grizzly for a black bear.

A discussion of how out of whack this year is can be found here (link).

What is going on? We may never know for sure, with so few eyes and ears in the backcountr as federal budgets and the number of backcountry personnel shrink.

But this could well be more of the notorious "Shoot, Shovel and Shut up" behavior that landec grizzly bears on the endangered species list in the first place. In other words, armed thugs tired of waiting for delisting are looking for opportunities to illegally kill bears.

A recent article in the Jackson Hole News and Guide gives a glimpse of the mindset involved (link). Two years ago, in Wyoming's remote Thorofare area, one party of hunters shot into a group of five grizzly bears feeding on the carcass of an elk they had killed. They killed a 17 year old radio-collared bear, Number 764, with .44 and .357 magnum slugs. The hunters had watched the situation for many minutes and had the chance to walk away. This was not a surprise, defense of life situation. It was an act of raw aggression. The case was not prosecuted. Almost none are.

Another incident occurred in 2010 on Mountain Creek in the Teton Wilderness (link). A grizzl bear was killed at an outfitter camp. The protocol for dealing with bears that get near camps like this one is to try to scare them away with noise, dogs and shooting cracker shells. A worker who shot the involved bear in the chest and abdomen said later he intended to "hit it ir the ass." "Son of a bitch wouldn't leave," he said.

Fear, aggression, and lack of understanding and heart. These are the kind of ungenerous anc perverse connections with bears that seem to lie at the root of today's killing spate. The polar opposite of the relationships represented in the Callisto story, which are all about an intimate and compassionate connection between humans and bears.

To think it could get worse if grizzly bears are delisted next year and made the victims of spor hunting.

Ursa Major: Iroquois Tale
Here's a different take on a bear hunt, attributed to the Iroquois. The Bear emerges from the stars in the Corona Borealis. He is pursued through the summer skies by seven hunters: Robin, Chickadee, Moose Bird (Grey Jay), Pidgeon, Blue Jay, Owl, and Saw-Whet (a kind of owl). As autumn nears, the four hunters farthest from the Bear lose the trail, with the stars setting one after the other. At last Robin fatally wounds the Bear with an arrow. The blood of the Bear colors the fall leaves red. One drop of the Bear's blood falls on Robin, coloring his breast red.

The death of the bear in this story explains the cycle of the seasons. Yes, there is violence bu it is not mean-spirited. It is part of the fabric of life and the ecology of the human imagination that ties Robin and the other birds to the Bear and the vibrant hardwood forests of the northeast.

If you truly lived by the ethos of such a story, shooting into a group of innocent bears would b an anathema.

Losing True North

The agencies responsible for managing Yellowstone's grizzlies have responded to this year's spike in potentially illegal mortalities with stunning silence. The topic of these deaths was a nc -issue at recent meetings in Jackson and Missoula, which were instead a stage to glorify agency "successes" and promote delisting (link). Essentially, the agencies are committed to expediting delisting and hunting bears no matter what. It seems easier to legalize poaching than try to deter it, which, if so, begs the question why the agencies are so eager to placate people who behave like criminals.

The government, charged with restoring imperiled species on behalf of all of us, seems to ha\ lost its way. I have written previously about the heartless government mindset. The metaphor that came to mind was that of a zombie in service of some relentless master (link).

The US Fish and Wildlife Service (FWS), that leads recovery of Yellowstone's grizzly bear population, has been enslaved to the agenda of state politicians who see bears only as things to be dominated and killed (link). Despite their mandate – and what could be a more compassionate mission than to save species – the FWS is now catering to the thugs.

Further, all of the government agencies are banded together in pursuit of the age-old tactic of avoiding the problem by attacking their critics, including scientists, advocates, and the 41 Indian Tribes that are opposed to delisting. At the recent meetings of agency managers, the Tribes, which have been raising objections over killing and hunting grizzly bears on spiritual and cultural grounds, were criticized by the government as being out of touch with reality (link

The Tribes have not forgotten the direction of True North, of course. They object to delisting because it would give authority for managing grizzly bears to the states, which are yet bastior of the ethos of Manifest Destiny that drove the genocide of Indian people and the slaughter o millions of buffalo, wolves and grizzly bears in the name of progress.

The debate over grizzly bears highlights the battle we are engaged in today, which is over stories: killing and dissociation versus reverence and respect.

Unbearable Killing

Government data puts the lie to agency claims that the population can absorb high levels of mortality. The Yellowstone grizzly bear population is no longer growing, and more likely has been declining since 2007 (link). This trend is probably explained by high rates of mortality in the wake of the loss of two former key native grizzly bear foods, cutthroat trout and whitebark pine (link). Bears have turned increasingly to foraging on meat, mostly cows and big game, which draws them into mounting conflicts with ranchers and hunters (link).

As the US Fish and Wildlife Service has long recognized, most bear-human conflicts are avoidable. The solutions are not starry eyed, but practical. They include paying attention and being prepared to encounter bears in the backcountry (link). Carrying bear pepper spray (link Keeping clean camps. Dealing responsibly with dead game to help keep grizzly bears alive.

These are some of the tools of coexistence. Our choice to use them, or bullets, depends on the story we choose to tell ourselves.

Ursa Major: Zuni Tale

The Great Bear guards the land from the frozen gods of the north. In winter, the land is ravaged by the frozen breath of the ice gods as the bear sleeps. In the spring, when the bear wakes, she drives the frozen gods back and the land is refreshed.

This Zuni story gets to the heart of the meaning of the bear throughout our shared history: renewal and transformation. An animal that seemingly dies underground in winter and emerges with new life in spring is, indeed, a miracle. To people who watched bears disappea into the earth when it snowed and reappear when the plants sprouted, bears represented the changes of the seasons, and the rebirth of life.

It is still amazing: no matter how much scientists have learned about hibernation and the general lifeways of bears, they are still in awe at the power and mystery of the bear (link).

Today, we have the power of life and death over the Great Bear. If unchecked, an armed and hostile few, aided by the government, will continue on the path of aggression and the grizzly bear in Yellowstone will likely be pushed back to the brink of extinction. The interests of the majority who want to see bears alive and flourishing around the nation's oldest park could be sacrificed for those of a death-oriented minority.

And we could pay a bigger spiritual price. By turning our back on the stories that Ursa Major reminds us of each night, we reject ancient, life-affirming connections with the earth and the cycles of the seasons.

What kind of world will the grizzly bear wake up to next spring? What will we look to for direction? Find Ursa Major and you can always find True North.

As daylight slowly returns to the Northern Hemisphere, may light shine in our hearts also.

--

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- Why Delisting is a Bad Idea: http://www.grizzlytimes.org/#!delisting-a-bad-idea/c15sd
- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sy
- Cool Video: The Changing World of Yellowstone Grizzly Bears: https://m.youtube.com/watch?feature=share&v=VogRHZr0bNQ

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Trash (80) [Empty]

My Folders [Edit]

elk in yellows...

fuels treatmen...

Delete Reply Reply All Forward

Fwd: Grizzly Times: Don't Delist, Risk Yellowstone Grizzly Bears' Future, Louisa Willcox Thursday, March 10, 2016 10:29 AM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Hi Friends of Grizzly Bears,

Here is more background on why delisting is a terrible idea... Still no federal register notice published yet.

But with FWS essentially saying they will ignore any comments that "just say no" to delisting without justification, I thought it was important to provide ample rationale. There is a lot more to say, but this is a start...

Will let you know as more details emerge, Please be in touch if you have questions!

Best, Louisa

http://www.grizzlytimes.org/#!Dont-Delist-Risk-Yellowstone-Grizzly-Bears-Future/c1ou2/56e18ea70cf2e27c763fff0e

Don't Delist, Risk Yellowstone Grizzly Bears' Future

March 10, 2016

|

Louisa Willcox

As Yellowstone grizzly bears begin to reemerge from their dens after winter hibernation, they awake to a debate over what may be their first sport hunt in over 40 years. This was triggered by last week's proposal b US Fish and Wildlife Service (FWS) to remove federal endangered species protections.

Grizzly bears awaken too to a world of mounting threats, including a warming climate, ever more humans, poorly managed livestock, sloppy and incautious big game hunters, and isolation from other bear populatior

It is sad, but true, that without the vital safety net provided by the Endangered Species Act (ESA), Yellowstone's vulnerable grizzly bears will likely be pushed back to the brink of extinction. Here I briefly summarize the major reasons why delisting is premature and needlessly risks the future of the grizzly bear i and around our nation's oldest park.

Yellowstone's current population of roughly 650 to 750 grizzly bears is much smaller than the 2000+ animal widely considered by experts to be necessary for long-term viability. Altogether, the five remaining grizzly bear populations in the lower-48 states number perhaps 1500, a mere 1-2% of the 100,000 grizzly bears th once roamed the contiguous U.S. in a range that was formerly 100 times larger.

The federal government plans on deliberately perpetuating this precarious situation, even though it means trucking bears into Yellowstone every ten years to deal with genetic problems, and trusting state wildlife management agencies that have notoriously anti-carnivore track records.

We can do better. Yellowstone grizzly bears can be reconnected naturally to the more robust grizzly bear populations that live in Canada and lands surrounding Glacier National Park. But with mounting numbers of ranchettes, second homes, and hunters prospectively in pursuit of a grizzly bear trophy, the window of opportunity to link these grizzly populations is closing fast.

Caught Between Love and Aggression

The grizzly bear has been called "uncle," "grandmother," and "healer" by native peoples around the world, whereas the European-given Latin name, *Ursus arctos horribilis*, bespeaks a more negative, fear-based relationship.

Today, while more people embrace protecting wild animals and their ecosystems, views of grizzly bears are still conflicted. Just as families flock to Yellowstone and Grand Teton parks to catch a glimpse of a grizzly bear in the flesh, ranchers outside the parks pressure state officials to kill them to protect their cows. More fundamentally, the debate about grizzly bear delisting is about competing values, one oriented to life, the other death.

With the passage of the Endangered Species Act (ESA) in 1973, we as a nation rejected the ethos of domination that had resulted in the slaughter of wolves, bison, grizzly bears, and other species. We chose t embrace instead an attitude of respect and reverence for nature. Without the ESA's protections, including a prohibition against hunting, grizzly bears would likely have been relegated to just a few bears hanging on in the confines of Yellowstone Park.

But under the ESA's umbrella, grizzly bear numbers have probably doubled in Yellowstone since protection were instituted in 1975 (link). Population growth has been particularly slow because grizzly bears have one the lowest reproductive rates of any terrestrial mammal; a female in Yellowstone is lucky to replace herself with another reproductive female in her lifetime.

That the population has increased is cause for celebration. But bears are not out of the woods yet. Their future lies in our hands and in our practice of tolerance. Codifying respect for nature, the ESA has helped resolve our conflicted views about grizzly bears, but all bets are off if protections are removed.

An Unraveling Ecosystem, Leading to More Grizzly Killing

As scientists teach us, and as Native peoples know full well, the grizzly bear serves as a window into the complexity of entire ecosystems. The bear eats everything from ants to bison plus hundreds of plants in between. It knows when and where foods are most palatable, and it monitors them constantly for their nutritional quality, teaching their cubs to do the same. To win the seasonal war of calories, in preparation fo hibernation and winter birthing, the grizzly bear has to be a champion forager, which means keenly observir the subtlest details of the natural world.

We humans also have long watched what the bears ate, and followed suit. Foods that fatten bears sustain u as well: salmon, acorns, bison, elk, moose, berries, and pine seeds. In Yellowstone, grizzlies have historica depended on just four key foods for most of their energy and nutrients: seeds from whitebark pine, meat fro elk and bison, army cutworm moths, and cutthroat trout (link).

Tragically, since the early to mid-2000s, two of these critical bear foods have been essentially wiped out (link). Trout in Yellowstone Lake have been victims of drought, climate warming and predation by a nonnati fish. Mature cone-producing whitebark pine have been clobbered by the spread of a non-native fungal disease called blister rust and by an unprecedented climate-driven outbreak of bark beetles.

That leaves only two of the historically most important bear foods: elk and army cutworm moths. Yet most e populations have declined dramatically from highs reached during the 1990s and early 2000s, and moths a imperiled by the projected disappearance of their alpine haunts during the next 50 to 100 years (link).

Meanwhile, bears have been compensating by eating more meat, especially from cows and the remains of hunter-killed elk. Despite the protestations of government "experts," dandelions and mushrooms don't cut it (link). Unfortunately, with the turn to meat, trouble with livestock operators and hunters has mounted, resulting in dramatic increases in the numbers of grizzlies dying each year because of meat-related conflict (link). In fact, mortality rates are now at unsustainable levels.

Grizzly bears reminds us of what John Muir famously wrote: you can't "...pick out anything by itself [without finding] it hitched to everything else in the Universe."

There is a bottom line to all of this. Now could not be a worse time to remove ESA protections, as the Yellowstone ecosystem unravels. Yellowstone's grizzly bears need access to a lot more wild country to compensate for the loss of critical foods. They also need continued protections, incentives, and resources offered by the ESA.

Absent federal control and oversight, the states have little inclination and few resources to deal with mountir conflicts. Worse yet, these states intend to use a sport hunt and freer killing of bears involved in conflicts to reduce the size and distribution of Yellowstone's grizzly bear population.

Indeed, the central problem with delisting is that grizzly bears would be managed by anti-carnivore states.

State Management: of Domination and Handshake Agreements
Wildlife management in western states continues to be organized around controlling nature and killing large carnivores to produce a "harvestable surplus" of elk, deer, and other large herbivores. More to the point, wildlife managers in Idaho, Wyoming, and Montana are locked down in service of a politically influential minority who place top priority on opportunities to hunt big game (link). The interests of outdoor enthusiasts who prize anything other than hunting are not represented on the commissions or among the leaders of the state wildlife management agencies.

State managers commonly see large carnivores as tacit competitors for big game hunting licenses, which a the cash cow of these agencies. This despite the fact that there is no evidence that carnivores typically ham big game populations -- and plenty showing that excessive hunting does have major negative impacts, alon with climate change and drought.

Nonetheless, sport hunting has been used during recent decades by state managers to drive down populations of mountain lions and wolves, and accounts for roughly 70-80% of adult carnivore deaths in the Northern Rockies. State managers will almost certainly treat grizzly bears in the same ways as they do othe large carnivores -- which will preclude ever securing connections between ecosystems.

This is especially true given grizzly bears' inherent difficulty colonizing new habitats, due to females' tenden to stay in or near their mothers' range. (This lack of resilience contrasts with that of wolves and mountain lions, which reproduce at higher rates, and readily colonize areas hundreds of miles away.)

For these and other reasons, grizzly bears will be acutely vulnerable to the effects of sport hunting. Moreov the first bears to be killed will be those on the periphery of ecosystem best positioned to connect with other bear populations, as well as the highly popular and tolerant bears that frequent roads inside National Parks and occasionally range into non-park jurisdictions.

One big problem with the plans developed by state agencies to manage grizzly bears after delisting is that there is no binding commitments to do anything other than hunt bears. Despite some laudatory language or coexistence, all suggestions are voluntary.

The same is true of the Conservation Strategy (CS), developed to guide the monitoring of bears and bear habitat on public lands once ESA protections are removed. As FWS admits, the CS cannot compel any agency to do anything (link). It is a 100 plus page handshake agreement.

One of the biggest problems facing grizzly bears is the lack of any enforceable limits on mortality once delisting has occurred. What will happen if grizzly bear deaths exceed prescribed levels? The post-delisting plans do not compel ANY response. In fact, state laws don't limit but rather promote killing grizzly bears.

Even if the states were inclined to do more for grizzly bears after delisting, they lack most of the relevant authority. According to the federal government, over 40% of habitat currently occupied by grizzlies in the Greater Yellowstone lies outside an antiquated Primary Conservation Area (PCA) that was delineated decades ago primarily to serve political purposes.

After delisting, no habitat protections would apply in the extensive areas excluded from the PCA. Moreover, most areas occupied by grizzly bears are federally-administered public lands over which the states have no direct control.

In short, nothing in state management is about compassion for grizzly bears, which will get anything but a safety net after delisting. The fact that there is no free board and huge uncertainty regarding the size of the population exacerbates the problem.

Biased and Unreliable Numbers
You often hear from government officials how we have grizzly bears coming out our ears and that the population has grown at a rapid clip for decades.

Although some growth has likely occurred, it is much more modest than advertised. According to federal data, the population is probably declining as a result of high death rates linked to deteriorating habitat conditions (link). Moreover, recent research has shown that the methods used by Yellowstone's grizzly bea managers to assess the status of the population are unreliable and fatally biased (link).

The government's refusal to release the raw data upon which population estimates are based is making matters worse. These data have been paid for by taxpayers, and should be made available for independent review. Until then, the claims of scientists operating under a government monopoly should be treated with skepticism.

Dismissing the Spiritual Concerns of Nearly 50 Indian Tribes
The Tribes have emerged as another major critic of the government's science and management of grizzly bears. Native people across western North America saw grizzly bears as relatives, teachers and guides vita to their cultural and spiritual health.

Not surprisingly, the proposal to delist and permit sport hunting of grizzly bears is an anathema to most Indians. So far, nearly 50 Tribes, from Canada to Mexico, have passed legal resolutions opposing delisting and trophy hunting of grizzly bears (link).

As sovereign nations, Tribes are demanding that the federal government formally consult with them to address their concerns about delisting. Reasonably enough, they seek a moratorium on delisting until an adequate consultation process has been completed. The Tribes are also articulating an alternative vision fo recovery of grizzly bears, involving restoration of bears on lands tribes own or have legal claims to.

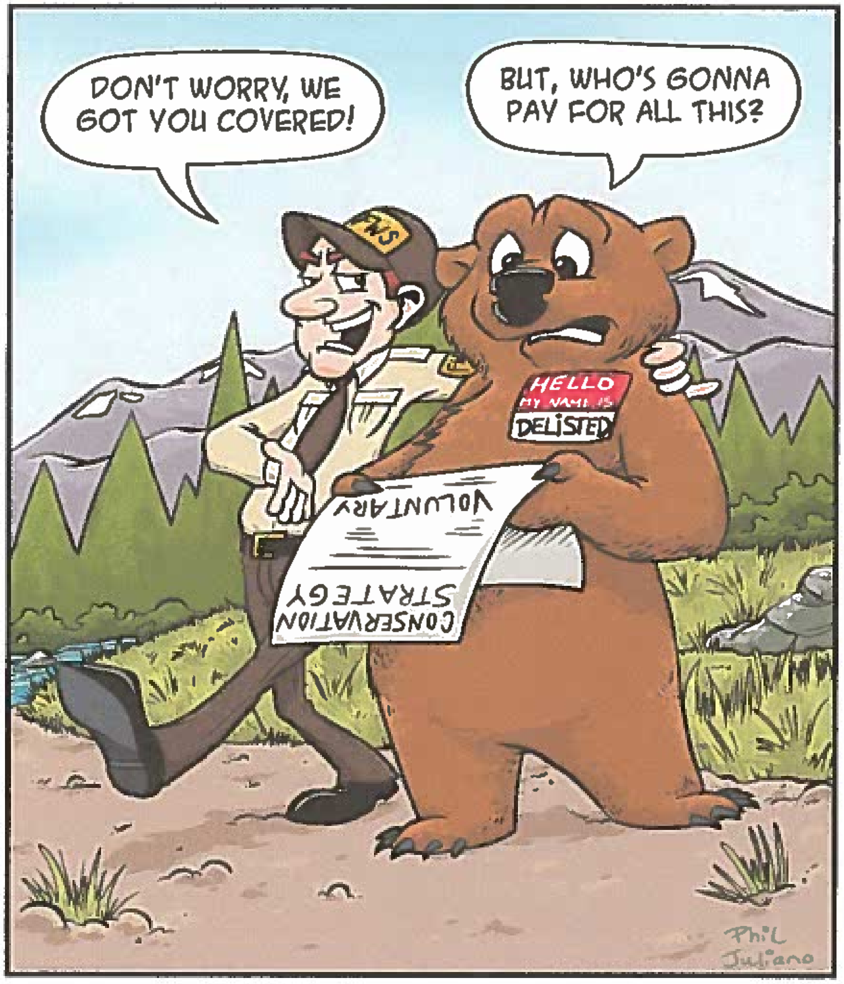
But so far, state and federal agencies have exhibited a disturbing lack of respect for the Tribes. Which is no surprising given the long history of racism among federal and state bureaus, and the deference of wildlife managers to largely white male hunters, typically at the expense of the broader public interest.

We Can Still Achieve Grizzly Bear Recovery

We can still achieve lasting recovery for our remaining grizzly bears, and in a way that respects the interest of all Americans. We have ample wild habitat capable of sustaining a contiguous grizzly bear population fro Yellowstone to Canada (link), but only if we protect these wildlands now and expand programs that foster coexistence between the people and grizzly bears living in connective habitat. We do not need to truck bear around to address genetic problems – bears can deal with the issue naturally, if we let them.

The grizzly bear is as an ESA success story even if bears in Yellowstone are not delisted any time soon. Science shows that grizzly bears are still threatened throughout the Northern Rockies, and will probably remain so for the indefinite future. But by sharing space with them as they seek the food that they need in ever-larger areas, we will insure that grizzly bears will be here for generations yet unborn to marvel at.

With their ability to awaken after a long winter of seeming death, the grizzly has long embodied the promise of transformation. In fits and starts, as a society we have been of transforming our relationship with grizzly bears to one that is more life-affirming. But now is not the time to gamble with their future.



Money and politics have driven decisions about the fate of Yellowstone's grizzly bears for the last 50 years. You often hear that more is known about Yellowstone grizzly bears than any other population of bears. But the truth is that managers and researchers here have benefitted from ample resources to support research and monitoring primarily because of the controversies that surround this population, not because of any greater curiosity or competence on the part of those involved.

Money will continue to matter after the removal of federal endangered species protections for Yellowstone's grizzly bears, because the government will rely on implementation of the expensive post -delisting Conservation Strategy (CS) to maintain the population. According to the delisting rule published last week (hereafter, the Rule), inadequate funding to implement the CS could trigger a status review of the population and possible relisting (link).

While on one hand the US Fish and Widlife Service (FWS) touts the CS as a key part of "adequate regulations" for protecting Yellowstone's grizzlies, the agency at the same time admits that the CS cannot compel any land or wildlife management agency to do anything. (link). Everything in the plan, including funding, is voluntary.

How can both be true? Well, they can't. Here, the government speaks out of both sides of its mouth, telling all sides what they want to hear.

Even if management agencies want to implement the CS, there is no reliable source of future funding for implementation, which amounts to about $3.8 million per year, not accounting for inflation (link). Agencies can't obligate funds -- Congress and state legislatures jealously guard that duty. In the Rule's discussion outlining which agency is supposed to do and spend what, the FWS reinforces this basic truth, saying that the: "[CS] neither obligates nor implies a requirement for the identified party to implement the action(s) or secure funding for implementing the action(s)".

The fact is that implementation of the CS relies on funding from no fewer than eight different entities, any one of which could withdraw funding at any time. The likelihood of funding shortfalls is all the greater because successful implementation of the CS requires an astounding 50% increase of annual budgets from pre-delisting levels of around $2.5 million-- to roughly $3.8 million. This comes at a time when both federal and state agencies face an unprecedented funding crisis, especially the US Forest Service. More on this later.

Furthermore, the FWS relies on 3 Indian tribes--the Shoshone Bannock, Northern Arapaho, and Eastern Shoshone—to participate in funding and implementing the CS. These very same tribes face enormous financial challenges, and have passed resolutions opposing the delisting decision. What are the chances that the tribes will fund a plan they do not support and cannot afford?

Why Managing Grizzly Bears Post-Delisting is So Expensive
Grizzly bear recovery costs a lot because of the expense involved in monitoring bears and their habitat using all of the requisite radio-collars, airplanes, field checking, etc. Also, it is not cheap to prevent and manage human-bear conflicts, including buying bear-resistant dumpsters and replacing them when they wear out, as well as educating the many thousands of Yellowstone's visitors about how to recreate safely in bear country. Adequate funding is especially important in the case of Yellowstone's grizzly bears because this population is genetically so vulnerable that it will require perpetual life support in the form of expensive importation of bears to address genetic concerns.

And monitoring what is happening with the population and its habitat is particularly critical if, as proposed, the government loosens restrictions, turns increasingly to killing bears to resolve conflicts, and allows trophy hunting for the first time in 40 years. Delisting will lead to a smaller population, thus adding risk to a situation that is already fraught in light of the increasingly excessive human-caused mortalities that have occurred during most of the last 10 years. A breathtaking 61 grizzly bears died in 2015, 55 of them human caused – possibly an unsustainable 12% of the population (link).

If hunting and otherwise killing more bears were not in the cards, it might be possible to spend less money on monitoring.

The Problem of Accountability
When the FWS last attempted to delist Yellowstone's grizzly bears in 2007, they had no accounting system in place to allow the involved agencies or the concerned public to determine when funding gaps had occurred and how large they might be. Nothing has been done to remedy the problem since then.

Worse, members of the Interagency Grizzly Bear Committee (IGBC), which oversees management of listed grizzly bear populations in the lower 48 states, spent much of last winter's meeting in Missoula arguing about the purpose and duties of the committee. The identity crisis seems far from over (link).

It is true that there are many in state and federal agencies who have good intentions when it comes to fostering co-existence between grizzly bears and humans. These good intentions that have been expressed in various documents focused on a post-delisting world. But the road to extinction is paved with good intentions. The Endangered Species Act requires more.

The 2007 Delisting: A Cautionary Tale
The story of what happened when grizzly bears were delisted in 2007 provides a cautionary tale. There are many readers who probably know that the FWS' 2007 delisting rule was overturned in federal court in 2009, because the rule pretty much ignored all of the science highlighting the threats posed to Yellowstone's grizzly bears by losses of whitebark pine, a key grizzly bear food source that was all but wiped out by an unprecedented climate-driven outbreak of mountain pine beetle.

But most do not know that, during the two years that Yellowstone grizzlies were delisted, the agencies blew through a windfall of $2 million and still fell far short of funds to implement the Conservation Strategy.

Here is what happened. A strident opponent of the Endangered Species Act and avid supporter of grizzly bear delisting, then Montana Senator Conrad Burns, served as Chair of the Interior Appropriations Committee. In the days when congressional earmarks were as common as mud, he was able to earmark $1 million/year for the first two years after delisting to support grizzly bear management (link). Knowing that inadequate funding would be a problem jumped on by those who opposed delisting, Burns' intent was to make this issue disappear for a while.

But it didn't. As I pointed out earlier, there was no central recordkeeping of how the funds were spent. After repeatedly being denied requests for whatever records the agencies had kept, I secured a response through a request from then Montana Senator Max Baucus. Even with the extra cash, the funding gaps were striking. The Forest Service showed a funding shortfall of at least $0.5 million during these 2 years post-delisting management, and Montana was $170,000 or so short (link). The problem was likely worse, but records from other agencies were so incomplete as to be incomprehensible. Burns' $2 million funding buffer proved far from enough.

Since that time, congressional earmarks were banned because of their widespread abuse. They no longer provide an option for filling the gaps, which are likely to be greater this time around.

Government Agencies are Strapped More Than Ever
Delisting comes at a time when funding for agencies such as the Forest Service has been tanking, with support for management of wildlife habitat hit hardest. By contrast, fire management and related extractive uses such as "forest restoration" logging now get the lion's share of funding. The Bridger Teton National Forest budget has declined by 30% (link), and the future is not likely to bring improvements.

State wildlife management agencies are in no better shape. Even though Wyoming was relatively flush until recently due to energy-related revenues, it is loath to spend on conservation of grizzly bears, which are seen a competitors for their cash cow, big game such as elk (link).

In light of the States' zeal to keep the grizzly bear off the endangered species list once they wrest control away from the federal government, there is little chance that funding shortfalls could trigger a relisting, no matter how bad the problem. Meanwhile, given the larger economic forces at play on both the state and federal levels, funding shortfalls will likely only increase.

Hunting Grizzly Bears Won't Generate Net Revenue
You hear from some quarters that hunting grizzly bears will generate revenue for the states that will offset the cost of management. This is bunk.

Wyoming officials have announced that they will charge nonresidents a fee of $6,000 for a tag to hunt a grizzly bear and residents a fee of $600 (link). It is not yet clear what Montana and Idaho will do: they could follow Wyoming's lead, or possibly the example of Alaska or British Columbia. In Alaska, the costs of a brown bear tag for residents are $25, for nonresidents $500, and for "aliens" $650. In British Columbia a tag for a resident is $80 and a nonresident $1,050. Given the level of harvest, none of these tag fees come close to covering the costs of bear management in either Alaska or British Columbia.

Given that the northern Rockies states will, combined, be sport hunting no more than a couple of dozen grizzlies, license-related income will only be a trivial fraction of grizzly bear-related expenses, outweighed by the rising costs of management outlined in the CS.

To the extent that a hunt has economic value, the lions share goes to the outfitter – and outfitted hunts start at $15,000. But right now in Greater Yellowstone, outfitters are increasingly dependent on watching rather than killing wildlife – and this is the overall trend in recreation and public demand regionally and nationally. The fact is that hunting is an industry in decline. Since 1998 hunting has declined by over 40% in Greater Yellowstone (link), and the trend is expected to continue. In any case, while you can still justify subsistence hunting of birds and big game, killing carnivores is about little more than gratifying the ego and libido.

By contrast, alive, wildlife is worth over a billion annually (link), and provides the base of the economic and cultural well-being of the region.

Rather than generating revenue, hunting grizzly bears will give the Northern Rockies states a black eye. It will come at the cost of the growing outfitting industry that depends on something other than killing. Further, by hunting bears at a time when the ecosystem is unraveling (link), states are risking the future of the Great Bear. Hunting will invite an even more expensive emergency response if and when relisting is necessary.

Grizzly Bear Trust Fund?
To fill the funding gap, people inside and outside the government have been talking for the last 25 years about creating a trust fund for managing grizzly bears, and possibly other large carnivores such as wolves. No matter how you cut it, large carnivores are expensive, with high costs entailed by both monitoring and reducing conflicts. It makes sense to establish a stable source of funding not subject to the vagaries of Congress and state legislatures.

But no one has sorted out how to do this. No billionaire grizzly bear fan has decided to part with several millions to make this idea a reality. Given the government's chronic accountability problems, I doubt that this idea can be realized unless it is made truly separate from the government, with a rigorous system of transparent record-keeping.

Funding is important to sustaining Yellowstone's grizzly bear population. It is time for the government to come clean and admit that the funding is not in place to manage grizzly bears after delisting and fulfill the terms of the Conservation Strategy. Nor is there a system of accountability in place. Sport hunting and the promotion of ever more bear killing will increase risk for Yellowstone's grizzlies. With this risk comes a demand for rigorous monitoring at a time when the government is increasingly short on funds.

What happens if the needed funds are not forthcoming? A likely scenario over time is that we will know less and less about the status of bears and their habitat. As is the case now, the government will likely continue to hold its monopolistic death grip on Yellowstone's grizzly bear data as a means of preventing close scrutiny of its science. Meanwhile, the states will probably continue unsustainable levels of sport hunting until population problems are so obvious that they cannot be denied. At which point, interventions are hideously expensive – but more important, too little, too late.

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Public Comments Processing
Attn: Docket # FWS-R6-ES-2016-0042
U.S. Fish and Wildlife Service
5275 Leesberg Pike
Falls Church, VA 22042-3830

Hello,

Native Ecosystems Council (NEC) and the Alliance for the Wild Rockies (AWR) would like to submit the following comments on the USFWS's proposal to delist the threatened grizzly bear. Along with these comments we have provided "Attachment A" which includes copies of the various reports cited in these comments.

A. The proposed delisting is premature and unsupported by science; the grizzly bear population is not currently stable due to drastic changes in their food resources in the Yellowstone Ecosystem; long-term impacts on the population are unknown at this time, but clearly are troubling; to propose removing Endangered Species Act (ESA) protection for this species at this time clearly threatens their long-term viability and genetic diversity in this ecosystem.

1. The status of the Yellowstone grizzly bear population is controversial.

The current status of the Yellowstone grizzly bear is unclear. In 2012, at the Interagency Grizzly Bear committee meeting, it was reported that a comparison between 2 time periods (1983-2001 and 2002-2011), cub and yearling survival had declined in the last decade; mean litter size and the proportion of females with cubs also declined; the younger age classes have reduced survival this last decade; the annual population growth rate has decreased by about 5% over the last decade; under a more conservative mortality scenario, the population may be stable, with no growth; the population has leveled out across the ecosystem.

More recently, in a peer-reviewed study, Doak and Cutler (2013) reported that the government's data on grizzly bear population levels and trends was suspect; they reported inadequate attention to increasing observation effort and also to the life history characteristics of bears is likely to have substantially influenced past analyses of the populations' trajectory; they concluded that the Yellowstone grizzly bear population has probably increased far less than generally believed, but also that past analyses have been to inaccurate to allow any firm conclusions about the dynamics or status of this population; other problems noted were ignoring senescence in models, and changes in sightability of bears over time, as well as human recognition of new feeding sites. Their results case doubt on the assertion that this population underwent a sharp increase from 1980 to 1995 and has recently stabilized in number, or even continued to increase. They also noted that three trends were almost certain to have negatively impacted grizzly bears, the loss of trout runs, ongoing collapse of whitebark pine, and increasing rural development. Finally, they noted that very little is actually known about past trends of this population; they believed that in a rapidly changing landscape, it is quite likely that the population is now in fact declining. They concluded that more care is needed in making inferences about population trends, especially when these results are being used in a direct policy context.

Doak's study was reported in the Bozeman Daily Chronicle on 6/2/13. In that article, USFWS biologist Chris Servheen said that the government's research was reviewed by outside scientists. This is a concern, however, with some bear experts, such as Dr. David Mattson. He noted in a December, 2015 blog that the data set on grizzly bears in the hands of the Interagency Grizzly Bear Study Team is a monopoly that is withheld from other scientists.

In a recently published paper (Kamath et al. 2015), the grizzly bear study team claimed that the Yellowstone grizzly bear population had increased by 4.5 times (from 100 to 450) since the 1980s. However, bear scientist Dr.

Dave Mattson was quoted in the Chronicle about the same time that the grizzly bear study team's analysis was inconsistent with everything else we know about this population. Mattson said that most people would agree that the bear population has been largely stagnant since the early 2000s. In a blog, Dr. Mattson in December, 2015, he noted that there is something fatally flawed about the research reported in Kamath et al. (2015); their methods were among the most arcane out there and built on a veritable tower of assumptions about genetic, demographic, and sampling processes; the methods and derivative results are pretty far abstracted from any tangible reality; the results defy logic; this analysis warrants skepticism on the basis of first principles and the logical violations outlined above. He noted this type of problem arises when a government agency holds a monopoloy on scientific inquiry; the only way to produce reliable scientific results is to have multiple independent reviews with scientist double-checking each other's work. Also, in an article in the Bozeman Daily Chronicle on 6/25/13, Mattson is quoted as saying that Doak's conclusions were in line with his own conclusions that current estimation methods are "essentially worthless; there is this belief that somehow, through some sort of statistical magic, you can compensate for bias in your field methods; my conclusion is that's just not simply possible."

On November 6, 2015, the Bozeman Daily Chronicle had another article on the grizzly bear population trend, noting that the population estimate had been revised by a 6% reduction (714 down from 757); van Manen of the grizzly bear study team claimed that the long-term trend was still flat to slightly increasing.

Although the current population level is claimed to be 717 bears, this estimate covers a range that could be as low as 642 bears; given the loss of up to 90 bears in 2015 (59 deaths plus unrecorded deaths which could be another 30 bears), the current population estimate could be as low as 552 bears (Thuermer 2015). 600 bears is the lowest number of bears the USFWS would allow after delisting.

B. The inevitable declines in the Yellowstone grizzly bear population that will be triggered by replacing ESA protections for this bear with the proposed Conservation Strategy will exacerbate the current tenuous status of this population due to unraveling of the Greater Yellowstone Ecosystem and the associated permanent increase it is causing in grizzly bear-human conflicts that result in grizzly bear mortality.

1. **The proposed conservation strategy will allow a significant increase in habitat losses for the grizzly bear from logging, losses that will further exacerbate ongoing habitat losses caused from decline in whitbark pine, cutthroat trout, and elk.**

Habitat conditions that currently exist will decline with delisting, and thus affect grizzly bear population trends in a negative manner. The Conservation Strategy will allow an increase in timber harvest in occupied grizzly bear habitat because road densities will not be controlled in most of grizzly bear habitat. Unlimited road densities will promote timber harvest activities, which in the Greater Yellowstone Ecosystem, degrade grizzly bear habitat as well as increase mortality risk. Logging will degrade grizzly bear habitat because red squirrel habitat will be reduced (Holloway and Malcolm 2006). Red squirrels are essential to make whitebark pine nuts available to grizzly bears (Kendall 1981; Reinhart and Mattson 1989). Just protecting whitebark pine stands alone is not effective for maintaining red squirrel populations, because the most dense squirrel populations occur in low and mid-elevation forests, below the whitebark pine zone (Reinhart and Mattson 1989).

Timber harvest in the Northern Continental Divide grizzly bear population, and well as in British Columbia, has been shown to reduce grizzly bear habitat due to avoidance of recently-logged forests (McLellan and Hovey 2001; Waller and Mace undated). Apps et al. (2004) also noted in British Columbia that grizzly bear locations were strongly negatively associated with very young, logged forests. Negative impacts of logging have also been reported for grizzly bears in the Greater Yellowstone Ecosystem in the past, mainly due to the removal of the more heavily used older forest habitats as cover and foraging sites. Blanchard (1983) reported that 90% of aerial radio relocations of grizzly bears were in timber too dense to observe the bear; also the majority of feeding sites were in forest stands at least 3 meters in height. Radio locations and feeding sites indicate the majority of feeding activities and day beds occur in mixed age ands species stands of moderate to dense (26-75%) canopy cover. Although open habitats were also important, these were generally natural openings, not timber harvest areas. Blanchard (1983) thus noted that logging will negatively impact grizzly bears by reducing shelter.

Blanchard's (1983) conclusions on impacts of logging on grizzly bear habitat was followed with similar conclusions from an Interagency Grizzly Bear Study Team. Mattson (1983) evaluated grizzly bear feeding sites in the Yellowstone Area, and reported that a reduction of overmature and mixed-age stands over a broad area in favor of early successional, even-aged immature stands would very likely be detrimental to grizzly bears; average importance scores were much higher for late successional or climax cover types than for early successional cover types. A similar analysis completed by the Interagency Grizzly Bear Study Team in 1991 provided similar results. Mattson and Knight (1991) reported that on a broad scale, habitat value will likely decrease under short-rotation management regimes. They noted that the idea that food availability increases in early stages of forest succession does not generally hold in the Yellowstone area; in most places Yellowstone grizzly bears rely on ungulates and pine seeds for fattening; use of these 2 foods is primarily associated with older forest stands; use of globe huckleberry has also been associated with the semi-shaded and typically patchy conditions of mid- to late-successional stands; conversely, grazed fibrous foods that predictably increases in abundance in the earliest stages of forest succession cannot be efficiently digested by bears and are not critical to the nutrition of most Yellowstone grizzly bears; also foliage in open areas predictably cures sooner than foliage in shaded areas and thus would be effectively available for a shorter period; bears also used natural versus man-made ecotones created from timber harvest. They noted that timber harvest of any type in the whitebark pine and Douglas-fir areas would degrade grizzly bear habitat.

In a later report by the Interagency Grizzly Bear Study Team, Mattson (1997) analyzed more data on grizzly bear habitat use of lodgepole pine forests. He noted use was highly variable, but that there was no conclusion evidence that grizzlies favored young (under 40 years in age) forest stands in general, or their infrequent use of berried; they did favor young open areas that were wet and fertile sites for grazing; he noted that grizzlies used frequently-disturbed sites mostly for travel; use of berries was very low in this ecosystem, with only 15 instances of berry use from 16 years of data; he noted that these results do not support the premise that widespread conversion of lodgepole pine forests to early successional stages would benefit grizzly bears; there is no rational for systematic harvest of older stands to increase bear use of berries; and these results support the proposition that grazing opportunities for bears can be increased by logging on wet sites, although it is highly improbable that grazing opportunities limit grizzly bear densities anywhere in this ecosystem; he noted that removal of lodgepole pine stands that contain whitebark pine would be detrimental to grizzlies. We are providing this summary to demonstrate that logging should not be used as a claimed benefit to bears as an offset of the increased disturbances and mortality risks that will occur.

2. **The Conservation Strategy will allow significant increases in grizzly bear mortality risk over exising levels because unrestricted road access will promote increased logging in grizzly bear recovery habitat, logging which will increase mortality risk**.

Blanchard (1983) concluded that conventional logging negatively affects bears in part due to increases in human activity, which will in turn increase grizzly bear mortality risk. Mattson and Knight (1991) also noted that timber harvest will create an increase in grizzly bear mortality risk in the Greater Yellowstone Ecosystem. They noted that any increased exposure of bears to humans predictably results in a longer-term increase in mortality risk to bears, partly mediated through the process of habituation; under optimal conditions, bears may be able to minimize mortality risk over the short-term despite increased exposure to humans, by avoiding humans as much as possible; however, habituation and associated mortality risks will predictably increase with longer-term equilibration; implementation of short-rotation timber management requires increased access by humans; thus more widespread practice of intensive silviculture in occupied grizzly bear habitat predictably increase mortality risk to the population; this holds whether bears die because poachers are able to use road built to harvest timber, or whether bears that die elsewhere under divers circumstances are at least partially habituated or food-conditioned to humans by exposure around cutting units. They concluded that on the broad scale, mortality risk will likely increase and habitat value will decrease as short-rotation timber management increases in the Yellowstone area; timber harvest should be assumed to have a significant negative affect on the Yellowstone grizzly bear population until proven not to contribute to increased mortality risk or habitat degradation.

Mattson and Knight (1991) noted that designating security areas for grizzly bears during logging activities should include previously-disturbed areas; designating areas that are already providing security does not offer mitigation for increased disturbances due to logging.

3. **The Conservation Strategy will allow highly significant reductions in available habitat for grizzly bears by removal of almost all existing restrictions of open and total roads in grizzly bear habitat.**

The current best science for grizzly bears in northwestern Montana identified the displacement impacts of roads (Mace et al. 1996; Mace and Manley 1993). These reports noted that when open road densities exceed one mile per section, and when total road densities exceed 2 miles per section, grizzly bear use decreases. Based on this science, the Interagency Grizzly Bear Committee Taskforce Report (1998) identified road management as key to conservation of grizzly bears. It has also long been documented that roads in the Yellowstone ecosystem avoid roads (Mattson et al 1987); this displacement is believed to probably result in poorer conditions of adult females, and consequently higher mortality rates and lower fecundity for the cohort. Displacement of grizzly bears from roads, and thus habitat, is well documented in other areas as well (Apps et al. 2004; Chruszcz et al. 2003; Wielgus et al. 2002). Ciarniello et al. (2007) reported that grizzly bear densities in developed landscapes of British Columbia were only about a quarter of what they were in adjacent unroaded areas, even though habitat qualities were better in the former landscapes, indicating and disturbances and associated mortality risks were responsible for the differences in densities.

The Conservation Strategy only limits densities of permanent roads. The distinction between a permanent versus a temporary road is unclear; temporary logging roads could have a much higher traffic level than a permanent road. The Conservation Strategy does not identify specifically why a road being used for logging up to 5-10 years does not displace grizzly bears, or increase mortality risk. The Interagency Grizzly Bear Study Team at one time actually measured the mortality risk of bears in regards to road quality. Mattson and Knight (1991) found that secondary roads had a much high mortality effect on grizzlies than primary roads (see Table 1). As the level of human access in an area increases, so does the mortality risk to grizzly bears in the Yellowstone Ecosystem (Mattson et al. 1992).

4. **The Conservation Strategy will allow unlimited displacement of grizzly bears due to increases in logging activity that will be triggered by removal of road density restrictions upon delisting.**

The Conservation Strategy ignores the displacement impacts of logging on grizzly bears. These displacement effects will reduce habitat available to bears. Blanchard (1983) and Mattson and Knight (1991) noted that logging will displace grizzly bears. Even human recreational activity, nonmotorized, within Yellowstone National Park has been shown to displace grizzly bears. Coleman et al. (2013) evaluated grizzly bear activity within various bear management areas within Yellowstone National Park, and reported that grizzly bears were twice as likely to be within the area when the managements were restricted, or when people were inactive; their study provides evidence humans presence can displace grizzly bears if people are allowed unrestricted access to bear habitat; they noted that management closures are important to protect grizzly bear habitat use. Mattson (1991) used data on grizzly bear habitat use to conclude that 58% of the landscape should provide grizzly bear security, with security areas being a minimum of 5,400 acres in size. This recommendation was based on the need of grizzly bears to be free of human disturbances on a significant portion of their habitat, to avoid both displacement and increased mortality risk. Mattson et al. (1995) noted that providing secure undisturbed habitat is essential for grizzly bear conservation.

5. **The Conservation Strategy will allow highly significant increases in grizzly bear mortality risk due to removal of almost all existing restrictions on road densities.**

Research in the Greater Yellowstone Ecosystem has documented that roads increase grizzly bear mortality risk (Mattson et al. 1992; Schwartz et al. 2010). Road densities in the Primary Conservation Area (PCA) of the Yellowstone Area are currently limited, but will not be limited upon delisting. Open road densities in between secure areas for grizzly bears will not be limited, even though the current best science demonstrates that limits on road densities in these area are essential to ensure protection of grizzly bears (Schwartz et al. 2010). Simply providing some secure areas for grizzly bears will not address the mortality risk created by high open road densities when bears travel between security areas. Id. Other current research in British Columbia (Boulanger and Stenhouse 2014) also noted the problem of increased grizzly bear mortality risk due to roads; they noted that there has to be a threshold road density identified and implemented to ensure population stability for grizzly bears. Kite et al. (2015) also reported on the association between grizzly bear mortality risk and roads.

6. The science is not currently available to measure how logging projects, aside from increased road access, impacts grizzly bear displacement and mortality risk, even though logging is the primary use of occupied grizzly bear habitat outside the Park; limited data indicates that logging also changes the quality of grizzly bear habitat, changes that need to be identified as potentially detrimental to the grizzly bear.

There is currently no science that defines how logging activities affect grizzly bear mortality risk and displacement. With delisting, logging will increase in occupied habitat, both within and outside the PCA. The effects of these impacts on grizzly bears will not be measured, due to a lack of science. It is apparently why the Conservation Strategy does not address the impacts of logging on grizzly bears. The apparent assumption in this Strategy is that a lack of evidence means that there is no impact. Thus the impacts of logging on grizzly bear mortality risk and displacement has not been considered in the Conservation Strategy, so it will also not be considered when grizzly bears are delisted. In the Yellowstone Ecosystem, there are expansive ongoing plans to log grizzly bear habitat, such as for the Greater Red Lodge Project, the Lonesome Wood Project, and Bozeman Watershed Project, the Rendezvous Trails Project, the Millie Fire Salvage Project, and the upcoming North Hebgen logging project. These projects have been planned when the grizzly bear was listed. There will most likely be even more projects planned in occupied habitat following delisting. The impacts of logging activities, and habitat impacts, need to be addressed in the Conservation Strategy.

As with displacement and mortality risks to bears from logging, there is only limited information available as to how logging affects grizzly bear habitat, aside from its severe impact on red squirrels, which are needed to provide whitebark pine nuts to grizzly bears (Kendal 1981, Reinhart and Mattson 1989). Since logging will likely increase with delisting, the government needs to address how habitat changes will affect the population trend of grizzly bears due to increased logging.

7. **The Conservation Strategy does not require implementation of the current best science for grizzly bear security.**

The proposed level of security in the Conservation Strategy is arbitrary, as it suggests that 1998 levels of security are adequate for grizzly bears, without any actual analysis or data. The recommended level of security for the grizzly bear in the Greater Yellowstone Ecosystem is 58% of the landscape in occupied habitat (Mattson 1991). Individual security areas should be at least 3.5 miles wide, and total 5,400 acres in size. This level of security would provide enough secure habitat to allow grizzly bears to use their habitat, without undue exposure to humans. This limited exposure has been demonstrated to be essential to limit the mortality risk of bears (Schwartz et al. 2010; Mattson and Knight 1991; Mattson et al. 1996; McLellan and Shackleton 1988; Boulanger and Stenhouse 2014).

8. **The changing habitat conditions in the Yellowstone Ecosystem are alone causing increased, likely irreversible increases in grizzly bear mortality.**

In 2015, there was a record mortality level for grizzly bears (59 deaths), with another potential for 30 unrecorded deaths. These high deaths are likely due to the deteriorating habitat conditions in Yellowstone due to losses of whitebark pine, trout, and elk declines (Wilcox blog 3/18/16). Elk have been compensating for these losses by eating more meat, including livestock and elk hunter kills. Id. Thus trouble with livestock operators and hunters have increased. Id. The conflicts with hunters was recently addressed in a blog by Louisa Wilcox on 1/2/16, where she noted that bears are readily killed by hunters. In regards to livestock conflicts, the Montana Standard noted on 8/19/15 that more bears venturing out of the Park are eating more livestock, amid a long-term trend in declining livestock-bear conflicts. In addition, Yellowstone bears are moving further out of the Park to take advantage of moth concentrations in high alpine areas (Dave Mattson blog 4/14/16). He provided a map that shows where bears are moving to utilize moths, and these areas are far outside the PCA for the Yellowstone population. He also noted that bear-livestock conflicts have increased in this area due to increased use by bears.

In addition, cubs and yearling grizzly bears are increasing dying because their mothers are being forced to a meat diet with the loss of other key foods as whitebark pine and trout (Dr. Dave Mattson blog 12/17/15); meat-eating is an incredibly hazardous undertaking for any bear, especially those with vulnerable young. This increased mortality rate of these young bears is not going to change, at least any time soon.

These changes in bear use of habitat in the Yellowstone Ecosystem are unlikely to change any time soon, meaning that the increased bear mortality triggered by these changes in habitat use are not going away. These high mortality rates are likely to continue.

9. **The government's claim that grizzly bears have reached the carrying capacity of their habitat in the Yellowstone Ecosystem, and thus can tolerate delisting and hunting, are illogical and not supported by science.**

As was noted in Dr. Dave Mattson blog of 12/17/15, the notion by the government that there is no more room for any more grizzly bears in the Yellowstone Ecosystem is illogical. Grizzlies are living in roughly twice the area they were in during the 1970s; multiple analyses by government and independent scientists alike show that there is ample habitat with natural foods sufficient to support grizzly bears in places where grizzlies have not yet established themselves.

10. **The government's claim that hunting grizzly bears will reduce conflicts with people conflicts with science.**

In an article in the Bozeman Daily Chronicle on 6/25/13, the article noted that rising numbers of bear-human conflicts –such as a mauling last week south of Cody, that sent a man to the hospital with severe facial lacerations – have lent new urgency to calls to allow limited hunting to resume. Dr. Dave Mattson provided a blog on 1/19/16 regarding the claim that hunting will scare grizzlies, where he cited an editorial in the Chronicle as hunting to increase bear fears of humans as justification for delisting. He noted there is little to no empirical evidence to support this contention. He noted that grizzlies are "hard wired" to respond aggressively to threats, perceived or real. This response would increase, not decrease, when bears fear people. On the other hand, with benign encounters with humans, bear can learn to be more tolerant, known as habituation. He also noted that hunting bears would like increase the exposure of younger bears to humans, bears that are notoriously prone to push human boundaries. Social hunting would also disrupt the social order for the bear population, which often results in more cub-killing by males, and with that, unexpected and sometimes problematic population declines. Also, he noted there is little direct evidence that bears become warier with hunting, and certainly no evidence that people become safer. Surprise encounters and food encounters are the driving factors for risk. He noted that unless you kill most bears, you are not going to substantially reduce the chance of surprise encounters, or eliminate the hard-wired tendency of bears to defend themselves or their cubs when surprised. He also notes that essentially, we have been hunting grizzly bears in Yellowstone for decades, due to removals for various conflicts, real or imagined. There is no evidence that these bear removals have increased human safety. Finally, he noted that there would be no hunting in Yellowstone National Park, where many of the bears reside.

11. **The delisting of grizzly bears will greatly reduce their long-term viability by essentially eliminating the connectivity between the Greater Yellowstone and Northern Continental Divide Ecosystems.**

The Conservation Strategy will not protect any grizzly bears from any adverse effects outside the PCA. This means that the likelihood of grizzly bears eventually connecting with the NCDE bears is basically eliminated, even though this is believed to be key to long term viability of the Yellowstone grizzly bear (Dr. Dave Mattson, talk on 3/31/16 in Bozeman, MT). Given the high mortality risks that will be allowed on bears outside the PCA, their long term viability even in these areas is likely doomed. There will be no bears surviving that over time, could expand in the direction of the NCDE.

C.The process for delisting has no logical process; the process is severely fragmented making it impossible for the public to be involved, let alone provide input; the public has not been provided a draft environmental

impact statement which provides a detailed analysis of delisting impacts, including how bears will be managed with hunting, a significant change from management under the ESA.

The delisting process includes a Conservation Strategy that is not yet finalized for the public. This Conservation Strategy to date has no analysis of how delisting will affect grizzly bear mortality rates both inside and outside the PCA. Without this analysis, it is a violation of the NEPA, the NFMA and the ESA. The few standards in the Conservation Strategy are not supported with any science or analysis, nor do they demonstrate how grizzly bears will respond to the purported conservation measures, including restrictions only on "permanent roads." The public has yet to be provided any management plans by the 3 states that intend to hunt grizzly bears. The Conservation Strategy does not address how grizzly bears will survive outside the PCA. It is not clear why 600 bears has been selected as the threshold population level needed for viability. It is not clear why the loss of major food resources in the Park are not causing population declines for bears. The controversy over grizzly bear population trends is not addressed. The failure of the government to obtain outside peer review by other scientists is not addressed. Overall, this Conservation Strategy does not demonstrate that grizzly bears will remain viable after delisting.

A draft environmental impact statement needs to be completed to define specifically how grizzly bears will be managed upon delisting, as is required by the NEPA and the NFMA, since delisting is a major change from current management on public lands. This is necessary so that the public has an opportunity to review all the current best science, and how bear management will proceed, upon delisting, including hunting and management of bears both within and outside the PCA.

1. **The basis for the delineation of the PCA needs to be defined to the public in an environmental impact statement.**

There is no actual rationale provided, based on science, as to why bear management will be based on the PCA, an area that was established over 40 years ago. The government needs to provide the science and hence basis for delineating 2 separate management zones for grizzly bears upon delisting, including how different levels of management will affect the long-term viability of the bear, including in regards to genetic diversity. There are at least 2 critical issues that need to be addressed in the delineation of the PCA. How will this planned failure to protect bears outside the PCA promote connection between the Yellowstone and the Northern Continental Divide bears, and long-term viability. And what data specifically identifies that these are 2 distinct grizzly bear populations, and thus there is no overlap between bears within and outside the PCA, in order to justify different management proposals for what is actually more likely one grizzly bear population. If this is the case, then the failure to protect these bears when they move outside the PCA (for example, to obtain moths) means that the claimed management of bears within the PCA is misleading and doomed to failure.

2. **The ability of the government to provide accurate measurements of the grizzly bear population in occupied habitat of the Greater Yellowstone Ecosystem needs to be demonstrated in an environmental impact statement.**

There is currently significant controversy about the methods the government is using to measure the Yellowstone grizzly bear population (e.g., Doak and Cutler 2013; Mattson comments in newspaper articles and blogs). This controversy is based in part by the government's refusal to provide basic population data and parameters for measurement to the general public, in violation of the NEPA and the Freedom of Information Act (FOIA). The public needs to be provided with full access to the data on which delisting assumptions are being based. And the government also needs to provide a full public disclosure of the controversy in regards to population measurements on the threatened grizzly bear, so that the public has a full understanding of why this controversy exists. This controversy is at the heart of the delisting proposal, and public disclosure of all aspects of why the government has decided to proceed with delisting, based on their science, needs to be provided in an environmental impact statement.

This information is key to delisting, as the government claims that they will maintain the grizzly bear population within the PCA within an established threshold of 600 bears. If they are not able to actually provide valid measures of the grizzly bear population, by using inflated measures, this means that the 600-bear threshold is meaningless.

3. **<u>The impacts of increased logging and reduced requirements for road density controls need to be assessed in an environmental impact statement prior to delisting, so that the public can understand why delisiting will ensure continued viability of the Yellowstone grizzly bear.</u>**

We have noted many different aspects that will increase the mortality risk of grizzly bears, as well as habitat reductions due to displacement, that will negatively impact grizzly bears after delisting. IN order to demonstrate that the agencies have taken the requisite "hard look" required by the NEPA for significant government actions, the USFWS, Forest Service, and state agencies need to provide a complete a detailed analysis of the expected increase in grizzly bear mortality that will be triggered by delisting, and how this increase in mortality and reduction in available habitat will affect the population trend. This analysis also needs to include the cumulative impacts of habitat losses to the grizzly bear due to declines in whitebark pine, trout, and elk in the Yellowstone ecosystem, and how these changes have also added to what may be permanent increases in grizzly bear mortality as bears use more meat resources (increased mortality of cubs and yearlings) and increased human conflicts with livestock. The long-term effects of these changes in food resources appear to be highly significant for the grizzly bear population trend, and these impacts need to be added to the proposed impacts of delisting, including hunting.

4. **<u>The environmental impact statement for delisting the grizzly bear needs to fully disclose that funding for management of bears will be adequate to ensure the Conservation Strategy will be fully implemented in the long term</u>**.

It is not clear with delisting how funding to manage grizzly bears will be ensured. If funding is not ensured, then the Conservation Strategy is nothing more than a desired condition, not a standard. The mechanisms by which funding will be ensured over the long term needs to be fully disclosed to the public, which is part of the "hard look" requirement for the NEPA. If funding is not fully ensured over time, then the government needs to inform the public that there are no assurances that the Conservation Strategy will actually be implemented, including any protection measures for bears, including minimum population thresholds.

Sara Johnson of Native Ecosystems Council (NEC) would like to request a "hard copy" of the revised "draft" Conservation Strategy and draft environmental impact statement when these are released for public review and comment. Mike Garrity of the Alliance for the Wild Rockies (AWR) would be satisfied to receive an electronic copies of these documents.

Regards,

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Attachment A for comments provided by NEC and AWR on grizzly bear delisting, April 18, 2016.

This attachment contains the relevant portions of reports and research articles cited in the comments provided by NEC and AWR for delisting the Yellowstone grizzly bear.

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2004

ESTIMATING GRIZZLY BEAR DISTRIBUTION AND ABUNDANCE RELATIVE TO HABITAT AND HUMAN INFLUENCE

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Abstract: Understanding factors that influence and predict grizzly bear (*Ursus arctos*) distribution and abundance is fundamental to their conservation. In southeast British Columbia, Canada, we applied DNA hair-trap sampling (1) to evaluate relationships of grizzly bear detections with landscape variables of habitat and human activity, and (2) to model the spatial distribution and abundance of grizzly bears. During 1996–1998, we sampled grizzly bear occurrence across 5,496 km^2 at sites distributed according to grid cells. We compared 244 combinations of sampling sites and sessions where grizzly bears were detected (determined by nDNA analyses) to 845 site–sessions where they were not. We tested for differences in 30 terrain, vegetation, land cover, and human influence variables at 3 spatial scales. Grizzly bears more often were detected in landscapes of relatively high elevation, steep slope, rugged terrain, and low human access and linear disturbance densities. These landscapes also were comprised of more avalanche chutes, alpine tundra, barren surfaces, burned forests, and less young and logged forests. Relationships with forest productivity and some overstory species were positive at broader scales, while associations with forest overstory and productivity were negative at the finest scale. At the finest scale, the strong negative association with very young, logged forests and with increasing values of the Landsat-derived green vegetation index became positive when analyzed in a multivariate context. For multivariate analyses, we considered 2 variables together with 11 principal components that describe ecological gradients among 4 variable groupings. We applied multiple logistic regression and used AIC to rank and weight competing subset models. We derived coefficients for interpretation and prediction using multi-model inference. The resulting function was highly predictive, which we confirmed against an independent dataset. We transformed the output using a multi-annual population estimate for the sampling area, and we applied the resulting grizzly bear density and distribution model across our greater study area as a strategic-level planning tool. We discuss conservation applications and design considerations of this DNA-based approach for grizzly bears and other forest-dwelling species.

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Key words: British Columbia, DNA, distribution, GIS, grizzly bear, habitat, human influence, landscape, population density, predictive modeling, resource selection function, *Ursus arctos*.

The spatial structure of a population has direct bearing on its dynamics, resiliency, and thus viability (Kareiva and Wennergren 1995, Ritchie 1997, Wiegand et al. 2002). Estimating the density and distribution of populations, monitoring spatiotemporal trends, and understanding factors that influence these trends are fundamental to an adaptive conservation strategy for any species. Yet, despite heightened management concerns, few examples are available at scales relevant to population conservation for solitary, wide-ranging species associated with forested environments. In addressing questions of population distribution and abundance over large spatial scales, options for using animal tracking systems such as radiotelemetry are limited by the ability to apply consistent and cost-effective capture effort and to achieve adequate sample sizes over a representative range of conditions. Moreover, researchers may not accept the associated disturbance to study animals, especially when less invasive techniques are available. Harvest or sightings data have been used to understand population distribution at very broad scales, but are typically subject to quality issues and nonrandom sampling bias at regional conservation planning levels (e.g., <30,000 km^2). Noninvasive sampling protocols have been developed for some species, but the regional application of these protocols may be subject to technological, logistical, and budgetary constraints (Zielinski and Kucera 1995, Foresman and Pearson 1998, Sargeant et al. 1998, Moruzzi et al. 2002).

For bears, recent advancements have been made in noninvasive hair-capture, genetic tagging, and population density estimation (Woods et al. 1999, Mowat and Strobeck 2000, Boulanger and McLellan 2001, Poole et al. 2001). These advancements have facilitated research to develop and refine spa-

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GRIZZLY BEAR - TIMBER RELATIONSHIPS IN THE YELLOWSTONE AREA

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Abstract: Grizzly bear (*Ursus arctos*) - habitat relationships were studied from 1976 through 1979 in a 20,000 km^2 area with Yellowstone National Park in the center. Ninety percent of the 2,261 aerial radio relocations of 46 instrumented grizzlies were in timber too dense to observe the bear. Three-fourths of the relocations were less than 100 m from a timber-opening edge. The majority (56%) of 515 feeding activities observed were recorded in timber over 3 m tall with a canopy cover greater than 5%, 20% were in open habitats, 18% were in timber over 3 m tall with a canopy cover of 5% or less, and only 6% were in timber less than 3 m tall. Most day beds were constructed less than 1 m from a tree, and usually in the *Abies lasiocarpa*/*Vaccinium scoparium* habitat type.

J. WILDL. MANAGE.

Key words: Grizzly bear, habitat, timber.

In 1975 the grizzly bear south of Canada was listed as a threatened species. To comply with the Endangered Species Act of 1973, Federal agencies must, therefore, avoid destruction or adverse modification of grizzly bear "critical habitat."

At that time insufficient data were available to define critical habitat, so management agencies were poorly equipped to evaluate the effects of land practices upon the grizzly. Research to determine the

Radio telemetry in this study has shown that grizzly bears in the Yellowstone system were located much more often in timber than in the open during the day. Examination of these locations has documented that substantial foraging by the bears occurred in the timber. Herrero (1978) has noted that "the brown bear has not lost its ability to forage on the forest floor, but it has gained the ability to exploit open habitat types at their peaks of productivity." Schallenberger and Jonkel (1979) found Rocky Mountain east front grizzly bears preferred timber to open (81% vs. 6% of total observations), while brown bears in Italy have also been found to prefer dense timber during the day (Roth and Osti 1979). Visual observation - in contrast to radio observations - suggests that "grizzlies appeared to occupy primarily fertile, open grasslands" (Mealey 1975) and that these bears appear to prefer open habitats as foraging grounds (Craighead 1979).

We don't know whether grizzly bears in the Yellowstone system presently use timber to the extent recorded because of an innate preference or in avoidance of contact with humans. Researchers in North America and Eurasia have documented negative correlations between the levels of human activity and grizzly/brown bear activity (Jurgenson 1968, Craighead and Craighead 1972, Priklonskij 1972, Zunino and Herrero 1972, Kaleckaja 1973, Pearson 1975, Martinka 1976, Chester 1977, Elgmork 1978, Nagy and Russell 1978). Others suggest that bears can become accustomed to activity associated with food sources (Cole 1972, Mundy and Flook 1973, Hamer 1974, Gilbert 1977). Yellowstone grizzly bears have been subjected to several selection pressures that may have caused them to seek out and remain in the timber. Bears outside the National Park were hunted until 1974 in Wyoming and Montana and are presently subjected to substantial poaching. Problem bears inside and outside the park are currently subject to control actions.

Despite the preponderance of observations in the timber, the importance of interspersion of timber and open habitats is apparent. Three-fourths of the total relocations were less than 100 m from a timber-opening edge. The importance of habitat interspersion to grizzlies has been documented by Graham (1978), Knight et al. (1978), Schallenberger (1976), Mealey (1976), Mealey and Jonkel (1975), and Craighead and Craighead (1972). A positive correlation between the length of timber to opening edge and the number of brown bear observations was noted by Elgmork (1978) in Norway.

Since Yellowstone grizzly bears use forested areas to a large extent, any alterations in the quantity and/or quality of timber cover may affect the availability of "preferred" habitat. Radio relocations and feeding sites indicate the majority of feeding activities and day beds occur in mixed age and species stands of moderate to dense (26-75%) canopy cover. Sterile lodgepole pine communities are frequently used as day bed sites and for certain feeding activities such as tearing logs for insects or carcass feeding. Mature and decadent stands are also used, largely as day bed sites.

Conventional logging negatively affects bears through reduction of shelter and increases in human activity. Black bears in the Whitefish Range of Montana used all seral stages of burned timber but did not use clearcuts or logged areas for about 10 years after logging (Jonkel and Cowan 1971). Brown bears in Norway were considerably disturbed by logging activities, especially networks of roads and the resulting secondary traffic (Elgmork 1978).

Logging operations may not be detrimental to the Yellowstone grizzlies if management actions are taken to minimize the negative impacts. Such actions would include: (1) permanently closing roads after logging; (2) making small, irregularly shaped clearcuts no greater than 300 m wide with long timber-to-opening edges; (3) making selective cuts and leaving a canopy over 3 m tall with cover greater than 25%; and (4) leaving strips between logging operations at least 100 m wide. Any measures taken to lessen the impacts of logging upon the grizzly will be worthless unless logging roads are permanently closed after logging because roads provide increased human activity and more frequent human-grizzly encounters. Increased human activity is clearly detrimental to the grizzly bear, both directly - through poaching and control actions - and indirectly through avoidance behavior.

PLOS | ONE

RESEARCH ARTICLE

The Impact of Roads on the Demography of Grizzly Bears in Alberta

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CrossMark

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Abstract

One of the principal factors that have reduced grizzly bear populations has been the creation of human access into grizzly bear habitat by roads built for resource extraction. Past studies have documented mortality and distributional changes of bears relative to roads but none have attempted to estimate the direct demographic impact of roads in terms of both survival rates, reproductive rates, and the interaction of reproductive state of female bears with survival rate. We applied a combination of survival and reproductive models to estimate demographic parameters for threatened grizzly bear populations in Alberta. Instead of attempting to estimate mean trend we explored factors which caused biological and spatial variation in population trend. We found that sex and age class survival was related to road density with subadult bears being most vulnerable to road-based mortality. A multi-state reproduction model found that females accompanied by cubs of the year and/or yearling cubs had lower survival rates compared to females with two year olds or no cubs. A demographic model found strong spatial gradients in population trend based upon road density. Threshold road densities needed to ensure population stability were estimated to further refine targets for population recovery of grizzly bears in Alberta. Models that considered lowered survival of females with dependant offspring resulted in lower road density thresholds to ensure stable bear populations. Our results demonstrate likely spatial variation in population trend and provide an example how demographic analysis can be used to refine and direct conservation measures for threatened species.

Introduction

One of the primary factors that has reduced grizzly bear populations in some portions of North America, has been the effects of unsustainable human caused

FWS_Pub CMT_006310

BOBCATS IN OUTER SPACE

MSU faculty, students counting down launch of solar mission they worked on

BIG SKY

LEAKING MILLIONS

Millions of dollars are disappearing through cracks in city policy

BUSINESS JOURNAL

BOZEMAN DAILY

CHRONICLE

DAILYCHRONICLE.COM TUESDAY, JUNE 25, 2013 75¢

Study: Yellowstone grizzly numbers lower than estimated

Trends within Yellowstone's bear population have taken on importance as the U.S. Fish and Wildlife Service considers lifting federal protections for the animals.

By MATTHEW BROWN
Associated Press

BILLINGS — Flaws in how the government measures Yellowstone's grizzly bear population raise questions about whether the animals have recovered sufficiently to merit lifting federal protections, according to a new study.

The study concludes that a major reason more bears have been counted in recent years is that more time is now spent counting bears. The authors argue that the region's bruin population could in fact be in decline, even as officials consider revoking the grizzly's threatened species status.

The peer-reviewed findings have been accepted for publication in the journal Conservation Letters. The work was partially funded by the Natural Resources Defense Council.

Population trends within Yellowstone's bear population have taken on added importance as the U.S. Fish and Wildlife Service considers lifting federal protections for the animals, possibly as early as next year.

Government biologists countered that there is no evidence of a decline. They said newly-revised population data shows more than 700 grizzlies living in and around Yellowstone National Park, an area that includes Wyoming, Montana and Idaho.

Meanwhile, rising numbers of bear-human conflicts — such as a mauling last week south of Cody, Wyo., that sent a man to the hospital with severe facial lacerations — have lent new urgency to calls to allow limited hunting to resume.

But the new study's lead author, University of Colorado environmental studies professor Daniel Doak, said shortcomings in the government's method of tracking grizzly numbers mean their recovery from widespread extermination last century may have been overstated.

The bears lost protections once, in 2007, before a federal judge ordered grizzlies back onto the threatened species list two years later. The reversal came in part over concerns that one food source for bears, the nuts from white bark pine trees, has grown increasingly scarce as insects kill large stands of the trees.

AP

This May 30 photograph provided by Wolves of the Rockies shows a grizzly bear at Mary Bay along Yellowstone Lake in Yellowstone National Park.

More BEARS | A8

FWS_Pub CMT_006311

Spokane	69/53/t	73/54/pc
Topeka	94/73/s	96/74/s
Washington, DC	95/75/pc	95/75/pc

Jun 29 Jul 8 Jul 15 Jul 22

Weather (W): s-sunny, pc-partly cloudy, c- fl-flurrie

For up-to-the-minute weather

Bears/from A1

Doak said the loss of whitebark pine and a decline in another food source, cutthroat trout, may have pushed bears into areas where they are more likely to be seen during aerial surveys done by government agencies. That doesn't necessarily mean there are more bears.

"It's a pretty standard thing in all of wildlife biology and conservation biology that if you triple the amount of time you're looking for some rare species, it's likely you're going to seem more of them, just because you spend a lot more time doing so," he said.

Doak and co-author Kerry Cutler also say wildlife officials have mistakenly assumed female grizzly bears reproduce throughout a 30-year lifespan, compounding the government's overly-optimistic population estimates.

They did not offer an alternative population size, nor say outright that the current estimate was wrong.

The government's latest estimate of 718 bears in the Yellowstone area is up from prior published estimates of roughly 600 bears.

That does not mean the bear population suddenly grew by about 100 bears. U.S. Geological Survey bear researcher Frank van Manen said the new figure results from revisions to the prior estimate based on increased survival rates for adult male bears in recent decades.

One reason more effort has gone into counting bears is that they are now spread across a much bigger landscape, said van Manen, who leads an interagency grizzly bear study team for the Yellowstone region. The results of those aerial surveys are corroborated by other factors, including the expansion of the animals' range and a trapping program that consistently identifies new bears, he said.

U.S. Fish and Wildlife Service grizzly bear coordinator Chris Servheen said the government's methods are reviewed by outside scientists and other government agencies.

"We're certainly interested in what they did," Servheen said of Doak's work. "But we've done a lot of work on this. We've given very careful consideration and critiques to everything we've done multiple times."

Another U.S. Geological Survey bear researcher, David Mattson, said Doak's findings were in line with his own conclusions that current estimation methods are "essentially worthless."

"There is this belief that somehow, through some sort of statistical magic, you can compensate for bias in your field methods," Mattson said. "My conclusion is that's just not simply possible."

Yellowstone's grizzly population is the second largest in the Lower 48, behind an estimated 1,000 bears in the Northern Continental Divide region that includes Glacier National Park. Smaller populations live in the Cabinet-Yaak, North Cascades and Selkirk areas of Idaho, Montana and Washington state.

Immigration/

He said the measure would be good for the economy, for

Leaving little to chance, the U.S. Chamber of Commerce

fied on the vote.

Republicans were anything

Police Reports

The Bozeman Police Department reports for Monday included the following:

■ At 12:40 a.m., an officer found two young adults in the rear seat of a car with fogged up windows parked at Lindley Park. The officer told them the park was closed and warned them.

■ An officer stopped and offered some education to a driver who purchased a new vehicle and was unfamiliar with how to turn the

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9:45 a.m.; Breathing
breathing and relax
techniques, 5:30-6:3
102 S. 11th Ave., Bo
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only for those affect

k hunters kill 2 grizzly ears, drivers kill 3

ELENA (AP) —
e wildlife officials say
hunters in southwest-
Montana reported
ng two female griz-
bears in self-defense
weekend while three
er grizzly bear deaths
e reported along
dways in northwest-
Montana.
hunter near Gar-

told Fish, Wildlife and Parks officials that he came upon a bear feeding on a carcass on Oct. 28. The West Yellowstone hunters said a female grizzly bear with two cubs charged them on Oct. 31.

Grizzly bear management specialist Tim Manley says a female

Former government researcher disputes grizzly study results

By **MICHAEL WRIGHT**
Chronicle Staff Writer

A former government scientist has doubts about a recent grizzly bear study that said the number of Yellowstone area bears passing genes to the next generation had more than quadrupled since 1980, saying it's an attempt to shore up evidence to remove federal protections for the bears.

Former government grizzly researcher David Mattson criticized the study in a post on www.grizzlytimes.org. Mattson says the study's claims don't "pass the laugh test."

In an interview Tuesday, Mattson went on to say that the study was "inconsistent with everything else we know about this population." Moreover, he said the Interagency Grizzly Bear Study Team — which produced the study — and U.S. Geological Survey work to support the "sanctioned political agenda" of delisting the bears.

Pauline Kamath, one of the study's authors, said in an email the U.S. Geological Survey is "committed to providing unbiased, objective scientific information upon which other entities can use to base their actions and/or decisions on."

This comes as grizzly managers and advocates are meeting in Wyoming, where some expect a push for a delisting of the bears. Except for a brief time between 2007 and 2009, the grizzly bear has been listed as threatened under the Endangered Species Act since 1975. Lately, though, the push to delist has resurfaced.

The study found the effective population of Yellowstone National Park grizzly bears had increased from 100 to 450 since the early 1980s. A higher effective population means a slower loss of genetic diversity, which could mean bears would be better prepared to adapt to climate change or other environmental changes.

That doesn't mean the population size itself quadrupled in that time — just the number of bears passing genes along. Mattson — who researched carnivores for the federal government for 30 years and now is a lecturer at Yale University — said most people would agree that the population size of the Yellowstone bears has been largely stagnant since the early 2000s. The latest USGS count put the overall population at 757 bears.

More **GRIZZLIES** | C2

Recent YNP grizzly bear count shows decline

JACKSON, Wyo. (AP) — The estimated number of grizzly bears in and around Yellowstone National Park has been revised downward by 6 percent from a year ago, but wildlife biologists say the drop isn't cause for concern that the animals are in trouble.

"There's no evidence of a major change in the long-term trend of the population, and the long-term trend is still flat to slightly increasing," Frank van Manen, a wildlife biologist with the U.S. Geological Survey, said.

The number of grizzly bears in the Greater Yellowstone Ecosystem, which includes areas of Wyoming, Montana and Idaho, is estimated at 714 this year, down from 2014's estimate of 757, according to information released at a meeting of wildlife biologists Wednesday.

The decline comes during debate about whether federal protections for the grizzly bear should be lifted. Wildlife advocates say grizzly bear numbers are not sufficient enough to warrant lifting protections and subjecting the bears to possible hunting. But delisting advocates say grizzly bear populations have grown to the point where they are expanding beyond their current habitat and are coming more and more into conflict with humans.

Van Manen, a team leader with the Interagency Grizzly Bear Study Team, said the new grizzly bear population estimate is a single-year snapshot and not any indication that the population is in decline.

"It is within the range of variability, and we know there's sampling bias involved," he told the Jackson Hole News & Guide. "What we look at is that trend line over time, and if we look at that, there's no evidence of an actual decline."

The model that federal bear managers use to gauge grizzly numbers is biased low, van Manen said.

"We are underestimating probably by about 40 percent, according to these calculations," van Manen said.

Adjusting for the model's underestimation, the grizzly population would have come in this year at around 1,000.

Van Manen presented data Wednesday to the Yellowstone Ecosystem Subcommittee that counted 52 grizzly bear deaths so far this year and 90 percent of those deaths have been caused by people.

But mortality levels for both sexes are still within the limits set by recovery plans, van Manen said.

Nearly 6 percent of female grizzlies have died this year, he said, which is below the 7.6 percent threshold that can lead to decline. Among boar grizzlies, 11.4 percent have died, again below the acceptable mortality limit of 15 percent.

The grizzly bear has been a protected species under the Endangered Species Act for all but two years since 1975.

Officials with the U.S. Fish and Wildlife Service have said there are no firm plans to propose a rule that could lift protections for the Yellowstone ecosystem's grizzly bears.

BOZEMAN DAILY CHRONICLE

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SECTION C | FRIDAY, NOVEMBER 6, 2015

CHILD'S PLAY

Families demand push for pint-sized medical devices for sick kids PAGE C3

Police reports, obituaries PAGE C2

FWS_Pub CMT_006315

Relationships among grizzly bears, highways, and habitat in the Banff-Bow Valley, Alberta, Canada

Bryan Chruszcz, Anthony P. Clevenger, Kari E. Gunson, and Michael L. Gibeau

Abstract: Banff National Park and surrounding lands constitute one of the most developed landscapes in the world where grizzly bears (*Ursus arctos*) still survive. We examine the relationships among roads, grizzly bears, and their habitat in a protected area with low road density but dominated by a major transportation corridor and highway system. We examined grizzly bears' spatial response to roads, road-crossing behaviour, crossing-location attributes, and habitat and temporal patterns of cross-road movements. Grizzly bears used areas close to roads more than expected, particularly roads with low traffic volume (low volume). Habituated bears were closer to roads than wary bears. Males were closer to low-volume roads than females but crossed roads less than females during the berry season. Bears were more likely to cross low-volume roads than high-volume roads and were more likely to cross at points with higher habitat rankings. In addition, bears were more likely to cross high-volume roads when moving from areas with low habitat values to areas with high habitat values. Efforts to prevent loss of habitat connectivity across highways should involve maintenance of high-quality grizzly bear habitat adjacent to roads and should address the effects of traffic volume on the road-crossing decisions of grizzly bears.

Résumé : Le parc national de Banff et les terres avoisinantes représentent un des paysages les plus développés au monde dans lesquels les grizzlis (*Ursus arctos*) survivent toujours. Notre étude examine les relations entre les routes, les grizzlis et leur habitat dans une région protégée avec une faible densité de routes, mais traversée par un important corridor de transport et un axe routier majeur. Nous avons étudié la réaction spatiale des grizzlis aux routes, leur comportement de traversée des routes, les caractéristiques de leurs points de traversée et les structures spatiales et temporelles reliées aux déplacements de traversée. Les grizzlis utilisent les espaces près des routes plus que prévu, particulièrement celles qui ont peu de circulation (volume faible). Les ours habitués se tiennent plus près des routes que les ours méfiants. Les mâles se tiennent plus près des routes à faible volume de circulation que les femelles, mais ils traversent les routes moins volontiers que les femelles durant la saison des petits fruits. Les ours sont plus susceptibles de traverser des routes à faible plutôt que forte circulation et de traverser aux endroits où l'habitat est de plus grande qualité. De plus, les ours sont plus susceptibles de traverser des routes à forte circulation lorsqu'ils se déplacent d'un habitat de faible qualité à un autre de qualité supérieure. Dans le but de prévenir la perte de connectivité entre les habitats à travers les routes, il faudrait maintenir près des routes des habitats de qualité pour les grizzlis et étudier les effets du volume de la circulation sur les décisions des ours de traverser la route.

[Traduit par la Rédaction]

Introduction

Many landscapes are undergoing extensive and rapid change as a consequence of human activities (Hansson and Angelstam 1991; Houghton 1994). One of the major changes associated with landscape modification is the fragmentation and loss of habitat (Bennett 1999). Less conspicuous than other forms of habitat disturbance, linear features such as roads can have immense and pervasive impacts on wildlife populations (Forman and Alexander 1998; Trombulak and Frissell 2000). In an increasing number of landscapes, the regular movements of animals involve road crossings.

In view of their great mobility and extensive spatial requirements for survival, large mammalian carnivores are vulnerable to road effects (Noss et al. 1996; Woodroffe and Ginsberg 2000). Currently, many wide-ranging predatory species are a source of conservation concern worldwide (Landa et al. 1997; Breitenmoser 1998; Sanderson et al. 2002), and the need to protect them from the harmful consequences of roads is paramount (Kerley et al. 2002).

Landscape fragmentation due to human activities and blockage of wildlife movement in the Bow Valley are major stressors affecting the Banff National Park (BNP) ecosystem (Banff – Bow Valley Study 1996). The Trans-Canada Highway (TCH) is a potential barrier to large-mammal movement in the mountain parks and the significantly larger Central Rocky Mountain ecosystem. Given the national importance of the cross-country transportation corridor (McGuire and

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12

Research Article

Components of Grizzly Bear Habitat Selection: Density, Habitats, Roads, and Mortality Risk

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ABSTRACT We used resource selection functions (RSF) to estimate the relative probability of use for grizzly bears (*Ursus arctos*) adjacent to the Parsnip River, British Columbia, Canada, 1998–2003. We collected data from 30 radiocollared bears on a rolling plateau where a large portion of the landscape had been modified by human activities, primarily forestry. We also monitored 24 radiocollared bears in mountain areas largely inaccessible to humans. Bears that lived on the plateau existed at less than one-quarter the density of bears in the mountains. Plateau bears ate more high-quality food items, such as meat and berries, leading us to conclude that food limitation was not responsible for the differences in densities. We hypothesized that plateau bears were limited by human-caused mortality associated with roads constructed for forestry activities. Independent estimates of bear population size from DNA-based mark–recapture techniques allowed us to link populations to habitats using RSF models to scale habitat use patterns to population density. To evaluate whether differences in land-cover type, roads, or mortality risk could account for the disparity in density we used the mountain RSF model to predict habitat use and number of bears on the plateau and vice versa. We predicted increases ranging from 34 bears to 96 bears on the plateau when switching model coefficients, excluding land-cover types; when exchanging land-cover coefficients, the model predicted that the plateau population would be 9 bears lower than was observed. Large reductions in the numbers of mountain bears were predicted by habitat-selection models of bears using the plateau landscape. Although RSF models estimated in mountain and plateau landscapes could not predict bear use and abundance in the other areas, contrasts in models between areas provided a useful tool for examining the effects of human activities on grizzly bears. (JOURNAL OF WILDLIFE MANAGEMENT 71(5):1446–1457; 2007)

DOI: 10.2193/2006-229

KEY WORDS British Columbia, density estimation, forestry, grizzly bear, habitat selection, mortality, risk, roads, resource selection function, *Ursus arctos*.

Landscapes contain temporal and spatial variation among and within habitat patches (Southwood 1977), and habitat selection has a direct impact on population density and behavior (Rosenzweig 1981). Frequently, the spatial distribution of foods has been used to explain the spatial distribution and dynamics of animals (MacArthur and Pianka 1966, Charnov 1976). In theory, animals should optimize their foraging strategy by choosing richer patches over poorer patches (Charnov 1976). Higher quality habitats are assumed to be linked to increased fitness at a given density, generally resulting in higher densities of animals in higher quality habitats (Fretwell and Lucas 1970, Garshelis 2000, Bock and Jones 2004). Also, experimental studies have shown that avoidance of predation risk can alter habitat selection (Gilliam and Fraser 1987, Abrahams and Dill 1989, Resetarits 2005).

In our study area, a relatively pristine mountainous landscape contained 4 times the density of grizzly bears (*Ursus arctos*) as an adjacent plateau landscape that had been heavily harvested for timber (Mowat et al. 2005). A similar pattern occurs in Alberta, Canada, where the highest density of bears exists in the mountains and bear densities decline further east in the foothills, where access to development has been greater (Boulanger et al. 2005). High-quality habitats close to areas of human use are often areas of high bear mortality (Knight et al. 1988, McLellan 1989, Mattson and Merrill 2002, Nielsen et al. 2004), thereby negatively affecting populations (Mattson and Merrill 2002). Further, high-risk food-rich habitats that attract individuals can serve as local population sinks, or ecological traps (Delibes et al. 2001, Kristan 2003, Robertson and Hutto 2006). Consequently, individual occurrence and abundance are not necessarily related to habitat quality (Hobbs and Hanley 1990, Kristan 2003).

In areas with high food availability, particularly meat, bears tend to have increased reproductive success, larger body mass, and a higher population density (Hilderbrand et al. 1999). Elsewhere we reported significantly larger body masses, better condition, and higher cubs-of-the-year survival in our low-density area (i.e., the plateau); however, survival of subadult and adult bears was lower on the plateau than the mountains (Ciarniello 2006). Based on these observations we surmised that the density of bears on the plateau was limited by human-caused mortality linked to access afforded by forestry activities rather than habitat quality per se (Ciarniello 2006). In this paper, we evaluate this conclusion using 2 methods: 1) examining the foods consumed by bears that lived in the mountains compared with those that lived on the plateau to investigate whether bears on the plateau were limited by available forage; and 2) modeling the relationship between habitats and population structure using mechanistic and or statistical approaches to habitat selection.

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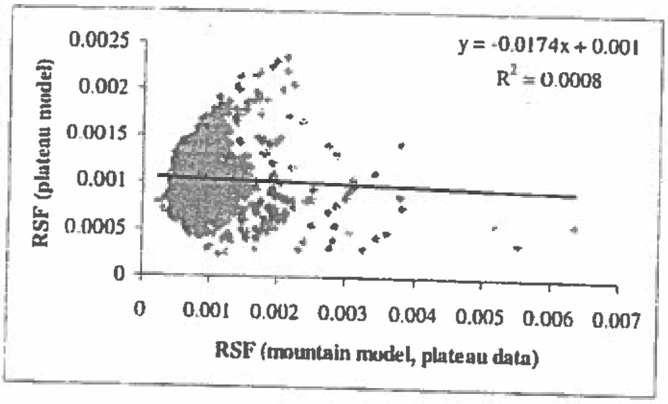

Figure 6. Plot of each resource selection function (RSF) point predicted in the plateau landscape versus the RSF scores predicted using the mountain model with the plateau data for the Parsnip River study area, British Columbia, Canada, 1998–2003. We define the RSF to be $\sqrt{|w(x)|}$ (see eq. 3).

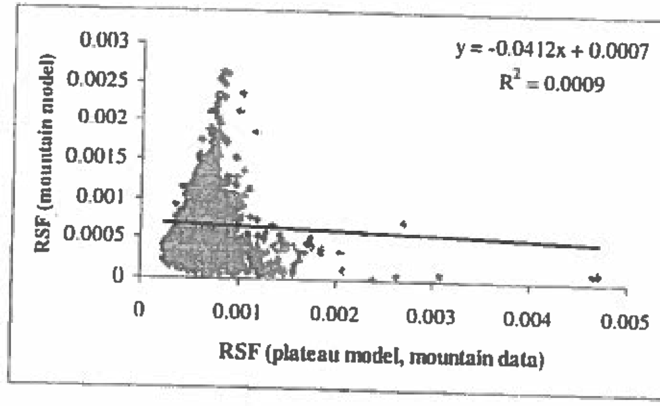

Figure 7. Plot of each resource selection function (RSF) point predicted in the mountain landscape versus the RSF scores predicted using the plateau model with the mountain data for the Parsnip River study area, British Columbia, Canada, 1998–2003. We define the RSF to be $\sqrt{|w(x)|}$ (see eq. 3).

Mowat et al. (2005; Table 4); however, the confidence interval represents a large range in density.

We estimated changes in population size obtained by switching models by comparing our estimated N with the observed N obtained from the DNA mark–recapture estimate adjusted for study area size ($N = 127$). The only predictor variables that predicted a reduced number of bears on the plateau were the available land-cover types. We predicted a decrease of 9 bears on the plateau (i.e., obs N of 127 bears in plateau study area minus predicted land-cover-swap N of 118 bears) when we applied the land-cover data from the mountains into the plateau RSF model. Conversely, the plateau population increased by 34 bears when we took the model coefficients associated with primary and secondary logging roads from the mountain model (i.e., if plateau bears avoided secondary logging roads similar to mountain bears, we would expect 34 more bears on the plateau landscape). If the risk of human-caused mortality was similar to what we observed in the mountains we estimate an increase of 49 bears on the plateau (Table 4). Lastly, we examined the effect of switching the model coefficients for all variables. If bears on the plateau had similar patterns of selection to mountain bears, we expect that the population of bears on the plateau would be 1.75 times higher than the observed population (predicted $N = 223$).

We also performed the analysis in reverse (i.e., using data from the plateau in the mountain RSF model). We predicted a lower density of grizzly bears when the plateau model was applied on the mountain landscape, which were well below the confidence intervals outlined in Mowat et al. (2005; Table 4). We obtained a slightly larger effect by switching the risk of human-caused mortality. We predicted a decrease to 31 bears (4 bears/1,000 km^2) if the risk of human-caused mortality was similar to what we observed in the plateau. Similarly, swapping coefficients for primary and secondary or decommissioned logging roads, and available land-cover types provided a predicted N of 34–36 bears (5 bears/1,000 km^2). Applying the plateau bear model to the mountain landscape reduced the model-predicted number of bears in the mountains from the observed 363 bears to 42 bears (Table 4).

DISCUSSION

Our results suggest that the availability of foods does not appear to be limiting the density of bears on the plateau. Our habitat use data supported earlier work using stable isotopes, which revealed that plateau bears ate up to 10 times the amount of meat and or ants as mountain bears (Mowat and Heard 2006), whereas body condition indices showed they were considerably heavier and in better condition (Ciarniello 2006). Because body mass and access to meat has been correlated with increased density in grizzly bear populations (Hilderbrand et al. 1999), we expected the density of bears to be at least as high on the plateau as in the mountains. Instead, compared with other DNA-based population estimates in interior British Columbia, grizzly bear density in the mountains was high (McLellan 1989, Hovey and McLellan 1996), but density on the plateau was low (Mowat and Strobeck 2000) despite the high-calorie foods they consumed.

We suggest that the density of bears was affected by bear selection or avoidance of areas close to open roads and the risk of human-caused mortality rather than differences in habitat. We found no evidence that the 4-fold difference in bear density between the mountains and the plateau could be attributed to differences in the respective land-cover types. Indeed, based on differences in land-cover alone, swapping model coefficients predicted a reduction in the number of bears on the plateau. Because we exchanged coefficients for only the variables in question, this suggests the effect of habitat alone cannot account for the difference in the number of grizzly bears between the mountains and the plateau.

Our model-swapping results point to the importance of roads and associated risk of human-caused mortality on bear density between the mountains and the plateau, although the magnitude of response does not account for the entire 4-fold difference. We do not think that the selection by bears for areas closer to the highway on the plateau was a true road "harmful" to population persistence. For example, if we had not previously examined the type and location of mortalities (Ciarniello 2006), we might have improperly interpreted model results by suggesting that increasing the number of roads (e.g., highways on the plateau or primary logging roads in the mountains) on the landscape would result in an increase in grizzly bears. However, if caution is applied during extrapolations, proper application of the link between habitat and density provides a useful tool for examining and quantifying the effects of human activities on grizzly bears.

We suggest that the decrease in density of mountain grizzly bears predicted by the plateau RSF model was also likely due to extrapolation to a landscape with a different suite of available resources regardless of similar underlying selection patterns by bears (Figs. 4, 5). Our results suggest caution when applying RSF results to different areas even though bears in both landscapes had comparable selection for variables that influence food availability in northern environments (i.e., SW-aspect hillshade values, open canopies, and higher greenness scores). Unlike Manly et al. (2002:187) where the presence of galaxiid fish were predicted "very well" at sites where trout were present, we predicted markedly different RSF models in our adjacent areas (Figs. 6, 7), even though both of our models had excellent internal predictive capability and were proportional to the probability of use. Such extrapolations have been completed for grizzly bears in the Bitterroot Mountains of Idaho and Montana, USA, where it was thought that bear densities could be predicted because the RSF models were from landscapes assumed to contain similar available resources (Boyce and Waller 2003). From our results, we suggest that extrapolation of RSF models into areas with a different suite of available resources may be misleading. For example, we had to omit a highly used land-cover type (i.e., alpine) by mountain bears when using the plateau model to predict the number of grizzly bears in the mountains, which likely underestimated mountain-bear density. We likely would have predicted a higher number of bears for the mountain landscape had grizzly bears on the plateau used alpine areas and had we been able to estimate the alpine beta coefficient.

The results of the habitat-based density modeling suggest that simply providing habitat is not enough to sustain grizzly bear populations at their current numbers. We predict that if our current system of forestry management continues, and logging roads remain accessible to the public after the timber has been extracted, the number of bears will decline. We suggest that for grizzly bears to remain viable outside of protected areas, we must maintain places secure from the risk of human-caused bear mortality across each landscape.

MANAGEMENT IMPLICATIONS

The opposite road coefficients and their effect on grizzly bear density suggest that emphasis should be placed on both the level and type of human use on roads rather than road networks. Access management plans should focus on reducing active road density. We suggest using indirect techniques such as removal of a bridge prohibiting human access past the obstruction to influence the extent and location of human impacts. We also suggest placing core secure areas throughout working forests where regeneration of blocks is encouraged to promote early seral bear foods and human access is restricted. For example, we suggest leaving debris in blocks and on roadways to increase opportunities for bears to forage on ants while restricting human access. Similarly, allowing natural regeneration promotes berry-producing shrubs, whereas planting alder (*Alnus* spp.) on roadways restricts motorized access.

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Human Dimensions

Grizzly Bear and Human Interaction in Yellowstone National Park: An Evaluation of Bear Management Areas

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ABSTRACT Wildlife managers often rely on permanent or temporary area closures to reduce the impact of human presence on sensitive species. In 1982, Yellowstone National Park created a program to protect threatened grizzly bears (*Ursus arctos*) from human disturbance. The bear management area (BMA) program created areas of the park where human access was restricted. The program was designed to allow unhindered foraging opportunities for bears, decrease the risk of habituation, and provide safety for backcountry users. The objective of our study was to evaluate human-bear interaction in BMAs and determine if they were effective. We used human and grizzly bear global positioning system location data to study 6 of 16 BMAs from 2007 to 2009. We contrasted data when BMAs were unrestricted (open human access) and restricted (limited human access). We used location data collected when BMAs were unrestricted to delineate a human recreation area (HRA) and determined a daily human active and inactive period. We applied the HRA and daily activity times to bear location data and evaluated how bear movement behavior changed when people were present and absent. We found that grizzly bears were twice as likely to be within the HRA when BMAs were restricted. We also found that grizzly bears were more than twice as likely to be within the HRA when BMAs were unrestricted, but people were inactive. Our results suggest that human presence can displace grizzly bears if people are allowed unrestricted access to the 6 BMAs in our study. Our study provides evidence for the utility of management closures designed to protect a threatened species in a well-visited park. Our approach can be reapplied by managers interested in balancing wildlife conservation and human recreation.

KEY WORDS bear management, displacement, global positioning system (GPS), grizzly bear, human-bear interaction, recreation, *Ursus arctos*, Yellowstone National Park.

Mitigating human disturbance of sensitive, threatened, or endangered species in protected areas is important because they serve as core areas for species recovery and provide a baseline for research (Sinclair and Byrom 2006). Concerns arise when places suitable for wildlife conservation are also popular with people. Human presence can alter wildlife behavior and ultimately change foraging patterns (Steidl and Anthony 2000, Rode et al. 2007), modify intra- and interspecific interactions (Mattson et al. 1987, Skagen et al. 1991, Rogala et al. 2011), increase physiological stress (Creel et al. 2002, Barja et al. 2007), reduce survival (Ruhlen et al. 2003), decrease reproductive output (Ellenberg et al. 2007), and lead to habituation (Herrero et al. 2005). Also, some wildlife species can be defensive over food, personal space, or mates, placing people at risk. Therefore, land managers use various methods to minimize potential human disturbance and reduce human-wildlife overlap (Leung and Marion 1999). One commonly used method is to close or restrict human access to allow foraging, nesting, or breeding behavior (Ashe et al. 2010, Burger and Niles 2012). However, this approach can constrain human recreation or exclude people from popular places and activities. Therefore, considerations must be made when closing or restricting human access. Managers must understand the consequences of human-wildlife interaction and determine if management closures provide adequate protection for animals and people (Whittaker and Knight 1998, Fernández-Juricic et al. 2004, Ashe et al. 2010). They must also determine if specific areas, times, and dates are effectively reducing potential interactions. These considerations allow managers to understand the consequences of inaction and help refine protocols to reduce unnecessary regulation.

Management closures involving moose (*Alces alces*; National Park Service 2013), grizzly bears (*Ursus arctos*; Parks Canada 2013), killer whales (*Orcinus orca*; Williams

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Re-Evaluating Evidence for Past Population Trends and

Predicted Dynamics of Yellowstone Grizzly Bears

2013

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Conservation Letters

Abstract

Sampling effort and demographic assumptions may powerfully shape conclusions about the status of endangered species. We re-examined data sets that suggest recent increases, and hence relative safety from future extinction, of the grizzly bear population inhabiting the Greater Yellowstone Ecosystem, one of the best studied large carnivore populations in the world. We find that inadequate attention to increasing observation effort and also to the life history characteristics of bears is likely to have substantially influenced past analyses of the population's trajectory. We conclude that the GYE grizzly has probably increased far less than generally believed, but also that past analyses have been too inaccurate to allow any firm conclusions about the dynamics or status of this population. The problems we illustrate here apply to many other threatened species, and suggest the need for more careful consideration of observation processes that can shape our perceptions of species' history and status.

and survival senescence are included in the model, we arrive at predictions of somewhat lower or extremely little growth from 1983 to 2002.

Discussion

Confidence in the recent growth and hence health of the GYE grizzle population has largely rested on Fcoy estimates, and their correction via the Chao2 estimator, as well as on the corroborating evidence from demographic rates. In all studies we found that use the Fcoy or Chao2 grizzly data dataset, authors take published estimates of these numbers at face value, as stable estimators of relative numbers. Even the most recent discussion of population trend data have accepted the basic narrative of long term growth of this population, even while, in some cases, concluding that new ways to estimate numbers are needed (Eberhardt and Breiwick 2010, IGBST 2012). Our results suggest the need to reevaluate these apparent trends. We find that a plausible and parsimonious explanation for most or all of the rise in Fcoy estimates is rising search effort, along with possible shifts in the mean and variance in sightability of bears, and that the Chao2 estimator does not meaningfully correct for these issues. Similarly, we show that the approach taken in past demographic analyses of ignoring senescence has likely resulted in overly high population growth estimates, and that incorporation of senescence patterns known for grizzlies results in substantially lower growth estimates for the recent past. These results suggest that a reevaluation of the acceptable mortality limits for bears is also needed.

Three recommendations follow from our work. First, one of several methods should be used to re-evaluate the last several decades of data on bear numbers, and to do so with explicit treatment of the rapidly changing observation effort. The most reasonable approach would be to analyze only the data collected on standardized

Our results cast doubt on the assertion that this population underwent a sharp increase from 1980 to 1995 and has recently stabilized in numbers, or even continued to increase (Harris et al 2007, Eberhardt and Breiwick 2010). Beyond addressing the status of this population, our results illustrate how shifts in the observation process can alter the perception of population viability and risk. As species become rare, or are proposed to be recovered, it is common for formal and informal observation effort to change substantially, and our results caution that unless these changes are carefully analyzed (e.g., Boyd 2010, Kery et al. 2010, Senyatso et al 2013), they can result in substantial misunderstanding of a population's history and hence safety from future extirpation.

BACKGROUND

Over the last 50 years many changes have taken place in the Greater Yellowstone Ecosystem that are likely to influence grizzly populations, and multiple shifts in the knowledge and monitoring of grizzles have also occurred. Some of these changes are illustrated in Figure 1 (also see Supporting Information). The changes most likely to influence our study questions are increasing effort searching for bears each year, increasing bear use of feeding sites where they are easily seen, as well as human recognition of these sites (in particular, high elevation moth aggregations, which have been increasingly used by bears since 1981 and were first recognized as feeding sites in 1986; Mattson et al. 1991), and three trends almost certain to negatively impact bears: loss of trout runs, ongoing collapse of white-bark pines (both important food sources), and increasing rural development.

Virtually all data on the dynamics of the GYE population come from the ongoing work of the Interagency Grizzly Bear Study Team (IGBST). The first data set we consider comprises annual estimates of minimum population numbers, used to infer trends in observation flights, so that effort could be treated clearly in the estimation of relative numbers. Dealing with the shifting observability of bears is more problematic, but even if this issue cannot be fully resolved, the overwhelming effects of effort could be dealt with in such a re-analysis.

Second, demographic rates should be re-estimated with acknowledgement of senescence effects. Given that senescence is well-known in bears, and that past work has used GYE data for the estimation of both reproductive and survival senescence, it is puzzling that these effects have not been included in past estimates of population growth rates. Verbal arguments that senescence is relatively unimportant (e.g., Schwartz et al. 2003) only make sense if age-representative samples of bears are used to estimate all pooled adult rates, which does not seem likely, given that average adult survival estimates suggest large fractions of adults living the maximum age of 30.

Finally, our results suggest that we actually know very little about the past trends of this population, and hence about their likely future fate, especially with rapid declines in multiple food resources and increases in opportunities for human conflicts (Fig 1). While our most basic conclusion is that we cannot confidently assess the past or future trends of this population without further and more careful work, our analyses show that trends in Fcoy and Chao2 are consistent with a population that has grown little, or perhaps not at all, in the recent past, but also that was higher in the past than was realized. In a non-changing landscape, this might imply considerable safety from future extinction. However, with rapidly accelerating impacts, and with Chao2 estimates flattening in the last decade, even as search effort has continued to increase, it is quite likely that the population is now, in fact, declining.

Our basic conclusion is that the perceived dynamics of this population rest on overly-simplified uses of the basic data sets available. While the GYE grizzlies have been for observation effort and realistic treatment of life history patterns) are likely to have resulted in misunderstandings of the data collected, systematic bias in the inferences about the dynamics of this population, and over-confidence in apparent trends. Given the wide-spread use of the Chao and related estimators in many other contexts, our work also suggests that caution is needed in interpreting patterns in this statistic in studies of either population numbers or species richness.

More generally, these results highlight the need to carefully consider shifting observation processes for species of conservation concern. Changing knowledge of a species, increasing attention to its plight, or shifts in individual behaviors in the face of habitat changes can all alter the observation process, with non-trivial effects on estimated population viability (e.g., Hernandez-Manrique et al. 2013). In different situations, these changes might lead to the perception of greater or less risk than is real, compounding other problems of implementing necessary management interventions (Martin et al. 2012). While a great deal of careful attention has been paid to the observation process in many areas of wildlife and conservation biology (Bellemain et al. 2005, Olea and Mateo-Tomas 2011, Chaudhary et al. 2012), this is not always the case, especially with very rare species. Our work highlights that in many circumstances more care is needed in making inferences about population trends, especially when these results are being used in a direct policy context (Mace et al. 2010).

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Red Squirrels Snags 2006

Research Article

Sciurid Habitat Relationships in Forests Managed Under Selection and Shelterwood Silviculture in Ontario

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Abstract

*Although partial forest harvesting is practiced over large areas, managers know little about its impacts on sciurid rodents, particularly on northern (*Glaucomys sabrinus*) and southern flying squirrels (*G. volans*) in the northeastern United States and Canada. We examined habitat relationships of sciurid rodents (northern flying squirrels, southern flying squirrels, red squirrels [*Tamiasciurus hudsonicus*], and eastern chipmunks [*Tamias striatus*]) at 2 spatial scales in managed and unmanaged coniferous and hardwood forests of Algonquin Provincial Park, Ontario, Canada. We live-trapped rodents in 26 northern hardwood stands and in 16 white pine (*Pinus strobus*) stands from 2002 to 2004. Northern flying squirrel and red squirrel densities were significantly lower in recently harvested (3–10 yr since harvest) shelterwood stands than in unmanaged stands. In contrast, southern flying squirrel densities were higher in selection-harvested stands than in old-forest areas. The densities of northern flying squirrels and red squirrels had a strong relationship with the density of large spruce (*Picea *sp.) and hardwood trees and snags in conifer sites. Southern flying squirrel numbers had a positive association with the density of mast trees at the landscape level but not at the stand level in hardwood forests. Eastern chipmunk density had a positive correlation with the volume of old downed woody debris and the stems per hectare of declining trees. We recommend forest managers retain more large spruce and hardwood trees to mitigate the impacts of shelterwood harvesting on northern flying squirrels and red squirrels, and that they maintain high mast availability at the landscape level to ensure the persistence of southern flying squirrels.* (JOURNAL OF WILDLIFE MANAGEMENT 70(6):1735–1745; 2006)

Key words

eastern chipmunk, Glaucomys sabrinus, Glaucomys volans, *habitat use, northern flying squirrel, Ontario, partial harvesting, red squirrel, southern flying squirrel, stepwise regression,* Tamias striatus, Tamiasciurus hudsonicus.

Many jurisdictions in North America, including Ontario, Canada, have selected flying squirrels (*Glaucomys* spp.) as indicators of sustainable forest management practices. This designation has resulted in a relatively large body of research on these and other tree squirrels in landscapes managed under clearcut logging (Rosenberg and Anthony 1992, Witt 1992, Carey 1995, 2000, Martin and Anthony 1999, Cote and Ferron 2001). However, partial harvesting techniques, such as selection and shelterwood logging, have received less attention. These are common silvicultural techniques employed in temperate mixedwood forests in northeastern Northern America. In these systems, forest operators remove a portion of the overstory at relatively shorter intervals (approx. 20 yr), creating a more frequent, but less intensive disturbance regime, than under clearcut logging. The effects of partial harvesting on canopy-dwelling organisms are likely to differ from those resulting from clearcutting because partial harvesting maintains a relatively closed-canopy mature forest throughout the harvest cycle. Unfortunately, only 2 studies have examined the effects of partial harvesting (shelterwood harvesting) on flying squirrels (Waters and Zabel 1995, Taulman et al. 1998). These studies found that relatively high harvest intensities (<10 m^2/ha residual basal area) negatively affected flying squirrel populations. Researchers have not examined the effects of selection harvesting systems in hardwood forests, which typically leave greater residual basal areas than shelterwood logging.

Although partial harvesting systems retain canopy cover on sites, impacts on tree squirrel populations may manifest through other logging-induced changes in forest structure. Partial harvesting typically involves a reduction in the abundance of diseased and dead trees (McComb and Lindenmayer 1999, McGee et al. 1999, Costello et al. 2000) and often results in more homogenous forest structure, with reduced tree density and size (Costello et al. 2000). These changes may be important for arboreal mammals (Gerrow 1996, Carey 2000) and could result in negative effects for cavity nesters (Imbeau et al. 2001).

Most past studies on sciurids have only considered local (site-level) effects; however, organisms may demonstrate different responses to the same factor at different scales (Wiens 1989). Studies in fragmented landscapes suggest that flying squirrels may be sensitive to area effects (Nupp and Swihart 2000) and indicate that large clearcuts may act as barriers to dispersal and movement (Bendel and Gates 1987). Taulman (1999) found that flying squirrels nested in adjacent unharvested forest following partial harvesting, suggesting that the amount and configuration of unharvested stands might modulate flying squirrel responses to forest harvesting. In concert, these studies raise the possibility that local responses to forest harvesting might,

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Fall 2012 YES Meeting Minutes
November 7- 8, 2012
Hilton Garden Inn, Bozeman, MT

Attendees:
Mary Gibson Scott, Grand Teton National Park and the John D. Rockefeller, Jr. Memorial Parkway;
Steve Cain, Grand Teton National Park;
Dan Wenk, Yellowstone National Park;
Jacque Buchanan, Bridger-Teton National Forest;
Chuck Mark, Beaverhead-Deerlodge National Forest;
Brent Larson, Caribou-Targhee National Forest;
Mary Erickson, Gallatin and Custer National Forests;
Joe Alexander, Shoshone National Forest;
Pat Flowers, Montana Fish Wildlife and Parks;
Tom Ryder, Wyoming Game and Fish;
Gregg Losinski, Idaho Fish and Game;
Maureen Davey, Montana County Commission – Stillwater County;
Frank van Manen, USGS Interagency Grizzly Bear Study Team;
Ann Bellman, USFWS – Wyoming;
Mark Wilson, USFWS – Montana;
David Kampenwerth, USFWS – Idaho;
Chris Servheen, USFWS Grizzly Bear Recovery Coordinator;
Scott Jackson, USFS Carnivore Program Lead;
Mike Stewart, BLM - Wyoming.

WELCOME - Mary Gibson Scott – YES Chair

- Introductions
- At the next meeting we will elect a new vice-chair from a Federal Agency.
- Motion to approve spring 2012 Meeting minutes by Jacque Buchanan, Seconded by Maureen Davey. *Motion carried*

IGBST DEMOGRAPHIC WORKSHOP REPORT - Frank van Manen (USGS IGBST)
This is an effort that involved 3 demographic workshops that took place over the last couple of years.

- Recognized the partner agencies involved (NPS, USFWS, FS, WYG&F, MTFW&P, IDF&G, Wind River Fish and Game).

Workshop Objectives
1. Improve estimation of population abundance
2. Update our understanding of grizzly bear vital rates from telemetry data
3. Examine intrinsic and extrinsic factors associated with grizzly bear vital rates
4. Recommend revisions to sustainable mortality limits.

Objective 1: Improve estimation of population abundance

- Current protocol is based on the Knight et al. rule set (1995) which was to distinguish unique females with cubs-of-the-year (F_{COY}).
    - An important part of this rule set is a distance criterion.
- Once we have assessed the number of F_{COY}, we use an estimator (Cherry et al. (2007)) to estimate the total population size of Fcoy - accounting for heterogeneity in sighting probabilities.
- Trend assessed using linear and quadratic regression models to detect changes in the population trend over time.
- This number goes into a flow chart (very complex) and goes through a set of ratios and rates that generates an estimate for the entire population and from that we develop mortality limits for the individual age classes.
- The problem with this approach is that it is biased when there are more and more animals on the landscape – so we know our population estimate is biased low.

The IGBST explored alternatives:

Alternative #1: Ancillary Data Resampling – lead by Dr. Meghan Higgs, MSU.
- This approach was very elegant but unfortunately involved one assumption about the distribution of animals on the landscape that we couldn't deal with effectively.
- As a whole, the group decided that it was too complex and the assumptions too rigorous to meet with this particular data set - so it was not further explored.

Alternative #2: Mark-Resight Technique (Dr. Higgs and Gary White)
- Standardized aerial surveys conducted since 1997
    - 2 surveys/year; all bears counted, focus on F_{COY}
    - Once an animal is seen, telemetry is used to determine if F_{COY} is marked.
    - We know how many marks are on the landscape.
- Proportion of marked F_{COY} seen (0, 1, or 2 times) during both surveys.
- Assume proportions are the same for unmarked F_{COY}

Key to making this technique work is:
- Aggregate the sightability for all the years.
- Should result in an approximately unbiased estimate.

We looked at the assumptions of this technique and generally met them with one exception:
- At moth sites unmarked F_{COY} have greater sightability than marked F_{COY}.
    - Positive bias if this is not accounted for.
- Solution: exclude moth sites from estimate and add in census of F_{COY} based on moth site only surveys.

Mark-Resight Considerations
- Small number of sightings of marked F_{COY} affects precision.

- Annual variation in estimates: smoothing of trend line needed.
- Radio-marked sample of adult females must be maintained.
- Annual observation flights must be continued and moth site-only surveys must be added.

We hope to be done with this by the end of Calendar Year 2012:

- Dr. Higgs and co-authors have submitted a manuscript that has come back with favorable reviews and is now in revision.
- Power analyses to examine trade-offs between sample size, precision, and ability to detect changes in trend over time.
- What is zone of influence for F_{COY} observed at moth sites?

Objective 2 and 3: Update Grizzly Bear Vital Rates

- Update vital rates for 2002-2011 period.
- Compare with 1983-2001 vital rates.
- Evaluate correlations with intrinsic (indicators of density-dependence) and extrinsic factors (e.g., whitebark pine indices).
- 2011 was the first year that the quadratic model had slightly more weight (.51) than the linear model and this triggered a demographic review and is why we reanalyzed vital rates for the 2002-2011 period.
- The system worked – the trigger that was in place for monitoring worked, it forced us to look at what has changed in the population.
- Repeat Monograph analyses – using the exact same methods with one exception – proportion of females with cubs based on Schwartz and White (2008).

Comparison of the two time periods (1983-2001 vs. 2002-2011)

- Cub and yearling survival
  - Reduced for the last decade as compared to 1983-2001.
  - Stronger signal that this is associated with population density parameters rather than a whitebark pine (WBP) effect.
  - Knowing what we know about bear populations, these are the two parameters where we expect density dependent effects to take place if they exist.
- Fecundity
  - Mean litter size and proportion of females with cubs did not decrease that much in the second time period.
    - Stronger signal that this decrease is associated with a WBP effect rather than a population effect.
- Independent bear survival (2 scenarios: Known Mortalities and Assumed Mortalities)
  - Known Mortalities
    - Not much of a change with female survival in this scenario but quite an increase in male survival.
  - Assumed Mortalities
    - More conservative scenario.

    - Male survival has increased quite a bit and female survival is pretty much the same.
    - We have to separate out sub-adult survival for this scenario and we see that this younger age class has reduced survival in this last decade.
    - Did not find a strong association with WBP or population (density) covariates.
- When you use those vital rates to then estimate population growth under the Known Mortality scenario we see that the annual population growth rate has decreased by about 5% over the past decade.
- Under the more conservative scenario, Assumed Mortality, we see that the population is stable, no growth.

There are a couple of independent data sources that support that something changed in the population during the second time period (2002-2011). We asked Dr. Higgs to look at this series of data and to define a change point in the data.

- 2001 is the one spot statistically that rose to the surface.
    - Indicates the same time as our previous analysis showed something had changed.
- The growth rates match very well with our vital rate analysis.
- Additional evidence to support this change comes from Population Reconstruction (capture records).
- How do these estimates of annual population growth (lambda) change around the ecosystem? Based on the Known Mortality Scenario:
    - Lambda in Yellowstone National Park (YNP) = slight decrease
    - Lambda outside YNP but inside recovery zone (RZ) = quite a decrease
    - Lambda outside RZ = increase

When Chuck looked at the proportion of time bears spent outside the RZ in the original Monograph there was a strong correlation with the estimate of annual population growth.

- The more time spent outside the RZ the lower the population growth.

If we look at this for the last 10 years (2002-2011), this line has flattened out quite a bit and we find no statistical difference in these lambda estimates for the three zones.

- Indicating that the population has leveled out across the ecosystem - we are filling up the ecosystem so to speak.
- If you look at residency that is confirmed.
    - Look at the number of radio locations from these different zones and we see a marked increase outside the RZ in the last decade.
- If you look at occupancy based on any type of location data we have about bears in the ecosystem you see that the range has expanded quite a bit.
- There is not a lot of suitable habitat anymore that is not occupied.

Objective #4: Revisions to Sustainable Mortality Limits

Current protocol

Interagency Grizzly Bear Study Team
P. O. Box 1376
Bozeman, MT 59715

1981

BEAR-SQUIRREL-PINE NUT INTERACTION

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Abstract: Whitebark pine (*Pinus albicaulis*) - red squirrel (*Tamiasciurus hudsonicus*) - grizzly/black bear (*Ursus arctos*/*U. americanus*) interactions were studied in Yellowstone National Park and adjacent areas during 1978 and 1979. Bear activity in whitebark pine stands was determined by ground examination of aerial observation sites of radio-instrumented and unmarked bears. Squirrel caching behavior and whitebark pine cone production were recorded in 10 x 25 m plots within bear activity areas. Results indicated that whitebark pine nuts are a preferred food source for Yellowstone bears, constituting 84% of the volume of all scats containing pine nuts in 1979. Pine nuts are used by bears in proportion to their availability. Virtually all pine nuts eaten by bears were obtained from red squirrel caches. Spring bear activity in squirrel middens was earliest on steep, south-facing slopes with 0.3 - 1 m of snow. Yellowstone bears and some captive bears obtain nuts from cones without consuming cone debris.

J. WILDL. MANAGE.

Key words: Black bear, food habits, grizzly bear, pine nuts, red squirrel, whitebark pine, Yellowstone National Park.

Whitebark pine nuts are an important fall and spring food for grizzly and black bears in the Yellowstone area (Mealey 1975, Blanchard 1978) and western Montana (Tisch 1961, Jonkel 1967,

Fwd: Grizzly bears (et al): Add roads, remove co ver, watch mortality increase Tuesday, January 12, 2016 9:59 AM

From: "George Wuerthner" <gwuerthner@gmail.com>
To: "Michael Garrity" <wildrockies@gmail.com>
Cc: "Sara Johnson" <sjjohnsonkoa@yahoo.com>
"Keith Hammer" <keith@swanview.org>

Full Headers Printable View

---------- Forwarded message ----------
From: Lance Olsen <lance@wildrockies.org>
Date: Tue, Jan 12, 2016 at 8:44 AM
Subject: Grizzly bears (et al): Add roads, remove cover, watch mortality increase
To: climateandbiodiversity@bigskynet.org

Biological Conservation Volume 195, March 2016, Pages 24-32
doi:10.1016/j.biocon.2015.12.020

A movement-driven approach to quantifying grizzly bear (*Ursus arctos*) near-road movement patterns in west-central Alberta, Canada
Robin Kite, Trisalyn Nelson, Gordon Stenhouse, Chris Darimont

Keywords
Wildlife movement; Disturbance; Spatial autocorrelation; Zone of influence; Grizzly bear; Roads

Highlights
*Subjective proximity thresholds limit the analysis of wildlife movement patterns.
*Consistency in movement parameters can quantify human influence on wildlife.
*Our method captures consistency in pattern to define the spatial scales of response.
*Response scales around roads varied by age, sex, and season in grizzly bears.
*Seasonal mortality can be linked to near-road movement characteristics.

Abstract
http://www.sciencedirect.com/science/article/pii/S0006320715301993
Advances in GPS telemetry and remote sensing technologies provide researchers with abundant data that can be used to investigate detailed questions about wildlife behavior. Existing methods for linking wildlife movement to remotely sensed landscape data generally rely on the application of subjectively derived distance thresholds to represent proximity (i.e., near or far) relative to disturbance, thereby possibly limiting the scope of research questions and insight gained. We develop an alternative method based on semivariogram modeling that quantifies consistency in movement parameters as a function of distance to disturbance features. Our approach uses movement data to identify spatially explicit scales of wildlife response to linear features. We illustrate the benefit of movement-driven approaches for generating hypotheses about wildlife movement with grizzly bear (*Ursus arctos*) movement data. We concentrate specifically on building hypotheses to explain how seasonal mortality is linked to near road movements. The movement-driven method demonstrated consistency in step length (i.e., spatial scales of response) ranging from 35 m-90 m from roads, depending on age, sex, and season. Given this pattern, our data suggest a minimum vegetation buffer of 90 m to serve as screening cover along roadsides to improve survival in this ecosystem. More broadly, our generalizable method can identify definitive spatial scales of response around human disturbance features in any wildlife system, thereby providing managers with movement-driven insight to reduce impacts on wildlife in multi-use landscapes.

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"But we need to be clear, the large-scale predicament and the emergent socio-economic stresses that we are beginning to experience has very little to with fraud, corruption and the greed of a tiny few. It has a lot to do with our human civilization running into limits."
http://www.resilience.org/stories/2014-03-25/anger-complicity-in-a-time-of-limits

FWS_Pub_CMT_006333

PRELIMINARY ASSESSMENT OF SHORT-ROTATION (70-120 YEAR) TIMBER MANAGEMENT EFFECTS ON FOREST COVER TYPE COMPOSITION AND GRIZZLY BEAR

Interagency Grizzly Bear Study Team

December 10, 1983

Prepared by David J. Mattson

DEFINITIONS AND DESCRIPTIONS

Cover Type Code	Description
ASP	Aspen forms predominant or entire forest overstory
DF	Mixed-age stand of predominantly Douglas-fir
DF1	Sapling to mature stand of even-aged Douglas-fir
LPO	Regenerating stand of predominantly seedling to sapling lodgepole pine
LP1	Usually dense, closed canopy, pole-size to mature, even-aged lodgepole pine stand
LP2	Closed canopy, mature, more or less even-aged lodgepole pine stand
LP3	Usually moderately open to moderately dense, uneven-aged lodgepole pine stands, where lodgepole pine is persistent seral or climax species
LP4	Overmature, moderately open lodgepole pine overstory with spruce and fir well represented in sapling to pole or mature categories
SF1	Sapling to pole-sized stand of typically dense, more or less even-aged spruce and fir
SF	Mature to overmature spruce and fir stand, characteristically uneven-aged
WB1	Sapling to pole-sized stand of predominantly whitebark pine
WB	Mature to overmature, characteristically uneven-aged, stand with greater than 50% of the overstory composed of whitebark pine
NF	Nonforest cover type, including lithic, mesic and wet nonforest areas
LP2/NF	Either a mosaic of LP2 and NF cover types or an open mature lodgepole pine stand over characteristically lush graminoid-forb vegetation
DF/NF	Open stand of uneven-aged Douglas-fir
WB/NF	Open stand of characteristically uneven-aged whitebark pine
DF3	Mature to overmature Douglas-fir with spruce and fir well represented in sapling to pole or mature categories

Variables	Definition
PF:	$\ln\left(1 + \frac{OBS_x}{EXP_x}\right)$, where OBS is the proportion of all feedsites (or daybeds) found in cover type X and EXP is the proportion of cover type X available (proportionate use versus proportionate availability) = preference
EMP. IV:	PF x USE_x, where USE_x is the proportion of all feedsites (or daybeds) found in cover type X = empirical importance value
P-ACT:	Proportion of radio relocations in cover type X at which no sign of feeding was found = in part indicates proportion of time bears were not feeding in cover type X; more appropriately used as an index
DER. IV:	(FVS_x x H_x) ÷ .621; FVS_x (food value score) is derived by the summation of weighted feeding activities known to occur in cover type X. H_x is the diversity index for feeding activity in cover type X. The value, .621, standardizes DER. IV to a maximum value of 1.0. = derived importance value.

Feeding Activity Code	Description
UNG	Feeding on ungulates, primarily elk; both carrion and kills
GOPH	Digging for voles or pocket gophers and their caches
CAMB	Stripping bark from conifers and eating cambium/licking sap
PIAL	Digging in squirrel middens primarily for whitebark pine cones
LOCO	Digging for biscuitroot (*Lomatium* spp.) roots
PEGA	Digging for yampa *(Perideridia gairdneri)* roots
CISC	Grazing thistle *(Cirsium scariosum)*
MUSH	Grazing mushrooms
SHCA	Eating Sheperdia *(Sheperdia canadensis)* berries
CLLA	Grazing and digging spring-beauty *(Claytonia lanceolata)*
ANT-LOGS	Digging in decomposing logs for ants
ANT-HILLS	Digging in ant-hills
FISH	Fishing for cutthroat trout
GRM	Grazing graminoids

Feeding Activity code (cont'd)	Description
WRMS	Digging for earthworms
EQAR	Grazing horsetail (primarily *Equisetum arvense*)
POTA	Digging for *Potamogeton* spp. roots
TAOF	Grazing dandelion (*Taraxacum* spp.)
EPAN	Grazing fireweed (primarily *Epilobium angustifolium* and *E. glandulosum*)
TRFL	Grazing and digging clover (*Trifolium* spp.)
STRW	Eating strawberry (*Fragaria* spp.)
VAGL	Eating huckleberries (*Vaccinium globulare*)
VASC	Eating whortleberries (*V. scoparium*)

Table 1. Feeding activity importance values, food value score and feeding activity diversity index by cover type.

		Feeding Activity														
		.52	(.32)	(.01)	.58	.08	.26	.16	(.01)	(.20)	.37	.13	.13	.01	.96	(.01)	.2
CT	n	UNG	GOPH	CAMB	PIAL	LOCO	PEGA	CISC	MUSH	SHCA	CLLA	ANT LOGS	ANT HILLS	FISH	GRM	WRMS	EQA
ASP	12	.17		.08								.42	.33				
DF1	7	.71										.28					
DF3	9											.89					.11
DF	22	.14		.09	.04							.54	.18				
DF/NF	1															(1.00)	
LP0	2	(.50)										(.50)					
LP1	13	.23		.08					.08	.15	.08	.38					
LP2	56	.23		.12					.07	.05		.38	.11			.04	
LP2/NF	16	.25		.31								.31	.06			.06	
LP3	36	.22			.08	.08			.08		.03	.33	.11				
LP3/NF	2										(.50)				(.50)		
LP4	42	.19		.12	.28							.38	.02				
LP4/NF	1										(1.00)						
SF1	5									(.20)		(.80)					
SF	92	.05		.15	.54							.29	.01				.02
SF/NF	3											(1.00)					
WB1	2				(1.00)												
WB	30				.87							.13					
WB/NF	2				(.50)	(.50)											
NF	236	.05	.24	.004		.10	.19	.06			.02	.01	.12	.03	.09	.01	.00

Table 2. Assessment of probable short-rotation timber management effects on grizzly bear feeding values or opportunities.

	Successional status index	Z*	Cover type	PF	EMP. IV	P-ACT	DER. IV	
Early	1	0	LPO	(.19)	(.002)	(.33)	(Low)	Mid elev
		3	ASP	(2.40)	(.12)	(.25)	(.37)	Low elev
	2	0	WB1	(.20)	(.001)	(.00)	(Low)	High elev
		-	SF1	-	-	(.17)	(.12)	High elev moist
		2	LP1	(.25)	(.01)	(.24)	(.59)	Mid elev
		2	DF1	(3.35)	(.09)	(.22)	(.39)	Low elev
	3	2	LP2	(.42)	(.13)	(.37)	(.52)	Mid elev
		2	LP2/NF	(2.87)	(.24)	(.41)	(.41)	Mid elev riparian (moist)
	4	2	LP4	(.34)	(.06)	(.29)	(.69)	Mid-high elev
		-	DF3	-	-	(.47)	(.08)	Low elev
	4.5	0	WB/NF	(.10)	(.001)	(.50)	(Low)	High elev
		3	LP3	(.65)	(.10)	(.26)	(.63)	Mid elev dry
Late		2	DF	(1.00)	(.11)	(.40)	(.39)	Low elev
		0	DF/NF	(.10)	(.0005)	(.50)	(Low)	Low-mid elev dry
(Climax)	5	1	WB	(.36)	(.04)	(.22)	(.32)	High elev
		4	SF	(1.51)	(.56)	(.26)	(.78)	Mid-high elev

Cover types likely to be propagated by short-rotation (70-120 yr) management:

LPO - 0
LP1 - 2
LP2 - 2
SF1 - 0
DF1 - 2

Average importance score (Z): 1.2

Cover types likely to be reduced or eliminated by short-rotation management:

LP4 - 2
DF3 - 0
LP3 - 3
DF - 2
SF - 4
(WB) - (1)

Average importance score (Z): 2.2 (2.0)

*Number of criteria (0-4) establishing importance of each cover type.

Table 3. Assessment of probable short-rotation timber management effects on grizzly bear daybed value or opportunities; 1977-78 daybed data.

	Successional status code	Z*	CT	PF	EMP. IV	
Early	1	0	LPO	.34	.01	Mid elev
		2	ASP	2.40	.13	Low elev
	2	1	WB1	1.10	.06	High elev
		-	SF1	-	-	High elev moist
		0	LP1	.28	.02	Mid elev
		0	DF1	-	-	Low elev
	3	2	LP2	.68	.52	Mid elev
		2	LP2/NF	2.40	.13	Mid elev riparian (moist)
	4	1	LP4	.46	.15	Mid-high elev
		-	DF3	-	-	Low elev
	4.5	0	WB/NF	.41	.03	High elev dry
Late		0	LP3	.40	.04	Mid elev dry
		2	DF	.95	.20	Low elev
		0	DF/NF	-	-	Low-mid elev dry
Climax	5	1	WB	.59	.17	High elev
		2	SF	1.69	1.00	Mid-high elev

Cover types likely to be propagated by short-rotation (70-120 yr) management:

LPO 0)
LP1 0)
LP2 2) Criteria "score" (0-2)
SF1 -)
DF1 0)

Average importance score: .50

Cover types likely to be reduced or eliminated by short-rotation management:

LP4 1
DF3 -
LP3 0
DF 2
SF 2
(WB) 1

Average importance score: 1.25 (1.20)

*Number of criteria (0-2) by which C.T. is "important."

RESULTS

Table 1 lists the occurrence of feeding activities by cover type and the relative importance (table value) of any feeding activity by cover type. Food value scores (FVS) and diversity index (H) for feeding activity are also listed by cover type. Food item weights associated with each feeding activity are listed above feeding activity code.

Sapling to mature, typically even-aged stands of Douglas-fir and lodgepole pine (DF1, LP0, LP1, LP2, LP2/NF) derive a substantial portion of their importance from ungulate (elk) feeding. Most often this feeding occurs in the spring coincident with elk winter range. Typically mature to over-mature spruce-fir and whitebark pine stands (SF, WB, WB/NF) derive substantial importance from feeding on whitebark pine nuts in middens. Almost all forest cover types are associated with digging in logs for ants.

Tables 2 and 3 list cover types and corresponding numeric evaluations of importance (PF, EMP. IV, P-ACT, DER. IV). Variable Z is the number of numeric evaluations substantiating the importance of corresponding cover types. Values of Z ranging from 3 to 4 reliably indicate the high importance of corresponding cover types. An average value of Z is also calculated for groups of cover types either likely to be propagated or reduced by short rotation management.

DISCUSSION

These results are substantive although not final. Several feeding activities not discernible by feed-site analysis are not accounted for by the derived importance values. Later analysis will account for these more elusive feeding activities; derived importance values will likely not change significantly, however.

The use of several criteria (two for daybed cover-type use and four for feeding activity cover type use) lends weight to the assessment of cover type importance to grizzly bear. Actual importance is a probable function of feeding and cover opportunity as well as intangibles such as learned or habitual behavior not readily attributable to site characteristics other than location. Therefore, "importance" is only estimated by this assessment.

Data from the entire grizzly bear range in and around Yellowstone Park was used. The nature of cover type use appears to be more or less consistent throughout grizzly bear range. Availability of cover types differs, however. Consequently, in any one area, grizzly bear may eat more ants, for example, in one cover type than another based strictly on availability.

Use of the Douglas-fir (DF and DF1) and probably aspen (ASP) cover types very likely reflects the availability of winter-killed or weakened ungulates (primarily elk) (Table 1). Therefore, the "importance" of these cover types may be a substantial function of coincidence with elk winter range.

Tables 2 and 3 results show that the reduction of overmature and mixed-age stands over a broad area in favor of early successional, even-aged immature stands would very likely be detrimental to grizzly bear. Average importance score (Z) for early successional cover types (LP0, LP1, DF, SF1, LP2) is less than for late successional or climax cover types (LP3, LP4, DF, SF, WB). On the other hand, the assessment does not indicate elimination or reduction of early successional cover types would benefit grizzly bear either. Rather, grizzly bear utilize almost all cover types, with a preference towards late successional types. Maintenance of area-wide stand diversity approximating natural conditions, including late successional and climax stands, is a management objective suggested by this assessment.

Effects of access and cover type juxtaposition are factors not covered by this assessment. Both factors are influenced by short rotation timber management and likely have critical influence on grizzly bear well-being and survival.

6/7/91

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MICRO-SCALE SECURITY AREAS FOR YELLOWSTONE GRIZZLY BEARS

Rationale

Historically, North American grizzly bears did not persist in areas with even moderate densities of humans and livestock (Mattson 1990). Grizzly bears continue to be killed by humans for numerous reasons, most commonly because of conflict over common resources (e.g., livestock and other human foods) or because the bear is percieved as a threat (Craighead et al. 1988). Human-bear conflicts often revolve around bears habituated to humans as they pursue natural or human-food related feeding opportunities near humans (Meagher and Fowler 1989; Mattson et al., in prep.). By inference, as human access and acitivites increase in an area, increasing numbers of bears are forced to come into contact with and tolerate humans as they use their natural habitat. Circumstantial evidence suggests that this results in an increased frequency of bears habituated to humans (McArthur-Jope 1983; Mattson 1990; Mattson et al., in prep.), and increased bear mortality either because of chance encounters with humans, where humans claim self-defense, or because management agencies judge the bear's tolerance to be a risk to humans (Mattson et al., in prep.).

Almost certainly, existing grizzly bear populations survived where frequencies of contact with 19th and 20th-century technological humans were very low. Although grizzly bear mortality can be regulated and influenced by changes in human attitudes, it seems unlikely that humans will generally tolerate much contact with an animal, like the grizzly bear, that is a direct competitor for foods (Mattson 1990) and a potential hazard (Herrero 1985). Thus there is a strong case for preserving areas where grizzly bears will be secure from encounters with humans; where bears can meet their energetic requirements while at the same time chosing to avoid people. Such areas would foster the wary behavior in grizzly bears that most managers consider to be desirable. In conjunction with management of attractants around human facilities and town sites, security areas could help to significantly reduce the incidence of poached bears, and bears killed out of self-defense or killed by management agencies because of undesirable behavior.

Parameters

Existing analyses of telemetry data from radio-collared grizzly bears provide a basis for estimating dimensions and spacing of security areas, suitable for the scale of an individual bear's home range. Wary bears consistantly avoid areas within 2 km of major roads and 4 km of major human developments or townsites (Mattson et al., in prep.). Bears that use areas near roads and developments exhibit disrupted foraging behavior out to the same distances (Mattson et al. 1987). These patterns logically suggest that security areas should be a minimum of 4-8 km in diameter to provide any buffer for bears exhibiting the preferred wariness of humans. Ideally this core area should be surrounded by an additional buffer corresponding to the average 24-48 hour foraging radius of grizzly bears, to allow bears additional space to meet foraging requirements without confronting people. The average 48-hour foraging radius of 3 adult female grizzlies monitored a total of 8 times was 0.96 km (Haroldson and Mattson 1985). Thus, micro-scale security areas should be an absolute minimum of 6 km in diameter or 28 km^2 (ca. 5,400 acres). If these areas were roughly pentagonal in shape, radii would vary from a maximum of 3.4 to a minimum of 2.8 km.

Ideally, spacing of these security areas would allow near full use of habitat by bears wary of humans. Thus distances between neighboring security areas would be no more, on average, than 2X the mean 48-hour foraging radius. After accounting for angular irregularities, this distance averages 1.8 km. If an entire analysis area or bear home range (averaging 884 km^2 for an adult female life range [Blanchard and Knight, in press]) were apportioned by these guidelines, 58 % would be security areas. Under less favorable conditions, existing or planned security areas should contiguous and part of a functional network rather than be scattered and isolated.

Identification

No absolute criteria are avialable for identifying security areas. However in a general sense security areas should receive very little or no use by humans. This may be due to poor human access, and could be achieved in candidate areas by effective road closures (i.e., closures that discourage even foot travel). Security areas may vary temporally as well as spatially as human use varies. Back-country or non-roaded areas should not automatically be considered security areas. Some back-country areas receive high densities of human use, especially during big-game hunting seasons. Optimally, security areas consist of areas not only secure from human access but also areas containing high value bear habitat.

Functionally, security areas can be identified by a series of map overlays done either manually or by a GIS. The optimal sequence will be (1) an initial screening with respect to existing open roads, (2) a subsequent screening to identify high-priority security areas containing high-quality bear habitat; and (3) a final screening to identify canditate areas where sufficient road-closures could create a security area.

To facilitate use and recognition of security areas by bears, these tracts should be secure for a minimum of 5 and preferably 10 years. Although not as critical, security areas should be secure during all seasons, but especially during the season of peak value to bears.

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USE OF LODGEPOLE PINE COVER TYPES BY YELLOWSTONE GRIZZLY BEARS

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Abstract: Lodgepole pine (*Pinus contorta*) forests are a large and dynamic part of grizzly bear (*Ursus arctos*) habitat in the Yellowstone ecosystem. Research in other areas suggests that grizzly bears select for young open forest stands, especially for grazing and feeding on berries. Management guidelines accordingly recommend timber harvest as a technique for improving habitat in areas potentially dominated by lodgepole pine. In this paper I examine grizzly bear use of lodgepole pine forests in the Yellowstone area, and test several hypotheses with relevance to a new generation of management guidelines. Differences in grizzly bear selection of lodgepole pine cover types (defined on the basis of stand age and structure) were not pronounced. Selection furthermore varied among years, areas, and individuals. Positive selection for any lodgepole pine type was uncommon. Estimates of selection took 5–11 years or 4–12 adult females to stabilize, depending upon the cover type. The variances of selection estimates tended to stabilize after 3–5 sample years, and were more-or-less stable to slightly increasing with progressively increased sample area. There was no conclusive evidence that Yellowstone's grizzlies favored young (<40 yr) stands in general or for their infrequent use of berries. On the other hand, these results corroborated previous observations that grizzlies favored open and/or young stands on wet and fertile sites for grazing. These results also supported the proposition that temporally and spatially robust inferences require extensive, long-duration studies, especially for wide-ranging vertebrates like grizzly bears.

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Key words: cover types, feeding activity, forest management, grizzly bears, habitat ecology, habitat selection, lodgepole pine, resource selection, Yellowstone National Park, *Ursus arctos*

Lodgepole pine is the most common overstory tree in the Yellowstone ecosystem. About 67% of forests in Yellowstone National Park (Despain 1990) and 48% of forests on adjacent public lands (Greater Yellowstone Coord. Comm. [GYCC] 1987) are dominated by this species. The structure and age of lodgepole pine forests have been influenced in recent years primarily by stand replacement fires, mountain pine beetle (*Dendroctonus ponderosae*) epidemics, timber harvest, and increasing dominance of more shade tolerant species (Cole and Amman 1980, Lotan and Perry 1983, McGregor and Cole 1985). Major mountain pine beetle epidemics swept through the western-half of the ecosystem from the 1960s through the mid-1980s (McGregor and Cole 1985, Despain 1990). Timber harvest was increased on national forests to salvage merchantable beetle-killed timber, reduce fire hazard, and support local timber industries (Cole and Amman 1980, Cole 1985). About 68,000 ha of lodgepole pine forests on public lands were harvested during this period, typically by clearcutting (Cole 1985, GYCC 1987). An additional ca. 562,000 ha of the ecosystem were partially or completely burned by wildfires during 1988, including substantial areas that had been occupied by mature lodgepole pine forests (Romme and Despain 1989, Schullery 1989).

Because Yellowstone's lodgepole pine forests are extensive, I anticipated that changes in their manage specific areas with allowance for seasonal or annual variation in use. Making the critical assumption that sampling bias was spatially and temporally uniform, use of years and analysis areas as sample units allowed me to estimate variation in these explicit dimensions, and also provided estimates of selection that were specific to a given time or place.

Grizzly Bear Activity

By negative evidence (i.e., lack of feeding and bedding sign or coincidence with a trail), grizzly bears used the recently disturbed LP0 type primarily for travel. These relatively open sites presumably facilitated movement, although I question whether this result would be repeated with data collected 20 years after the 1988 fires, after most currently standing snags had fallen (Lyon 1984). As expected by studies elsewhere, grizzlies also made greatest use of the open LP0 and LP/NF types for grazing forbs and graminoids, especially on wetter, more fertile sites. Based on these results, I confidently rejected H_{a3}. On the other hand, and again as expected by open stand conditions, grizzlies strongly avoided the LP0 type for bedding. Together, these observations suggested that grizzly bears derived less net energy from their use of the LP0 type especially compared to their use of the LP1, LP, and LP/NF types.

With the exception of mushrooms, grizzly bear use of the highest quality foods in lodgepole pine forests was not associated with forest structure, and in the case of berries and ungulates, was not contingent upon habitat type. This result was partly a function of small sample sizes and low statistical power, especially in the case of berry and whitebark pine seed use. Only 15 instances of berry use were recorded at radiotelemetry locations in lodgepole pine forest during 16 years of data collection. This infrequent use of berries agrees with the infrequent presence of berries in grizzly bear feces from the Yellowstone area, especially in contrast to the feces of grizzlies in northwestern Montana and southern Canada (Mattson et al. 1991). Nonetheless, these 15 instances of berry use were not obviously related to successional stage, and are a tentative basis for not rejecting H_{a2}. In the case of whitebark pine, it is implausible, a priori, that use was not related to stand age. Whitebark pine does not produce seeds under typical stand conditions within 40 or even 100 years of stand replacement disturbance (Mattson and Reinhart 1994). However, forest structure probably had little effect on seed use after canopy closure.

MANAGEMENT IMPLICATIONS

These results do not support the premise that widespread conversion of lodgepole pine forests to early successional stages would benefit grizzly bears in the Yellowstone area. There is no rationale here for the systematic harvest of older stands to increase bear use of berries. Yellowstone's grizzlies consume few berries probably because of climatic constraints especially upon globe huckleberry production (Mattson et al. 1991, Mattson and Reinhart 1994). There is also evidence that in areas of Yellowstone where berry consumption is more common (as on the Targhee National Forest), globe huckleberry is substantially diminished by total overstory removal, especially on drier or more exposed sites (Martin 1983, Orme and Williams 1986). On the other hand, these results support the proposition that grazing opportunities for bears can be increased by logging on wetter sites, although it is highly improbable that grazing opportunities limit grizzly bear densities anywhere in the Yellowstone ecosystem (Bunnell and Hamilton 1983, Pritchard and Robbins 1990, Mattson 1997*b*).

Even so, these results suggest that Yellowstone's grizzlies would not respond strongly to any changes in lodgepole pine forest structure, per se, with the following 2 provisos. First, I cannot address the effects of changes in landscape-level structure of lodgepole pine forests beyond the range of what was analyzed here. This point holds for effects of the 1988 fires, especially given the attrition of snags expected during the next 2 decades (Lyon 1984) and the possible complications to movement posed by such an accumulation of large woody debris (Fancy and White 1985). Second, because whitebark pine seeds are a high quality food, and because seed production is limited to mature or near-mature trees, grizzlies will be affected adversely by the removal of lodgepole pine-dominated stands that contain productive whitebark pine (Mattson and Reinhart 1994).

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Tuesday, December 15, 2015 9:57 AM

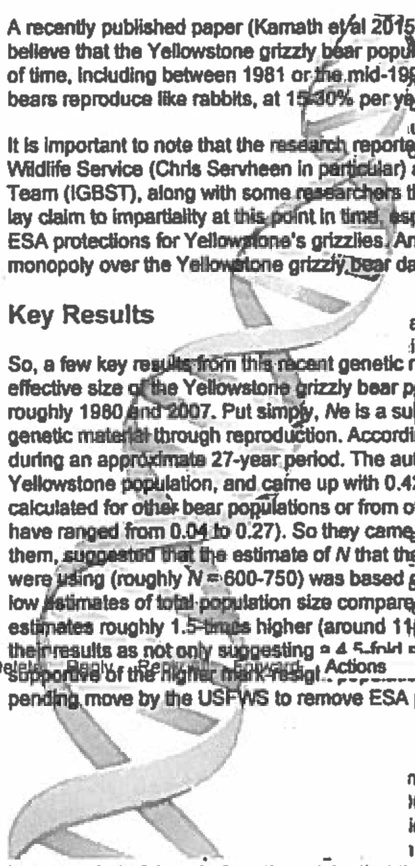
From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "SJ Johnson" <sjjohnsonkoa@yahoo.com>

Full Headers Printable View

Sarah, here is David's response on my web site and the link. doak is trying to get a colleague with genetics expertise to take a look too... best, Louisa

http://www.grizzlytimes.org/#!the-genetics-game/cjgja



A recently published paper (Kamath et al 2015), featuring genetics, could lead a naive reader to believe that the Yellowstone grizzly bear population had increased by 4.5-fold during some period of time, including between 1981 or the mid-1990s and 2002. (More on that a little later.) Or, that bears reproduce like rabbits, at 15-30% per year. This doesn't pass the laugh test.

...simply surrendered him-or herself to ... biased authors. But there are some major logical problems with the results prese... authors. Moreover, the deployed methods are yet another instance where arcane ... based on numerous often dubious assumptions, are offered up as some sort of

It is important to note that the research reported in this paper was funded by the US Fish & Wildlife Service (Chris Servheen in particular) and authored by the Interagency Grizzly Bear Study Team (IGBST), along with some researchers they invited to participate. None of these players can lay claim to impartiality at this point in time, especially when it comes to the agenda of removing ESA protections for Yellowstone's grizzlies. And all have fought tooth and nail to maintain a monopoly over the Yellowstone grizzly bear data.

Key Results

So, a few key results from this recent genetic research: This paper claims that the genetically effective size of the Yellowstone grizzly bear population (denoted Ne) increased 4.5-fold between roughly 1980 and 2007. Put simply, *Ne* is a subset of the total population (denoted N) contributing genetic material through reproduction. According to this research, *Ne* increased from 100 to 450 during an approximate 27-year period. The authors also calculated the ratio of *Ne* to *N* for the Yellowstone population, and came up with 0.42 to 0.66, which is substantially higher than ratios calculated for other bear populations or from other data (other results, at least the point estimates, have ranged from 0.04 to 0.27). So they came in more than twice as high. Which, according to them, suggested that the estimate of *N* that they were using was too low. In fact, the estimate they were using (roughly *N* = 600-750) was based on the Chao2 method, which is known to produce low estimates of total population size compared to another method (mark-resight) which produces estimates roughly 1.5-times higher (around 1100; see The Numbers Game). So they interpreted their results as not only suggesting a 4.5-fold population increase since 1980, but also as being supportive of the higher mark-resight population estimates ... of which is clearly supportive of a pending move by the USFWS to remove ESA protections for Yellowstone's grizzlies.

...researcher, Craig Miller, also estimated *Ne* for the Yellowstone grizzly population ... including a dissertation published in 2004 (for a summary of his results relative to ... at *Ne* for Yellowstone's grizzly bear population was around 80 between roughly 1... is. But Craig also estimated *Ne* for the 1990s using data collected from Yellowsto... this period that was a bit more than 100. On top of this, consider that the mark-re... grizzly bears suggests that there was no increase (possibly even a decrease) bet... Remember that these mark-resight estimates are recommended by the research...

...for the 1990s (Craig Miller's estimate) and accept that there has not beer... 2002, then the 4.5-fold increase in *Ne* offered by the Kamath paper would have had ... to 2002. That is roughly a 21% per annum rate of increase...which is unheard of in ... ever recorded have been closer to 10-15% per annum. And there is no indicatio... ...the Yellowstone grizzly bear population ... (most [illegible] biased) estimates of growth are

...ng advocates is to either reject Craig Miller's estimate for the 1990s or reject the e... ...002. The latter move would be in defiance of some pretty overwhelming evidence. ...id-1990s, you would be looking at sustained annual rates of increase for the perio... ...the most ardent apologists for population growth don't claim this rate of increase ... long a period of time. In fact, they claim that the turn-around for the population didn't happen until the late 1980s. And you woul... having to explain why you rejected Craig's estimate.

Illogical Extrapolations

Another problem has to do with the tacit assumption, embedded in the Kamath paper results, that *Ne* is essentially perfectly cor... with *N* over time. Meaning, that because (presumably) *Ne* has increased by 4.5-fold, then total population size did as well. Whic... bear managers have quickly claimed. This gets us into The Numbers Game.

Pretty much all of the available population estimates suggest that the Yellowstone population grew little if at all up until the 199... (see The Numbers Game). However, there are two population estimates from the 1990s that provide a helpful benchmark. One ... around 1992, and came in at 325 (with a huge confidence interval). Another was made for 1997, and came in around 420. So le... that the population itself (*N*) grew by 4.5-fold since either 1992 or 1997. This would mean a current population of between 1500

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1900 bears, and a growth rate between either 1992 or 1997 and 2002 of around 15-30%. All of these numbers are totally out of Not even close to what's biologically possible, or in line with any other available evidence. The highest population estimates cur being bandied about are 1000-1200 and (as noted earlier) the most optimistic population growth rates come in at only 4-7%.

The Problem of Models

The most logical conclusion from all of this is that there is something fundamentally flawed about the research reported in the K paper. Is this possible? Answering this question gets into the nature of the methods used to estimate *Ne* and the assumptions u which those methods and related models are built. Suffice it to say, the methods are amongst the most arcane out there and bu veritable tower of assumptions about genetic, demographic, and sampling processes. For a brief overview see the paper by Ha colleagues. Even a cursory overview of how an analysis might go wrong gets into the deep dark weeds. But perhaps it is suffici say that the methods and derivative results are pretty far abstracted from any tangible reality. So, yes, the analysis done by Kla warrants skepticism on the basis of first principles and the logical violations outlined above.

Let's Play Monopoly

But this critique needs to end, yet again, with the problems that inevitably arise whenever any group of scientists holds a monop scientific inquiry. In short, such circumstances debar any confidence in the results produced by such a group—such as the IGB: the scientists it invites to participate. The only way to produce reliable scientific results is to have multiple independent (and con scientists double-checking each others' work, whether by repeating experiments or reanalyzing data in instances where there is one possible dataset. And such is the case for Yellowstone's grizzly bears, where there is only one Yellowstone population, anc one set of data. The extent to which the IGBST and its primary funders have fought to maintain a monopoly can only invite susp especially in instances such as this one where some of the results defy logic and any other available evidence.

Fwd:

Thursday, December 17, 2015 10:40 AM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

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All, here is David's first blog... enjoy! Louisa

http://www.grizzlytimes.org/#!Grizzly-Sardine-Can-Blues/c1ou2/5672e2ab0cf2fb0fe5b252ad

Grizzly Sardine Can Blues

December 17, 2015

|

David Mattson

We can't support any more bears. We've got bears coming out of our ears. We've reached carrying capacity
Such is the purported state of grizzly bears in Yellowstone.

Sound familiar? It should. For those of you who have been paying attention to the rhetoric voiced by agency spokespeople during the last few years, you will have heard the refrain about too many bears in too little

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space over and over again. In fact, this claim undergirds much of the argument made by the US Fish & Wildlife Service (FWS) and state wildlife managers for removing ESA protections from Yellowstone's grizzli (which is to say, "delist" them). Just a few weeks ago, in a conversation with environmentalists, FWS Directo Dan Ashe emphasized that "the Yellowstone ecosystem just can't hold any more bears." Frank van Manen, leader of the Interagency Grizzly Bear Study Team (IGBST) put it another way: "we are packing more sardines in the sardine can."

If you were inclined to defer to the agency experts, you would probably heave a sigh and say, "well, I guess we just need to move ahead with delisting Yellowstone's grizzly bears. We've reached carrying capacity." In fact, that is the outcome that the agency experts probably hope for and expect.

Well...I would argue that there is cause to question the experts in this instance. In fact, there is an increasin and to my mind wholly justified tendency for the public to question experts, especially when there is reason suspect that they are politically motivated. And there is ample evidence for political motivations behind what we are hearing from spokespeople for all of the agencies involved in managing Yellowstone's grizzly bears, including the government's scientists (for more on this follow this link and this link).

Unpacking the Sardine Can

To start, it is worth unpacking the concept of "carrying capacity" given that this term is being bandied about with such abandon by government scientists and managers. To listen to van Manen you would think that the number of grizzlies able to live in the Yellowstone ecosystem (i.e., "carrying capacity") is a static food-relate attribute of the land contained within a fixed box. Hence the sardine metaphor.

The truth could hardly be more different. Even accepting the notion of fixed boundaries, within those bounds the food-related capacity of any given acre varies from month to month and year to year. In fact, we've seen a long-term and sustained decline in the availability of high-quality foods that has almost certainly caused a decline in the intrinsic food-related capacity of Yellowstone's core habitat to sustain grizzlies. Cutthroat trout have nearly disappeared; whitebark pine has been substantially reduced; and elk herds have declined, som dramatically. That's three of the four legs of the food stool that has supported Yellowstone's grizzly bears (th fourth leg is army cutworm moths). All of the evidence belies any claims, implicit or otherwise, that food-related carrying capacity is static. If anything, the sardine can has shrunk in size.

More importantly, carrying capacity is determined not only by the food-driven rate at which females produce cubs, but also by the rate at which grizzly bears of all description die. So, mortality is a major part of the equation. And guess what causes most deaths of adult grizzlies in Yellowstone? People do. So our lethality to bears is a big part of the carrying capacity equation. Which comes down to our collective attitudes and behaviors, and the extent to which they translate into dead bears. More on this a little later.

And the rate at which young bears (i.e., cubs and yearlings) die also matters. As it turns out, death rates of cubs and yearlings have increased substantially of late, primarily due to "natural" causes—including bears killing bears. Again, to listen to van Manen you would think that young bears in Yellowstone are dying in increasing numbers simply because of increasing densities of adult grizzlies, likening these adults to a bunc of equally lethal pinballs bouncing around according to some random Brownian motion in a fixed space. Toc many damn sardines. More on this a little later as well.

The notion of fixed boundaries to an immutable box is a final major fallacy in the government's "carrying capacity" argument. The capacity of Yellowstone's ecosystem to support grizzlies is determined not only by the per acre abundance of foods and the unit area lethality of the landscape, but also by the extent of the area within which bears can live and contribute to the larger population. And clearly, this extent has increase substantially over time. We have grizzlies living in roughly twice the area we had them in the 1970s. Moreover, there have been multiple analyses, by government and independent scientists alike, showing tha there is ample habitat with natural foods sufficient to support grizzly bears in places where grizzlies have no yet established themselves: the southern Wind River Range, the Palisades area, the Centennials, and more

A Social Sardine Can?

And, yet, the FWS and their minions claim that the box is fixed, invoking yet another pseudo-idea, that of "social carrying capacity." More to the point, the FWS claims that there is no more space for grizzlies in Yellowstone because "people" will not accept them anywhere else. So now we have gone from the simplisti static, food-based, box of van Manen's to a concept fielded by the FWS that begins to grapple, at least on th face of it, with the aspect of carrying capacity that relates to human attitudes and lethality.

But who are these "people" anyway, and who queried them, how? As it turns out, "people" amount to ranchers, outfitters, and others with enough political clout to bully not only state wildlife managers, but also the FWS. As a result, "social carrying capacity" has been defined by a few regressive energy executive as well as some sheep and cattle ranchers who don't want to live with grizzlies, not by the people whom the agencies are supposed to be serving under the rubric of the public trust. "Social carrying capacity" turns out to be a convenient political ruse, not any sort of on-the-ground reality determined by the attitudes, choices, and behaviors of a wide range of relevant people. In fact, the sardine can could be a whole lot bigger.

The Density Ruse

So, let's return briefly to the density issue, which is closely tied to the notion of carrying capacity and blithely invoked to explain rising deaths of young bears. Have grizzly bear densities actually increased, as van Manen claims? And, if so, are high densities the reason for increasing death rates among young bears? We the answers are No, and Probably Not. As it turns out, the Yellowstone grizzly bear population has not increased to any extent during the last 15 years. It may have even been declining since 2007 (see some infi on all of this here and here). At the same time, the distribution of this population has increased by over 40% Ergo, density axiomatically decreased—not increased. Which debars a connection between deaths of cubs and yearlings and densities of adults, as such. More likely, cubs and yearlings are dying in greater numbers because their moms have turned increasingly to eating meat (including livestock) to compensate for losses whitebark pine and cutthroat trout. And meat-eating is an incredibly hazardous undertaking for any bear, especially those with vulnerable young (for more information follow this link).

Putting this all together, we have a narrative being promoted by our government officials that is based on a simple-minded, poorly conceived, and highly-politicized notion of this thing called carrying capacity.

Moreover, the government narrative is at odds with the best available evidence. All of this politicized spin being billed under the rubric of "science" is clearly designed to support the agenda of delisting Yellowstone's grizzly bears.

Out of the Sardine Can

In fact, what we have is a picture altogether different from that being painted by government managers and scientists. We have a box with highly fungible and potentially much expandable boundaries within which we have experienced major declines in food-related carrying capacity, but within which, also, we've increased carrying capacity attributable to major beneficial changes in human attitudes and behaviors—related to increased sanitation, other controls on human foods, and reductions in livestock. Bear densities have declined, at the same time that distributions have expanded and grizzlies have turned to eating alternative foods, many of which are concentrated on the peripheries of the current ecosystem. This is not a sardine ca being crowded by ever greater numbers of sardines.

But perhaps the most important point is one that features us—and what goes on between our ears. History has shown that perhaps the most important determinant of the numbers of grizzly bears that can live in any given area is our behaviors. In turn rooted in our worldviews; how we see ourselves in relation to the world and to the creatures in it. There is no doubt that our European ancestors saw no place for grizzlies in the world. And they proved it by killing 99% of all grizzlies in 98% of all the places they once lived. But we are n our ancestors.

We have the chance to create a world where grizzlies and people coexist in places where we probably can't even imagine it is possible. But, believe me, it is possible. Grizzlies have proven that they can tolerate us ar live among humans with few problems. The famous mother grizzly of Pilgrim Creek, bear #399, is one amor many that has proven the point (for some more information on her see this Christian Science Monitor article) It comes down to us, and the grace and compassion we can bring to coexisting with grizzly bears.

Director Ashe and Dr. van Manen are wrong. We can have more grizzly bears in Yellowstone. And we shou have.

--
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- Why Delisting is a Bad Idea: http://www.grizzlytimes.org/#!delisting-a-bad-idea/c15sd

- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sy
- Cool Video: The Changing World of Yellowstone Grizzly Bears: https://m.youtube.com/watch?feature=share&v=VggRHZr0bNQ

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Fwd: Grizzly Times, Hunting to Scare Grizzlies? Dr. David Mattson, 1.13.2016 Thursday, January 14, 2016 11:19 AM S

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Hi All,

Another from David,

Seems timely given the mounting rhetoric on grizzly hunting. Louisa

http://www.grizzlytimes.org/#!Hunting-to-Scare-Grizzlies/c1ou2/5695cb910cf263fc5a89bf50

Hunting to Scare Grizzlies?

January 13, 2016

|

David Mattson

Kill grizzly bears to make them afraid of humans. This idea has gotten a lot of air time in recent years as one of several justifications for removing endangered species act (ESA) protections for Yellowstone's grizzlies, most recently in a January 10th editorial by the Editorial Board of the Bozeman Chronicle. Delisting (another term for removing ESA protections) would clear the way for a sport hunt managed by the states of Wyoming

Montana, and Idaho, which are currently squabbling over a share of the sport kill in anticipation of devolutio of authority from the federal government to them.

The idea of instilling fear in grizzlies through a hunt is emotionally charged because there have been severa bear-caused human fatalities in the Yellowstone region during the last few years. The media, of course, has duly sensationalized each death. So the idea is to have sport hunters kill grizzlies to teach them to fear people. As a result, there will be fewer bear attacks. People will be safer. To borrow a phrase from Valerius Geist, a proponent of hunting bears, people will have "freedom of the woods." Hmm. Well...

Although some people obviously consider hunting to be a self-evident guarantor of human safety, there is, i fact, little or no empirical support for this proposition. There is essentially no evidence that a sport hunt instil fear in grizzlies. The proposition also defies logic and everything that we otherwise know about grizzly bear If nothing else, how can a dead bear learn anything? A point that has been made by many others besides me.

Having made my assertion, I should probably elaborate, noting, though, that a thorough review of the evidence (or lack thereof) would probably bore you, the reader, to tears. Which means that I will confine myself to a (relatively) brief and necessarily cursory overview. So put on your seat belt and send me your questions if you want more detail.

Grizzly Bear Fundamentals

The first point to be made is that grizzly bears exist at a baseline characterized by a greater tendency to respond aggressively to perceived threats compared to other bear species. Steve Herrero, a Canadian behavioral ecologist, was the first to speculate that this aggressiveness was rooted in the evolutionary histo of grizzlies. Grizzlies (AKA brown bears) evolved in open environments where safety depended on standing your ground and intimidating or beating back any threat. (You can find more on the formative evolutionary environments of grizzlies by following this link and this link).

Even so, grizzlies can exhibit a high degree of tolerance for humans and other bears that might otherwise b viewed as threats. You can see this in coastal environments where bears have become highly socialized an tolerant of each other because of frequent interactions with conspecifics concentrated around salmon spawning streams. Or among bears that have interacted enough with benign humans to internalize a less fear-based response—a process known as "habituation."

So, a couple of key points are worth making at this juncture: First, grizzlies seem to be hard-wired genetical to deal with perceived threats aggressively. Second, and perhaps more importantly, grizzlies can become less reactive to people, not as a result of heightened fear, but rather as a result of the opposite. These fundamentals alone call into question the logic of using hunting to increase human safety. Killing grizzlies (and, as I address later, we've done a lot of that even with ESA protections) is unlikely to rewire the genetic underpinnings of their behavior; and less fear rather than more is probably going to make people safer, especially if we continue to reduce the number of circumstances (e.g., garbage around human residences o hunters near freshly-killed elk) that allow people to do things that trigger aggressive responses from even th most tolerant bears. More on that a little later.

Welcome to the Vacuum

Another important point to make up front is that we know virtually nothing about the behavioral and motivational responses of bears to hunting, certainly little that is grounded in research. The closest we come is a study out of Scandinavia showing that hunted brown bears increased their night-time activity, with little obvious relevance to whether humans were thereby safer. A coarse-grained review by Jon Swenson, a Scandinavian bear researcher (and, for a while, a Montana biologist), suggested that hunted European brov bears might be more wary, but that this possible behavioral response was trumped by whether food was available near people. Bears were likely to seek out food regardless of whether they were hunted or not, which goes back to my point immediately above about garbage and hunter-generated carrion.

By contrast, we know quite a bit about the negative and often unintended consequences of selectively hunting adult males of various carnivore species. Insofar as livestock depredation and other conflicts are concerned—including the type that could lead to human injury—we tend to get more rather than fewer. This is because adolescent males tend to gravitate to areas where the dominant resident males have been removed by hunters. And adolescent male bears are notoriously prone to push human boundaries. Moreove sport hunting tends to disrupt the social order of bear populations, which often results in more cub-killing by males and, with that, unexpected and sometimes problematic population declines.

So, a couple more points: There is little or no direct evidence that bears become warier with hunting, and certainly no evidence that people become safer. On the other hand, conflicts with people can paradoxically increase, along with unanticipated declines in bear populations. So, again, not a compelling case for the benefits of sport hunting.

The Immediate Circumstances of Attacks

At this point I return to Steve Herrero, who has spent essentially his entire professional career looking at the immediate circumstances of bear attacks, with emphasis on behaviors of the involved people and bears. His research shows that most attacks by grizzlies happened because people were moving quietly (or sometime rapidly) through the woods, or because the bears were lured to the vicinity of people by food. The former se of circumstances led to surprise encounters. Adult females with cubs almost invariably responded aggressively to protect their young. On the food front, when grizzlies spent more time around people the od mounted of us doing something stupid (or unintentionally risky), or of bears simply getting curious. So, surprise encounters and foods that attract grizzlies are prominent drivers of risk. And, again, foods were typically in the form of garbage or the remains of elk and moose that hunters had recently killed. Only rarely did Steve find that outright predation was a factor, typically as night attacks on people camping in tents.

This comports with what we know of circumstances surrounding the bear attacks that have occurred around Yellowstone. Several people have been injured or even killed because they were moving quietly through the woods (sometimes jogging), surprising a female that then defended her cubs, or a bear that defended a carcass, or, in the case of some hunters, just simply a bear that defended its personal space. But surprise encounters are a central theme. Then there were the few night attacks on people in tents, probably (or, in o instance, almost certainly) by bears that were in the habit of checking out campgrounds for food. So, the foc factor. And then there were the odd-balls, such as the botanist killed by an enraged boar grizzly recovering from being trapped and drugged (again, a surprise encounter), or the photographer killed by a frantic female that he had pushed beyond endurance. In this latter case, the stupidity factor.

So, given these concrete circumstances, what can be deduced about prospects for increasing human safety by hunting grizzlies? Well... unless you kill most bears, you are not going to substantially reduce the chance of surprise encounters. Nor, as I noted earlier, are you going to eliminate the hard-wired tendency for grizzli to defend themselves from a perceived threat when surprised, especially when guarding cubs or food. Hunting also does not deal with the availability of foods near people. And we would be foolish to expect that grizzlies will be less motivated to procure food because we are hunting them. Obtaining food is another harc wired drive for bears, especially during the late summer and fall when they are putting on fat to get through hibernation. And hunting does not address the stupidity factor.

As a bottom line, when looking at the reasons why people get injured by grizzlies, I am hard-pressed to divi how hunting will increase human safety. Unless, perhaps, we kill most of the grizzly bears in and around Yellowstone, as our European ancestors did.

And We've Already Run the Experiment

On top of this, we've already run the experiment and found no evidence that it has worked. Which is to say, we've functionally been hunting Yellowstone's grizzlies for years, complete with gunshots, blood, gory remains, and lots of associated human scent and sign. Think, for example, of all the grizzlies that have beer killed by big game hunters during surprise encounters or in conflicts over hunter-killed elk—increasingly. Or by ranchers and other people in defense of life-and-property. Functionally this is probably little different from a sport hunt, except in the heads and on the balance-sheets of wildlife managers. We've essentially been hunting grizzlies in Yellowstone, without any evidence that it has affected human safety one way or another

And What About Yellowstone Park?

And then there is Yellowstone National Park, where a substantial proportion of the bear attacks and resulting human fatalities have occurred. There will not be a sport hunt in the Park, even with a delisted grizzly bear population. So, even assuming the unlikely--that hunting would cause bears to avoid us becaus they are more fearful, how will this effect be propagated through over 2 million acres in the core of the ecosystem? From hunted bears on the periphery, which will presumable be killed by humans at a higher rat compared to protected bears living in the core--in Yellowstone Park? In the face of a resulting net movemen of bears outward rather than inward? Unlikely.

But We Probably Can Make Bears Fear Us Even More

At this point I've run much of the gauntlet of evidence and found little or no support for the idea that human safety can be enhanced by sport hunting. At least the traditional kind of sport hunting that focuses on killing trophy-worthy adult males, with little overt selection for bears known to be involved in conflicts with humans.

But there is a kind of hunting that probably could have an effect, and to understand this potential we need tc look at what we know about relations among bears. More specifically, bears fear other bears, more than the probably fear humans. And there are reasons for this.

For example, there is ample evidence that fear motivates adolescent bears and females with young cubs to exert themselves to avoid other adults, even to the extent of spending more time near people. In fact, we ca unintentionally serve as shields of sorts for bears that are seeking protection from aggressors of their own species. There are several reasons for all of this. Adolescents are often chased by solitary adults, and on occasion, probably thrashed to within inches of their lives... sometimes even killed. Likewise, cubs can be killed during encounters with adult grizzlies other than their mother, a phenomenon known as infanticide. All of this entails unpleasant experiences and interactions that happen on a relatively frequent basis, which fosters learning and even generalization of experiences.

So, what does this have to do with how we might hunt Yellowstone's grizzlies, with the objective of engendering fear of humans? It seems pretty obvious. You selectively hunt and kill cubs--but leave the mothers alive. And you trap bears, with an emphasis on adolescents, club them to within inches of their live and then let them go. And do this repeatedly and for as many bears as possible.

Having suggested such an approach, I find the prospect disgusting. But, then, I am sure there are some hunters out there that would relish the prospect of killing cubs and torturing trapped bears. The same hunter that have done something similar with wolves and coyotes. But the backlash from the broader public would be predictable, dooming such a hunting strategy to an early demise. Moreover, not unlike abused dogs, abused bears might, in fact, be even readier to attack a human should a surprise encounter happen.

Still, if the issue really is just simply about making grizzlies fear us... Or is the ardent promotion of sport hunting really about something else?

Concluding Thoughts

Take the case of Terry Schramm, a self-styled cowboy from Pennsylvania working for self-styled out-of-stat ranchers who own the Walton Ranch in Jackson Hole. Or the legislator-rancher Albert Sommers who raises cows in the Upper Green River of Wyoming thanks to heavy subsidies by environmentalists (in the form of a $1 million plus conservation easement), by the federal government (in the form of well-below-market-price grazing fees), and by the state of Wyoming (in the form of generous compensation for any cows that he claims are lost to predators). In a recent Wyofile article, both of these icons of the modern west explicitly or implicitly suggested that their fraught lives would be a lot less problematic if there were many fewer grizzlies in a lot fewer places.

The fundamental idea here is to kill grizzlies. The more the better, by whatever means, including sport hunting. My point being that many of those who promote hunting as a means of increasing human safety ar probably using the argument simply as cover for getting rid of grizzly bears that they see as an incovenienc or an affront to their personal ideologies.

Without having the space here to elaborate, I will leave you with a related thought. Perhaps those promoting the sport hunting of grizzlies are doing so viscerally, out of a place of fear and a derivative need to dominate and subjugate anything that subjectively threatens them. A dark place. A place that gives rise to the logic of owning lots of guns and affirming self through the act of killing—especially beings such as grizzly bears that somehow impart a sense of potency. Or that the habit of killing is so deeply ingrained personally and institutionally that it is impossible for most hunters and wildlife managers to conceive of wildlife managemen in any terms other than hunting. Possibly? Certainly not from a place informed by an objective and thorough examination of the evidence.

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- Why Delisting is a Bad Idea: http://www.grizzlytimes.org/#!delisting-a-bad-idea/c15sd
- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sv
- Cool Video: The Changing World of Yellowstone Grizzly Bears: https://m.youtube.com/watch?feature=share&v=VggRHZr0bNQ

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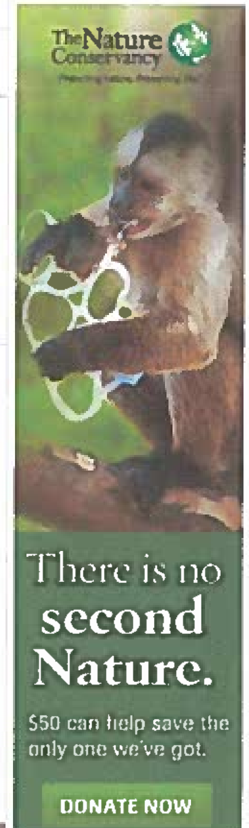


Fwd: Grizzly Times: The Grizzly Bear Moth-Eating Jig, Dr. David Mattson Thursday, April 14, 2016 12:29 PM

From: "Louisa Willcox" <wildgriz1@gmail.com>

To: "Louisa Willcox" <wildgriz1@gmail.com>

Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Friends of Grizzly Bears,

David does it again – weaves a great story about the magic of bear ecology, here involving moths. Even I was surprised at some of his connections, like with cows...

For the bears,

Louisa

http://www.grizzlytimes.org/#!The-Grizzly-Bear-MothEating-Jig/c1ou2/570d59610cf29719a3860158

The Grizzly Bear Moth-Eating Jig
April 14, 2016
|
David Mattson

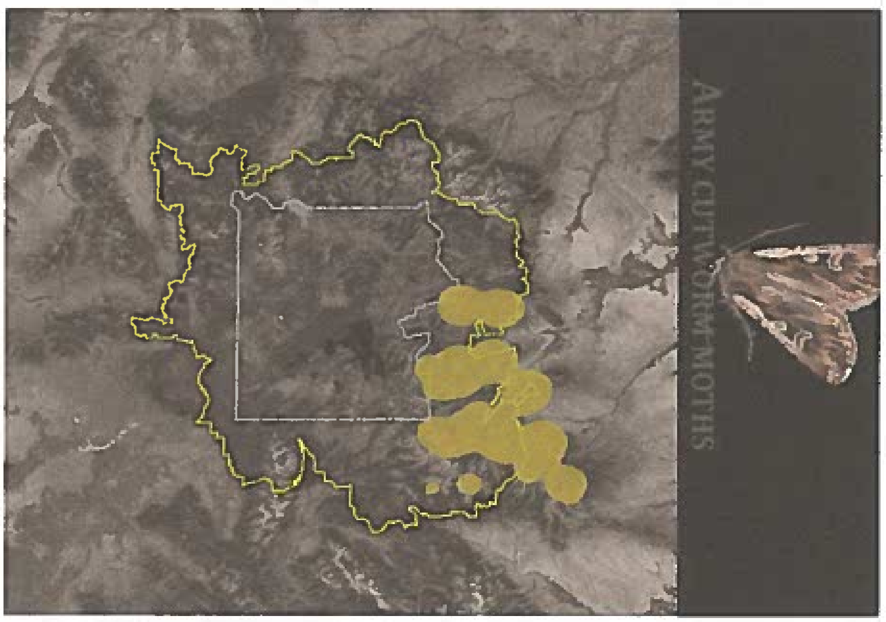
Public domain photo by the US Geological Survey

Back in 1955, a year after I was born, John Chapman published a paper in the journal Ecology describing a peculiar feeding activity by bears in the Mission Mountains of western Montana. Grizzlies and black bears were both rummaging through alpine talus fields—eating something. As it turned out, they were slurping up both ladybird beetles and army cutworm moths that had concentrated there during the summer to either aestivate or to feed on nectar of high-elevation flowers. Twenty plus years later John Craighead and his colleagues described grizzly bears gobbling up cutworm moths from under overturned talus rock in alpine reaches of the Scapegoat Mountains roughly 50 miles east of the Missions. Barring a few published descriptions by early mountaineers, these were the first and—for a while—the only written descriptions of bears feeding on cutworm moths.

In the late 1970s and early 1980s, when I first started working for the Interagency Grizzly Bear Study Team (IGBST), the Missions, Scapegoats, and their resident grizzlies seemed pretty remote and exotic, albeit only about 250 miles away as the crow flies from where I was working in the Yellowstone ecosystem. The idea that grizzlies in Yellowstone might feed on cutworm moths seemed equally strange and exotic. In fact, if anyone had asked me in 1985 if bears in Yellowstone ate moths I would have said "nope, no evidence of it at all," and this after having covered over 1000 miles by shanks mare each of the previous six years in this ecosystem. But one year later I would be proven wrong.

In July of 1986 the IGBST's veteran pilot, Dave Stradley, located a radio-collared grizzly camped on a talus slope straddling an alpine divide in the Absaroka Mountains east of Yellowstone Park. It seemed odd. Next year the same bear camped in the same location. Moreover other radio-collared bears were found camped on yet other remote talus slopes in the same area. This anomaly catalyzed an expedition to find out what the heck was going on, consisting of myself, Bart Schleyer, Carrie Hunt, and Kurt Inberg. Carrie and Kurt were employees of Wyoming Game & Fish at the time. What we found were multiple grizzlies on the site where our collared bear had first been located during 1986, all rummaging through alpine talus, feeding on slithering masses of cutworm moths. The same phenomenon was documented on three more sites during 1987 and 1988 thanks to strenuous efforts by IGBST field crews that included Gerry Green, Jamie Jonkel, Dan Reinhart, and Doug Dunbar.

Since then, ever more grizzlies have been found on ever more alpine sites gobbling up cutworm moths—a total of 31 now. All of the sites are above 10,000' elevation, all in the Absaroka Mountains east and southeast of Yellowstone Park (see the map immediately below). Anymore, it is probably not too much of a stretch to claim that the majority of the bears in this part of the ecosystem spend the majority of their time between mid-July and mid-September on these exceedingly remote moth sites eating moths gathered to feed on nectar of alpine flowers. The moths feed primarily during nighttime, dawn, and dusk, and spend the remainder of the day in the chilly cracks and crevices of angular rocks accumulated on talus slopes, which is where the bears find them. Why congregate like this in a cold microenvironment if you are moth? Who knows, but I suspect it has something to do with avoidance of predators and parasites—barring bears.

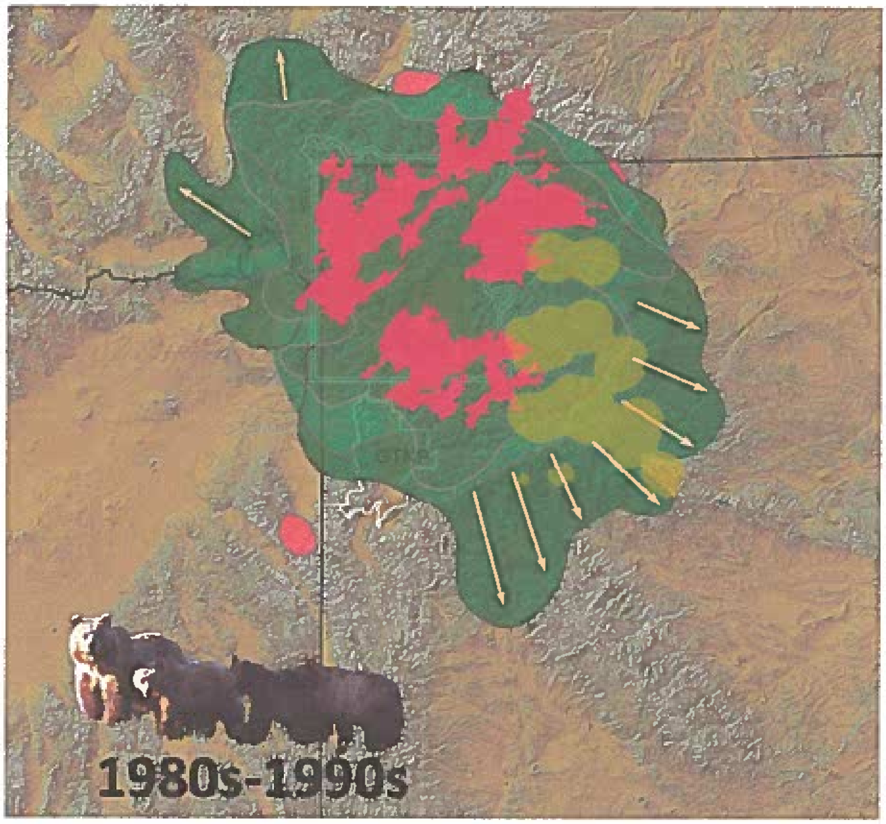


The moth sites in this map are encompassed by the yellowish-green blobs, with reference to the boundary of Yellowstone National Park (the gray line) and the Primary Conservation Area (PCA) for Yellowstone's grizzly bears (yellow line). There are three take-away points: first, all of the moth sites are in the Absaroka Mountains on the east side of the ecosystem; second, all of the sites are outside of the Park; and, third, some moth sites are outside of the PCA.

Since the early 1990s the phenomenon of grizzly bears eating moths in Yellowstone has been pretty thoroughly documented thanks to an initial research publication in 1991, successive papers by Steve and Marilyn French (in 1994) and Sean O'Brien (in 1998), and annual updates in the IGBST's Annual Reports. Of even greater import, bears eating moths in the remote and startlingly beautiful alpine haunts of Yellowstone has captured the public imagination, aided and abetted by the efforts of several enterprising and sometimes intrusive film crews, most notably from BBC. Their footage has probably been seen by millions of people worldwide thanks to being aired as part of the BBC series *Planet Earth*.

I could wrap things up here and leave this simply as an interesting bit of history. But I can't help think of larger ramifications for Yellowstone's grizzly bears, our current approaches to research and management, and a pending move by the US Fish & Wildlife Service (USFWS) to remove Endangered Species Act (ESA) protections for this bear population. Making these kinds of connections seems to be my plight.

As it turns out, the burgeoning use of moth sites by Yellowstone's grizzly bears probably explains much of the major increase in their distribution to the east and southeast that occurred between the mid-1980s and 2000. The match between where we find moth sites and where the greatest expansion occurred is uncanny. Remember, too, that this period was on the heels of the 1988 wildfires that killed nearly 30% of cone-producing whitebark pine in the core of the ecosystem (whitebark pine is another key source of bear food). The map below shows details of all this.



Here the moth sites are superimposed on the distribution of Yellowstone's grizzly bears, represented by the green shading, with the beige arrows denoting areas of major increase in distribution between the 1980s and 1990s. The red represents areas burned during the epic wildfires of 1988. There are two takeaway points: first, the largest increase in distribution was in the direction of the newly-discovered moth sites; and, two, these increases also occurred after the 1988 fires had taken out roughly 30% of the whitebark pine in the core of the ecosystem.

Coincidentally, dramatic increases in grizzly bear activity on moth sites have also contributed to inflated estimates of growth for the Yellowstone grizzly bear population. Bears on moth sites are almost certain to be seen by airborne researchers and managers out looking for females with cubs-of-the-year (COY) at their side. By contrast, bears engaged in virtually any other kind of feeding activity are likely to be seen only 1%…at most only 40% of the time… when somebody flies over. Which is to say, grizzlies have, in the net, become one heck of a lot easier to see in the last couple of decades, at the same time that managers and researchers have quadrupled their efforts to find bears. Given that sightings of females with COY are the foundation of all estimates of population trend, these estimates have correspondingly been inflated upward—because of increased search effort, but also by the increased ease of sighting females with COY on moth sites. Perhaps an unintended consequence? Maybe not.

Less positively for Yellowstone grizzlies, their expansion into Wyoming in apparent pursuit of moths has taken them deeper into cow country. Not surprisingly, a considerable portion of the increasing number of conflicts between grizzlies and ranchers over cattle (another nutritious bear food) in the Yellowstone ecosystem is concentrated not too far downslope from a number of moth sites. So, perhaps paradoxically, increasing exploitation by grizzlies of a food in some of the most remote parts of the ecosystem (that is, moths) has probably contributed to a substantial increase in the numbers of bears dying downslope and down-elevation in retaliation for predation on livestock.

And having expanded well inside the frontier of regressive Wyoming politics and attitudes, the arrangements proposed by the US Fish & Wildlife Service as part of a package for removing ESA protections from Yellowstone's grizzly bears would leave some of the moth-eating grizzlies high and dry outside the zone of meaningful protections, and the rest exposed to the potential excesses of Wyoming Game & Fish Department's post-ESA management. Wyoming is frothing at the mouth to institute a sport hunt, and there is going to be no easier bear for a hunter to find (albeit a little difficult to reach) than one camped on a moth site. The Department also seems dedicated to the proposition of reducing grizzly bear densities on the ecosystem periphery, which coincides with the areas containing all of the moth sites—this as part of a putative strategy for reducing levels of livestock depredation. The net prospects for moth-eating grizzly bears are not good. And, as I pointed out a little earlier, these moth-eaters comprise a substantial portion of the total Yellowstone grizzly bear population.

In light of all this, it only makes sense to expand the Primary Conservation Area out to include all of the known moth sites, and then protect these sites and a substantial surrounding area from any sport hunting. Better yet, don't hunt delisted grizzlies. And, even better yet, don't remove ESA protections and, instead, prioritize the protection of these grizzly bears that are otherwise at the edge of all protections, and the most exposed of all to thuggish enclaves of Wyoming citizenry.

But, I have one more thought that arises from the grizzly bear x moth phenomenon. As I noted before, the emergence of moth-eating by Yellowstone's grizzly bears was a complete surprise for me. And I've continued to be surprised by all sorts of things that I never could have imagined: the 1988 Yellowstone wildfires; the near-extirpation of cutthroat trout in Yellowstone Lake by climate change and predation by an illegally introduced predator; the widespread losses of whitebark pine to an unprecedented bark beetle outbreak driven by a warming climate; massive declines in virtually all of the ecosystem's elk herds, also driven in part by climate change; the emergence of Chronic Wasting Disease as a threat to larger mammals in the ecosystem; and more... The theme here is surprise and, barring cutworm moths, all of the surprises have so far been (more or less) really unpleasant.

The take away? Perhaps humility is in order for our federal and state wildlife managers—humility and caution. As is, I see little evidence of either in the USFWS's rush to remove ESA protections, Wyoming Game & Fish's eager embrace of lethal grizzly bear management, or the cocky attitudes of the current crop of IGBST researchers. What to do? I don't know exactly, other than sure as Hell don't turn the keys to the car over to Wyoming any time in the near future.

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IMPLICATIONS OF SHORT-ROTATION (70-120 YEAR) TIMBER MANAGEMENT TO YELLOWSTONE GRIZZLY BEARS

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Mattson, D. J., and R. R. Knight. 1991. Implications of short-rotation (70-120 year) timber management to Yellowstone grizzly bears. U.S.D.I. Natl. Park Serv. Interagency Grizzly Bear Study Team Report 1991A.

Executive Summary: We synopsized analyses of grizzly bear (*Ursus arctos horribilis*) use of forest successional stages and assessed changes in habitat value and bear mortality risk likely associated with short-rotation timber management in the Yellowstone area. We rejected our null hypotheses and concluded that, on the broad scale, habitat value will likely decrease and mortality risk increase under short-rotation management regimes. The Yellowstone grizzly bear population has not yet been proven viable. Consequently, any timber harvest and associated activities should be assumed to have a negative affect on the bear population unless proven through appropriate consultation to not contribute to mortality risk or habitat degradation. We also suggest measures to mitigate for timber harvest effects in instances where harvest has been deemed appropriate or is on-going.

INTERAGENCY GRIZZLY BEAR STUDY TEAM REPORT: 1991A

STATEMENT OF PURPOSE

Interagency Grizzly Bear Study Team Reports are intended to facilitate the timely transfer of research results and perspectives to management of Yellowstone's grizzly bear population. These reports are also a forum for presenting results that, while not suited for journal publications, are relevant to management. We have made every effort to validate the information presented here and have subjected this report to critical review.

INTRODUCTION

With the more aggressive pursuit of increased U. S. Forest Service timber production goals, conservation groups and Federal agencies in the Yellowstone area have expressed concern over the consequences of expanded timber programs to the grizzly bear population. More intensive management typically entails relatively foraging on whitebark pine seeds do not produce sufficient numbers of seeds to sustain bear use until stands reach approximately 100 ± 20 years of age". They also concluded that "... there seems little that active timber management can do to augment bear use of whitebark pine in drier portions of the Rocky Mountains, although in areas where timber harvest has already occurred or is being planned for other reasons, judicious planting of whitebark pine in mixtures with other tree species will likely benefit bears in the future".

Discussion. - The Yellowstone area and its associated bear food habits and habitat use are unique among most occupied grizzly bear habitat in North America. It resembles drier portions of the Rocky Mountain Front in Montana, where ungulates and pine seeds supersede fleshy fruits as critical fattening foods, but is most similar to central Siberia, in the vicinity of Lake Baikal (Mattson and Jonkel 1990, Mattson et al. 1991). Most general principles regarding the relationship of bear food production to silvicultural practices, derived from other bear habitat, are not extrapolable to Yellowstone.

Specifically, the idea that food availability increases in early stages of forest succession does not generally hold in the Yellowstone area. In most places Yellowstone grizzly bears rely on ungulates and pine seeds for fattening. Use of these 2 foods is associated primarily with older forest stands. Use of globe-huckleberry fruits, important in some areas, and sweet-cicely roots, important during some years, has also been associated with the semi-shaded and typically patchy conditions of mid- to late-successional stands. Conversely, grazed fibrous foods that predictably increase in abundance in the earliest stages of forest succession cannot be efficiently digested by bears (Bunnell and Hamilton 1983, Pritchard and Robbins 1990) and are not critical to the nutrition of most Yellowstone grizzly bears (Mattson et al. 1991). Further, foliage in open areas such as recently harvested timber stands predictably cures sooner than foliage in shaded areas (Graham 1978, Hammond 1980) and, thus, would be effectively available for a shorter period.

Productivity of grizzly bear habitat may be enhanced by the edge effect associated with timber harvest. Analysis of telemetry data has suggested that Yellowstone grizzly bears make disproportionally heavy use of areas near natural forest-nonforest ecotones (Blanchard 1983, Knight et al. 1984). This weighting of forest-nonforest edges is responsible for virtually all of the increased habitat value associated with timber harvest activities by the Habitat Submodel of the Yellowstone Cumulative Effects Model (Weaver et al. 1986). However virtually all of the data that suggest this phenomenon were collected from bears using natural rather than man-made ecotones, in remote wilderness areas. Natural timber edges tend to differ from edges associated with timber harvest because natural edges more often reflect natural ecotones and attendant greater vegetational diversity. Thus we do not have a high degree of confidence in the extrapolation of results from these data to man-made edges in areas with road access.

Problems may be associated with extrapolating analyses of cover type use to timber-harvest scenarios because, as with edge effect, most data were collected in wilderness areas, from bears using mosaics that resulted from fire and natural ecotones. However, most studies suggest that, if anything, silvicultural treatments have historically often decreased productivity of early successional stages compared to conditions following fire (Mattson 1990). Thus, our data would likely be biased towards over-estimating bear use of early-successional cover types, and reinforce the conclusion that timber harvest has, on average, degraded habitat conditions.

With appropriate future silvicultural prescriptions, grizzly bear habitat values (not considering mortality risks) could be maintained or even enhanced in places. This is most likely in subalpine fir (Abies lasiocarpa) habitat types below the whitebark pine zone, where lodgepole pine is the primary successional species, and with treatments other than clear-cutting. Timber harvest will most likely degrade grizzly bear habitat, regardless of treatment, in the whitebark pine zone and on Douglas-fir habitat types.

Grizzly Bear Mortality Risk

Most (80-90%) grizzly bear mortality in the Yellowstone area, 1975-1990, has been human caused (Craighead et al. 1988, Mattson and Reid 1991). Much of this mortality has been a consequence of humans killing food-conditioned or human-habituated bears that were either judged to be a risk or vulnerable because they exposed themselves to poachers (Craighead et al. 1988; Mattson et al., in prep.). Human-habituation and, in some cases, food-conditioning predictably increase as the frequency of encounter between bears and humans increases (McArthur-Jope 1983; Mattson et al. 1987; Mattson et al., in prep.). Thus any increased exposure of bears to humans predictably results in a longer-term increase in mortality risk to bears, partly mediated through the process of habituation (Mattson et al., in prep.). Under optimal conditions, bears may be able to minimize mortality risk over the short-term despite increased exposure to humans, by avoiding humans as much as possible (as along the North Fork of the Flathead River [McLellan and Shackleton 1988]). However, as in Yellowstone, habituation and associated mortality risks will predictably increase with longer-term equilibration (McLellan 1990).

Implementation of short-rotation timber management requires increased access by humans. Thus more widespread practice of intensive silviculture in occupied grizzly bear habitat predictably increases mortality risk to the population. This holds whether bears die because poachers are able to use roads (legally closed or not) built to harvest timber, or whether bears that die elsewhere under diverse circumstances are at least partially habituated or food-conditioned to humans by exposure around cutting units.

Few data from the Yellowstone area relate directly to timber-harvest effects on mortality, because timber harvest has not been historically wide-spread and because linkage of bear deaths with ultimate causes is difficult. However 2 analyses have bearing on mortality associated with timber harvest. Blanchard et al. (in prep.) analyzed changes in distribution of the Yellowstone grizzly bear population between the periods 1973-79 and 1980-89. Distribution increased the most to the east and southeast, in areas with the most wilderness acreages, and remained static to the west, where timber harvest and associated road building has been most extensive. These patterns suggest a causal relationship between extensive timber harvest and a static distribution, especially in light of gains achieved in wilderness areas.

Another analysis (Mattson 1991) looked at grizzly bear mortality associated with roaded and non-roaded areas, management jurisdiction, and primary developments in the Yellowstone area. Data from Craighead et al. (1988) and Knight et al. (1988, 1989) were used. This analysis showed that the unit-area mortality rate (1983-1990) associated with areas impacted by secondary road systems, typical of areas managed for timber harvest, was second only to the rate associated with primary developments. The secondary-road rate was also 5.0X that associated with Yellowstone National Park's back-country. Virtually all non-livestock-related mortality (51.4% of the total) associated with secondary roads was attributable to poaching, either with (12 of 22) or without (10 of 22) an attractant.

This deductive analysis is the best available for anticipating the effects of increased timber harvest on grizzly bear mortality risk. Because the argument presented is based on well-documented phenomena, we feel confident in its validity pending further analysis of mortality data.

CONCLUSIONS

Based on our assessment of mortality risk and grizzly bear use of different forest successional stages, we reject both of our null hypotheses and conclude that, on the broad scale, mortality risk will likely increase and habitat value will decrease as short-rotation timber management increases in the Yellowstone area. This conclusion will not hold for all specific circumstances, but is warranted when considering the welfare of the entire grizzly bear population, in keeping with the premises of cumulative effects analysis. This conclusion is relevant to long-term viability of the Yellowstone grizzly population because, as stated in the introduction, no one has yet proven that the population is not in danger of extinction. Given these considerations, current or planned timber harvest within Yellowstone's occupied grizzly bear habitat should be assumed to have a significant negative affect on the Yellowstone grizzly bear population until proven not to contribute to increased mortality risk or habitat degradation.

More research is needed to directly assess the effects of timber harvest on Yellowstone grizzly bears. These studies would ideally include both telemetered bears and site-specific transect studies of bear sign and foods. Such studies are underway under auspices of Wyoming Fish and Game and Montana State University, although research specific to conditions on the Targhee National Forest will still be lacking even with completion of these studies.

Increased administrative data collection is also needed. Ideally this would take the form of data collected along transects prior to timber harvest and any proposed mitigations, followed by post-harvest data collection along the same routes. Only by efforts such as this will we be able to evaluate the consequences of management actions, specific to given sites and treatments.

Mitigation. - Under circumstances where timber harvest has been deemed suitable or is already underway, several measures could be taken that would considerably mitigate for the associated risks to bears:

(1) Effectively close all roads after completion of timber harvest - This would require making roads unattractive even for foot, horse-back, or ATV travel and installing gates that could effectively bar 4-wheeled vehicles. Conceivably road-beds could be piled with slash and other debris, the surface ripped, and trees planted. Mere signing and installation of barricades is not likely to effectively mitigate for mortality risk associated with increased access.

(2) Schedule timber harvest so as to concentrate rather than disperse equal amounts of activity - If a given number of harvest units need to be cut in a given time, impacts on bears would be reduced if harvest activity were concentrated over time in specific sections of the timber management area. If equivalent timber harvest were continually dispersed over the entire area, bears would have a much harder time avoiding the involved people.

(3) Designate certain nearby areas as either permanently or temporarily closed to all humans - Designation of such areas would offer bears additional options for avoiding people and would be especially useful in areas that had previously been subject to some degree of use by humans; i.e., designation of an area already unused by people would offer little mitigation.

ACKNOWLEDGEMENTS

We appreciate the critical reviews of this report by D. Mike Cole, Bert Harting, and Daniel Reinhart.

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EFFECTS OF ACCESS ON HUMAN-CAUSED MORTALITY OF YELLOWSTONE GRIZZLY BEARS

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Mattson, D. J., and R. R. Knight. 1991. Effects of access on human-caused mortality of Yellowstone grizzly bears. U.S.D.I. Natl. Park Serv. Interagency Grizzly Bear Study Team Report 1991B.

Executive Summary: We analyzed grizzly bear mortality data by three 8-year periods (1962-1969, 1975-1982, and 1983-1990) and by association with different levels of human access (major developments, primary roads, secondary roads, and back-country areas). Unit-area mortality rates associated with all levels of access decreased over the 3 time periods. However, there is doubt whether this reduction in mortality is sufficient to insure the population's viability. Yellowstone Park's back-country remains the safest for bears, and areas impacted by secondary roads and major developments, remain the most lethal. Given questions about the grizzly bear population's viability, we cannot afford to increase the area impacted by secondary roads and major developments. It is also likely that the easiest gains in reducing grizzly bear mortality risk, associated with management of attractants, have already been made. Further reductions in grizzly bear mortalities will likely be much more difficult. Minimizing encounters between grizzly bears and humans remains the best option for minimizing mortality risk to Yellowstone grizzly bears.

INTERAGENCY GRIZZLY BEAR STUDY TEAM REPORT: 1991B

STATEMENT OF PURPOSE

Interagency Grizzly Bear Study Team Reports are intended to facilitate the timely transfer of research results and perspectives to management of Yellowstone's grizzly bear population. These reports are also a forum for presenting results that, while not suited for journal publications, are relevant for management. We have made every effort to validate the information presented here and have subjected this report to critical review.

INTRODUCTION

Management of human-caused mortality is key to the Yellowstone grizzly bear population's future viability; and of all the bear cohorts, mortality among adult females is most critical (Knight and Eberhardt 1985). Reduction of bear mortalities is contingent on identifying manipulable or constraining causal factors. Ultimately, management will be optimized by time- and space-specific analysis of mortality risks associated with existing or proposed human activities. This is dependent on assigning realistic time- and space-specific coefficients of mortality risk to various human activities and management regimes.

Several analyses have looked at factors historically influencing mortality risk for Yellowstone grizzly bears. Armed herders attending free-ranging domestic sheep have been clearly identified as a major mortality factor, primarily because sheep are a preferred prey of bears (Mattson 1990) and because the herders are intolerant of any risks posed by bears (Griffel and Basile 1981, Johnson and Griffel 1982, Knight and Judd 1983, Jorgensen 1983). Outfitters operating back-country camps have also been identified as a major risk to bears because edibles associated with their camps attract bears, and the outfitters have often retaliated by shooting the scavenging animal (Hoak et al. 1983). Human-food-conditioning (cf. Herrero 1985:51) increases mortality risk

Table 1. Numbers of grizzly bear mortalities and 1,000-km^2 8-year mortality rates, by time period and stratum; for the Yellowstone area.

Stratum	Number of mortalities			Mortalities per 1,000 km^2			Proportion of total area
	1962-69	1975-82	1983-90	1962-69	1975-82	1983-90	
Developments[a]	65	27	24	34.0	14.1	12.6	0.088
Primary roads[b]	6	13	7	2.2	4.9	2.6	0.123
Secondary roads[c]	16	26	14	6.3	10.2	5.5	0.118
Forest Service backcountry	48	18	12	5.8	2.2	1.4	0.385
Park Service backcountry	2	6	7	0.3	1.0	1.1	0.286

[a]6-km-radius buffers.
[b]6-km total width parallel buffers.
[c]3-km total width parallel buffers, plus inclusions.

1984:70). However because of major differences, we found it instructive to look at proportional distribution of mortalities among causes (Table 2). As we expected most of the mortality around developments resulted from lethal resolution of bear-human conflicts by management agencies. The largest portion of mortality associated with secondary road systems was attributable to conflict over domestic sheep. Assuming that this cause has been mitigated in recent years by closure of most sheep grazing-allotments and removal of sheep from other areas (U.S. Fish and Wildl. Serv. 1990), the largest portion of remaining mortality associated with secondary roads was from poaching not associated with any detected attractant. In the Forest Service back-country, cause of death was divided between incidents, legal or otherwise, involving armed non-agency individuals with (48%) and without (40%) an attractant involved. Distributions of mortalities among sex- and age-cohorts (excluding known dependent young) did not differ significantly among strata (df = 8, n = 92, X^2 = 9.79, P = 0.21), although there was a tendency for subadult males and adult females to die proportionally less often around secondary roads compared to developments and the Forest Service back-country.

DISCUSSION

Sources of Bias. - The mortality data was likely affected by considerable bias attributable to varying intensities of documentation with time and among different causes of death. In general, illegal back-country bear mortalities were probably under-represented during all time periods (Knight and Eberhardt 1985). It is likely that illegal mortalities in back-country areas were most under-represented for the period 1962-1969, especially on Forest Service lands, because there was less concern for the population and research was focused in central Yellowstone Park. For the same reasons, over-all mortality was probably under-documented for the period 1962-1969 compared to the later 2 periods. Natural mortality has also probably been consistently under-represented because it is less likely to be detected.

These biases compromised our results to varying degrees. In general, the disparity between front- and back-country mortality rates is probably not as great as indicated by the data, especially for the period 1962-1969. It is very improbable, however, that this bias entirely negates the orders-of-magnitude difference between front- and back-country rates. On the other hand, when comparing among time periods, the disparity in rates between 1962-1969 and the later 2 periods is probably greater than indicated by the data. Because illegal mortality has apparently dropped since 1982, mortalities attributable to secondary roads and the back-country were probably proportionally greater during 1975-1982 compared to 1983-1990.

Stratification. - In most areas of occupied grizzly bear habitat, management concern focuses on the implications of road access to bears. Roads do not usually directly effect bears, outside of the occasional bear hit by a motor-vehicle, often in association with an attractant along the road (e.g., carcass or spilled edibles). More importantly roads, as well as major human developments, appear to effect bears through a host of human activities facilitated by improved access (McLellan 1990). In short, increased access precipitates increased frequency of encounters between bears and humans, with usually negative consequences for bears. For these reasons, rather than focusing on proximal causes of death, we chose to look at mortality effects in terms of the overall complex of activities associated with what is ultimately the most important factor: the area impacted by varying degrees of access. Within these strata we then looked at more proximal causes as a diagnostic signature of the types of risks associated with different access.

The presence of fire-arms in association with legal big-game hunting also clearly has implications to the frequency and outcome of human-bear contacts. For this reason we stratified the back-country by areas where hunting and fire-arms were allowed (forest Service lands) and where they were not (Park Service lands).

Implications. - Yellowstone's grizzly bear population is clearly constrained by high densities of humans and human access. Peripheral areas with high road densities apparently correspond to a per annum probability of grizzly bear survival approaching zero. In the larger scale, even moderate levels of human access and resident densities are not compatible with grizzly bears (Mattson 1990).

Our analysis suggests trends over time towards lower unit-area mortality rates, in association with all levels of human access. As an alternate hypothesis, this could be the result of a declining bear population. However this explanation seems very unlikely given that the population appears to be stable (Knight and Eberhardt 1987, Knight et al. 1988), and that major improvements have been made in management of attractants that have been a primary cause of bear deaths in the past (e.g., sheep, garbage, and other unsecured edibles). Greatest improvements in recent years have been associated with primary and secondary roads, primarily by the reduction in sheep-related mortalities around secondary roads.

However we need to ask whether these improvements are sufficient. Recent analyses suggest that because of demographic constraints (Dennis et al. 1991) and uncertainties over future habitat conditions (Mattson and Reid 1991) optimism over long-term viability of the Yellowstone grizzly bear population is not justified. Thus, even though gains have been made, further efforts to reduce mortality rates are apparently required; and it may be that most of the easy gains have already been made.

Yellowstone Park's back-country serves as a standard for the rest of the ecosystem. It exhibits the lowest unit-area mortality rate and most mortality appears to be from natural causes. Whatever the trends associated with road access, areas impacted by secondary roads and major developments still have roughly 5X and 11X the mortality rate, respectively, of Yellowstone Park's back-country, and almost all front-country mortalities are still human-caused. These disparities make a case for preserving or increasing whatever refuge effect is associated with the Park's back-country.

Relative to Yellowstone Park's back-country, conditions in Forest Service back-country areas have improved markedly. The greatest improvement (0.4X the prior rate) was associated with termination of legal grizzly bear hunting in 1974. Since then, improvements have apparently been associated with sanitation of back-country camps and the elimination of baiting-stations for hunting black bears. However during the 1990 hunting season 5 grizzlies where shot in back-country areas, all probably by hunters (Knight et al. 1991). These events raise questions about future trends, and whether other mortality factors such as accidental encounters with hunters may become more important. None-the-less, it is encouraging that the unit-area mortality rate in the Forest Service back-country, where fire-arms are present, is comparable to Yellowstone Park's back-country.

Mortality rates associated with developments appear to have been comparatively unresponsive to management in the last 16 years. Areas near major developments, as well as primary roads, may serve as a temporary refuge for subordinate (typically subadult males) or security-conscious (often females with dependent young) bears from adult males that preferentially use back-country areas (Mattson et al. 1987; Mattson et al., in prep.). High quality foods other than pine seeds also occur around developments (Mattson and Knight 1989; Mattson et al, in prep.). Subadult males and adult females consequently become disproportionally habituated to humans; not as often in recent years by conditioning to human-origin foods, but in the course of using native foods near humans (Mattson et al., in prep.). Given that humans are nearly as likely to kill habituated bears as they are to kill food-conditioned bears (Mattson et al., in prep.), mortality problems associated with Park developments appear to have persisted. Some observations suggest that a portion of bear deaths around major developments may be a consequence of habituation developed along roads. Continued problems around major developments are also attributable to persisting availability of attractants around private residences and towns bordering Yellowstone Park (Servheen 1989).

Our results suggest that we can least afford to increase the area impacted by major developments (e.g., major campgrounds) and secondary road systems. Also, given rote proportions of mortality associated with developments, secondary roads and the Forest Service back-country, greatest improvements are still needed in these areas. Reduction of mortality associated with secondary roads may be relatively difficult, given the recent low involvement of attractants, unless management of fire-arms and human attitudes is considered. Similarly, mortality risk around developments will probably continue to be responsive to removal of remaining attractants, but management also may be stymied by an increasing involvement of human-habituation, without food-conditioning, in bear-human conflicts. In short, we may be reaching a point where relatively easily managed factors are no longer playing a major role in human-caused grizzly bear mortality, and where human presence alone may be a primary causal factor. Thus, even though improvements are evident, there is an argument for minimizing contact between grizzly bears and humans as the best future means of minimizing mortality risk to Yellowstone's grizzly bears.

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YELLOWSTONE GRIZZLY BEAR MORTALITY, HUMAN HABITUATION, AND WHITEBARK PINE SEED CROPS

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Abstract: The Yellowstone grizzly bear (*Ursus arctos horribilis*) population may be extirpated during the next 100–200 years unless mortality rates stabilize and remain at acceptable low levels. Consequently, we analyzed relationships between Yellowstone grizzly bear mortality and frequency of human habituation among bears and size of the whitebark pine (*Pinus albicaulis*) seed crop. During years of large seed crops, bears used areas within 5 km of roads and 8 km of developments half as intensively as during years of small seed crops because whitebark pine's high elevation distribution is typically remote from human facilities. On average, management trappings of bears were 6.2 times higher, mortality of adult females 2.3 times higher, and mortality of subadult males 3.3 times higher during years of small seed crops. We hypothesize that high mortality of adult females and subadult males during small seed crop years was a consequence of their tendency to range closest (of all sex-age cohorts) to human facilities; they also had a higher frequency of human habituation compared with adult males. We also hypothesize that low mortality among subadult females during small seed crop years was a result of fewer energetic stressors compared with adult females and greater familiarity with their range compared with subadult males; mortality was low even though they ranged close to humans and exhibited a high frequency of human habituation. Human-habituated and food-conditioned bears were 2.9 times as likely to range within 4 km of developments and 3.1 times as often killed by humans compared with nonhabituated bears. We argue that destruction of habituated bears that use native foods near humans results in a decline in the overall ability of bears to use available habitat, and that the number and extent of human facilities in occupied grizzly bear habitat needs to be minimized unless habituated bears are preserved and successful ways to manage the associated risks to humans are developed.

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The Yellowstone grizzly bear population will likely survive the next 30 years (Knight and Eberhardt 1985, 1987) but may not survive beyond the next 100–200 years (Dennis et al. 1991, Mattson and Reid 1991). Short- and long-term survival is contingent upon maintaining known average annual mortality at ≤2 adult female and 7 total deaths/year (Knight and Eberhardt 1984, 1985). Thus, management of Yellowstone's grizzly bear population has focused on reducing mortality to acceptable levels, which has in turn been dependent on understanding the causes of mortality.

McArthur Jope (1983), Jope (1985), and Herrero (1985) applied the concepts of human habituation and human food conditioning to the behavior and management of bears. They demonstrated that many management problems with bears arose from food conditioning and habituation, which are characterized by less fear of humans and a predilection towards humans or human facilities as a source of food. Subsequently, management of bears has become increasingly phrased in terms of habituation and food conditioning, and some programs have included a direct assessment of these factors as a basis for managing individual bears (Claar et al. 1986, Dalle-Molle and Van Horn 1989, McCrory et al. 1989, and McLean and Pelton 1990). Therefore, we posed hypotheses concerning distributions and mortality of Yellowstone grizzly bears in terms of human habituation and food conditioning, as follows:

- H_{o1}: Frequency of human habituation and food conditioning differs among grizzly bear sex-age cohorts.
- H_{o2}: Frequency of human-caused mortality differs between human-habituated and wary bears, and among sex-age cohorts.
- H_{o3}: Distributions of human-habituated and wary bears differ with respect to human facilities.

While the last hypothesis appears to be circular, given that frequency of human habituation would predictably increase with nearness to humans (Herrero 1985), it is relevant to determining spatial impacts of human facilities that are mediated through the habituation of bears to humans.

Whitebark pine seeds and ungulates appear to be the 2 most important foods of Yellowstone grizzly bears, whereas berries are relatively unimportant (Mattson et al. 1991). Consequently, food habits of Yellowstone grizzly bears are relatively unique in North America, and most closely resemble those of central Siberian brown bears (*Ursus arctos jeniseensis*) (Mattson et al. 1991). Whitebark pine seeds are predictably important because of their high fat content and potential abundance during pre-hibernation hyperphagia (Mattson and Jonkel 1990), and when available, Yellowstone grizzly bears consume the seeds almost exclusively, typically by raiding red squirrel (*Tamiasciurus hudsonicus*) middens (Kendall 1983, Mattson and Jonkel 1990). For these reasons we postulated that availability of whitebark pine seeds has the greatest potential of any single food-related factor to impact behavior and demography of the Yellowstone grizzly bear population.

Little specific information is available describing the effects of variation in food supplies on bear mortality, although poor food conditions often result in greater bear movements and mortality (Slobodyan 1976, Garshelis and Pelton 1981, Grenfell and Brody 1983, Garshelis 1989). In Siberia, brown bears apparently range farther, kill domestic livestock more frequently, and are in turn killed more frequently by humans when stone pine (*Pinus sibirica* and *P. pumila*) seed crops are small (Ustinov 1976). Yellowstone grizzly bears also exhibit greater movements and use lower elevations during years of small whitebark pine seed crops (Mattson and Knight 1989, Blanchard and Knight 1991). However, relationships among variation in seed crops, grizzly bear mortality, and nearness of grizzly bears to humans have not been analyzed for the Yellowstone Ecosystem. Thus, we posed the following additional hypotheses:

- H_{o4}: Distribution of grizzly bears with respect to human facilities differs between years of large and small seed crops, and among sex-age cohorts.
- H_{o5}: Human-caused mortality differs between years of large and small seed crops, and by sex-age cohorts.

Herein, we test the hypotheses posed, and speculate on causal linkages between what we suspect are 2 major factors influencing grizzly bear mortality in the Yellowstone area: whitebark pine seed crop size and frequency of human-habituation among the bears; we also offer interpretations for management.

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STUDY AREA AND METHODS

Our 20,000-km² study area was centered on Yellowstone National Park and included portions of Wyoming, Montana, and Idaho. Study area characteristics have been described by Knight and Eberhardt (1985), Mattson et al. (1991) and Blanchard and Knight (1991).

Transects for monitoring whitebark pine cone production have been maintained since 1980 (Blanchard 1990). Cones were counted on each of 10 permanently marked trees after cone maturation, but before heavy cone use by seed consumers. Although the number of transects increased over the years from 9 to 21 (Blanchard 1990), we used only the 9 transects first established in 1980 to allow systematic comparison of results.

Food habits were estimated by fecal analysis, 1976–90 (Mattson et al. 1991), and included the frequency of whitebark pine seed remains in grizzly bear feces for August–October and for the entire year. An acute sigmoidal relationship was evident between frequency of pine seeds in feces and transect cone counts (Blanchard 1990). Consequently, we classified years as either characterized by widespread use (use) or virtually no use (nonuse), with the cut-off point between the two being 20% frequency of seeds in feces (corresponds to about 220 cones/transect).

We hypothesized that the current year's crop, reflected in August–October use, most influenced autumn behavior, and that the entire year's diet also influenced mortality. Consequently, we used August–October pine seed use to stratify analysis of mortality, movements and behavior, while we also used data for the entire year to stratify the mortality analysis. Stratification of data by August–October use and the entire year's use differed because during June–July bears extensively consumed pine seeds from a large previous year's crop that had survived

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Science and Management of Rocky Mountain Grizzly Bears

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Abstract: *The science and management of grizzly bears (*Ursus arctos horribilis*) in the Rocky Mountains of North America have spawned considerable conflict and controversy. Much of this can be attributed to divergent public values, but the narrow perceptions and incomplete and fragmented problem definitions of those involved have exacerbated an inherently difficult situation. We present a conceptual model that extends the traditional description of the grizzly bear conservation system to include facets of the human domain such as the behavior of managers, elected officials, and the public. The model focuses on human-caused mortality, the key determinant of grizzly bear population growth in this region and the interactions and feedback loops among humans that have a major potential influence on bear mortality. We also briefly evaluate existing information and technical methods relevant to understanding this complex human-biophysical system. We observe not only that the extant knowledge is insufficient for prediction (and in some cases for description), but also that traditional positivistic science alone is not adequate for dealing with the problems of grizzly bear conservation. We recommend changes in science and management that could improve learning and responsiveness among the involved individuals and organizations, clarify some existing uncertainty, and thereby increase the effectiveness of grizzly bear conservation and management. Although adaptive management is a promising approach, we point out some key—as yet unfulfilled—contingencies for implementation of a method such as this one that relies upon social processes and structures that promote open learning and flexibility in all facets of the policy process.*

Ciencia y Manejo de los Osos Pardos de las Montañas Rocallossas

Resumen: *La ciencia y manejo de los osos pardos (*Ursus arctos horribilis*) en las montañas rocallosas de Norte América han producido considerables conflictos y controversias. Mucho de esto puede ser atribuido a los divergentes valores públicos, así como a reducidas percepciones e incompletas y fragmentadas definiciones de los involucrados, lo cual ha exacerbado la ya difícil situación. Presentamos un modelo conceptual que expande la descripción tradicional del sistema de conservación de los osos pardos para incluir facetas del dominio humano como son la conducta de los manejadores, los oficiales elegidos y en publico. El modelo se enfoca en la mortalidad causada por humanos, clave determinante del crecimiento de las poblaciones de osos pardos en esta región y las interacciones y retroalimentación entre los humanos que tienen un mayor potencial para influir en la mortalidad de los osos. Brevemente evaluamos la información existente y los métodos técnicos relevantes para entender este complejo sistema humano-biofísico y observamos que no solo el conocimiento actual es insuficiente para predecir (y en algunos casos para describir), sino también que la ciencia positivista por si sola no es adecuada para enfrentar los problemas de la conservación del oso pardo. Recomendamos cambios en la ciencia y manejo que pueden mejorar el aprendizaje y responsabilidades entre los individuos y las organizaciones involucradas, clarificar algunas incertidumbres existentes y por lo*

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and behavior of people, as well as dynamic biophysical attributes such as grizzly bear food and shelter. Continued research on trends will probably be easy because of historical emphasis on this topic, whereas systems to monitor humans will likely be complicated by uncertainty over good quantitative metrics and because of traditional antipathy to keeping records on certain types of public activity.

Finally, grizzly bears could benefit by the widespread adoption of management strategies known to be effective but not always implemented. This program would emphasize: (1) sanitation of human facilities wherever humans and grizzly bears come in contact so that conditioning of grizzlies to human foods is minimized (Herrero 1985; Herrero & Fleck 1990); (2) location or relocation of human facilities in or to areas that are likely to receive little grizzly bear use, either for travel, bedding, foraging, or security from other bears, to minimize conflict and habituation of grizzly bears to humans (Herrero et al. 1986); (3) limitation of human activity and numbers in occupied grizzly bear habitat, again to minimize conflict and habituation; (4) limitation of human access to grizzly bear habitat by road and trail; (5) reduction in number of armed people in grizzly bear habitat (other than during legal hunting seasons), especially in combination with foods or odors that attract grizzly bears (Herrero & Fleck 1990); (6) a balanced management of mortality that favors the survival of females (e.g., the sex-weighted point scheme used in the Yukon [Smith 1990]), but at the same time does not result in excessive mortality of adult males; and (7) education of back-country users and other local residents to minimize undesired conflicts with grizzly bears. We do not identify explicit thresholds or standards for these recommendations because the specifics need to await more rigorous analysis of data from each grizzly bear population. The standards will also be contingent upon the degree to which recommendations one through six are implemented.

We have not explicitly considered two factors that are perhaps as important as any to the ultimate survival of grizzly bears in the Rocky Mountains: (1) the degree to which politicians and managers involve the public in developing conservation strategies and corresponding ownership of the process by affected citizens (Gregory & Keeney 1994; Kellert 1994*b*; Wondolleck et al. 1994; Primm, this issue), and (2) the life-styles and values of humans in Canada and the United States. If grizzly bears are resented and consistently held in lower regard than other resources that we demand from their remaining habitat, then wild grizzly bears in the southern Rocky Mountains will almost certainly disappear, and their descendants will survive only as penned and catered relics. The survival of grizzly bears and other wild things in the Rocky Mountains might simply follow from the extent to which we can peacefully resolve conflicts among ourselves and adopt more tolerant and less acquisitive life-styles (McDougal et al. 1988; Daly & Cobb 1989).

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THE EFFECTS OF DEVELOPMENTS AND PRIMARY ROADS ON GRIZZLY BEAR HABITAT USE IN YELLOWSTONE NATIONAL PARK, WYOMING

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Abstract: Aerial locations of radio-instrumented grizzly bears (*Ursus arctos*) were used to analyze effects of human activity associated with developments and primary roads on grizzly bear habitat use in Yellowstone National Park. Grizzly bear occupancy of habitat near human facilities was reduced, efficient foraging strategies were disrupted, and cohorts tending to be subordinate or security-conscious were displaced into habitat nearer developments by more dominant cohorts, particularly during summer and fall. Adult females and subadult males residing closer to developments were management-trapped at a higher rate than animals of the same class residing farther away. Adult females and subadults bore a disproportionate part of costs associated with avoiding roads and developments. For this reason and because adult females are generally thought to operate under considerable energetic duress in the Yellowstone area, avoidance of developments and roads may have resulted in higher mortality and lower productivity among the adult female cohort.

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Grizzly bear populations have typically been reduced or eliminated after sustained contact with Western civilizations. This has primarily been a result of human-caused mortalities; habitat loss has been a secondary factor (Storer and Trevis 1955, Brown 1985). Therefore, management and research have been concerned with defining how much mortality and habitat loss a bear population can tolerate and remain viable. Key questions have been (1) how do bears respond to humans, and (2) how does a given response influence risk for, and habitat use by, grizzly bears?

The consequences of bear-human encounters to humans have been described and analyzed (e.g., Herrero 1976, Merrill 1978, Chester 1980, Herrero 1985, Jope 1985). Other research has attempted to determine encounter effects on bears as a function of individual bear history, site, and season (Schleyer et al. 1984, Haroldson and Mattson 1985). Still other studies have investigated more general impacts of human activities, primarily in association with logging and hydrocarbon exploration and development (Elgmork 1978, Harding and Nagy 1980, Schallenberger 1980, Zager 1980, Aune et al. 1984, McLellan and Mace 1985).

The effect of human activities on bears is an important issue in Yellowstone National Park; most human activities are concentrated at roads and developments. More than 2 million people visit the park each year during the period that grizzly bears are active. Fifty percent of the park is within 8 km of a primary road and within 11.5 km of a village or front-country campground. Furthermore, the Yellowstone grizzly bear population appears to be marginally viable (Knight and Eberhardt 1984, 1985). Therefore, the Interagency Grizzly Bear Study Team (IGBST) used existing data to analyze the effects of roads and human developments on grizzly bear habitat use in Yellowstone Park.

Our objectives were to (1) determine if observed levels of bear use were equal to that expected along roads and around developments; (2) determine if productivity of habitat occupied by bears was equal to that expected with nonselective use along roads and around developments; (3) quantify any evident avoidance by bears of roads and developments and; (4) determine if representation of different sex and age bear classes differed between areas close to and more remote from human facilities.

STUDY AREA

Yellowstone National Park (Fig. 1) comprised the analysis area. Most elevations in the park are from 2,100 to 2,450 m. Topography is dominated by an extensive central plateau and encircling higher relief mountains. Bedrock in many areas is of recent volcanic origin. Other areas are underlain by older volcanic and uplifted sedimentary strata (Keefer 1976).

The analysis area lies principally in the subalpine zone. Closed-canopy forest covered approximately 75% of the area. Most of this forest consisted of lodgepole pine (*Pinus contorta*) dominated stands in sapling to over-mature stages. Douglas-fir (*Pseudotsuga menziesii*), Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and whitebark pine (*Pinus albicaulis*) dominated stands were more common on high-relief topography underlain by andesitic bedrock. Extensive nonforest areas occurred primarily below 2,125 m and generally reflected warmer, drier conditions. Further details of the study area are available in Knight and Eberhardt (1985).

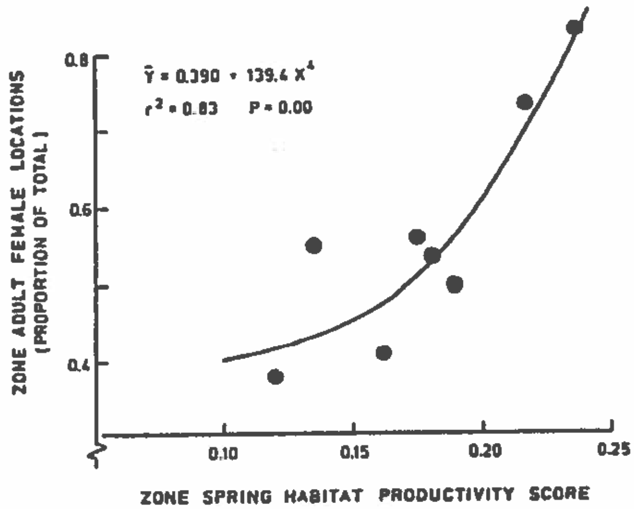

Fig. 10. Relationship of adult female locations to average habitat productivity score during spring for 15-km analysis zones; locations are expressed as a proportion of the zone total.

(Knight and Eberhardt 1984), that near 30 of these animals resided predominantly within the park, and that Yellowstone Park was near carrying capacity (Picton et al. 1986, Mattson 1987), then this effect translates into loss of habitat sufficient to support 4 or 5 adult females during summer.

DISCUSSION

Error and Bias

Some potential complications are associated \ using zone widths of 100–300 m, as we did for 1,500-m analysis. Aerial locations of telemet bears may have errors greater than 100 m. Gro analysis of aerial locations by IGBST personnel gested that a majority of our locations had errors than 200 m. Many locations were by sighting an were very accurate; a few locations were know be as much as 1 km in error.

The consequences of this error to our analysis \ probably minor even though a substantial numbe bear locations undoubtedly occurred in zones o than indicated by aerial telemetry. However, mos the trade-off due to this error would be with adja zones. Because our primary objective was to ana broad patterns, as much as 600 m in the 1,50 analysis, we concluded that location error did compromise interpretation of results.

Simple interpretation of results was more li complicated by biases inherent in aerial locatio telemetered animals. Most of our locations occu during morning hours and grizzly bear are ni active in the Yellowstone area, especially during s mer (Schleyer 1983, Harting 1985). Because of

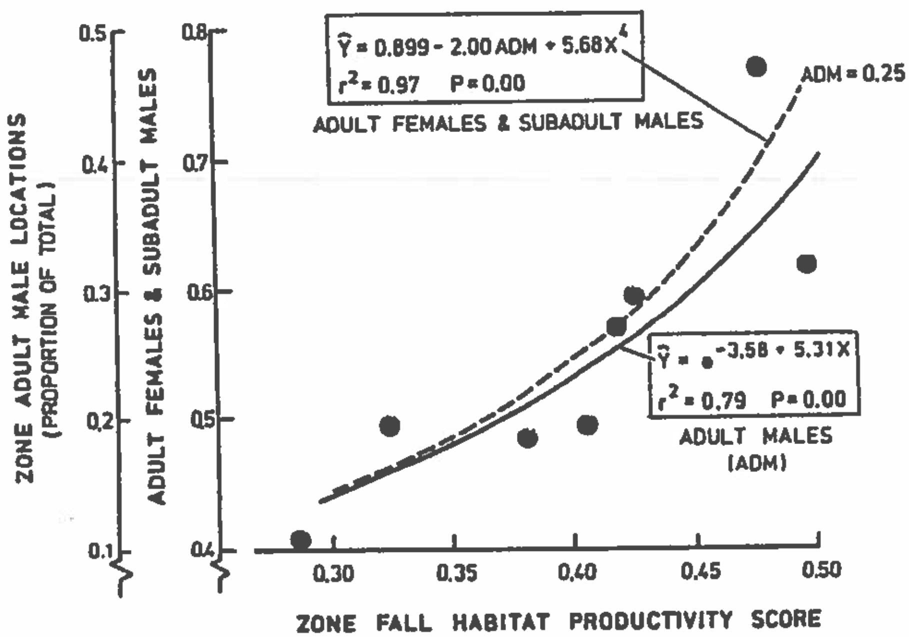

Fig. 11. Relationship of adult male, adult female, and subadult male locations to average habitat productivity score during spring for 15-km analysis locations are expressed as a proportion of the zone total.

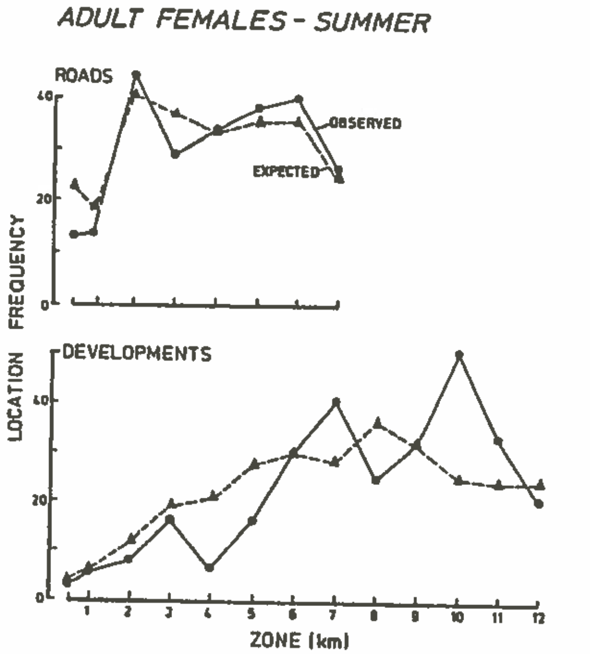

Fig. 12. Observed (adult female bear location) and expected (weighted grid-point) summer frequencies for road and development 15-km analysis zones.

diel bias, observed habitat use close to roads and developments may not reflect actual habitat use. Bears could have made additional night-time use of adjoining areas. This does not discredit the fact that bears were apparently avoiding humans during the day; however, actual was probably greater than calculated summer habitat use for adult females within road and development zones of influence.

Bear Behavior

Avoidance of humans by bears was interpreted as taking 2 forms: (1) disruption of foraging activities that tend to maximize use of the most productive habitat within a zone; and (2) outright avoidance of areas near front-country human facilities. Disruption of otherwise efficient foraging strategies was inferred primarily from bear location habitat productivity scores less than or nearly equal to zone averages, and outright avoidance from observed bear use less than expected in zones adjoining or near by human facilities.

We assumed that the costs of avoidance evident by aerial telemetry locations were greater during spring and fall compared to summer. This assumption resulted from the tendency for grizzly bears to be more day-active during spring and fall compared to summer in the Yellowstone area (Schleyer 1983, Harting 1985). Thus, daytime avoidance attributed to human facilities during spring and fall probably reflected a greater behavioral response and associated stress or energy related costs compared to summer. Spring and fall also corresponded to potentially critical periods of post-den emergence and prehibernation hyperphagia. The post-den emergence period is thought to be especially important to adult females in the Yellowstone area (Mattson 1987); prehibernation hyperphagia was probably important to all cohorts (Nelson et al. 1983, Nelson et al. 1984, Mattson 1987).

Spring.—Adult females occupied the most productive spring habitat; proportionate zone distribution of this cohort was positively related to zone distribution of spring productivity scores. Thus, because spring productivity was highest near roads and developments, adult females tended to occupy habitat near these facilities.

Adult males tended to be proportionately distributed farther from developments during spring. This distribution probably did not reflect avoidance of developments because spring distribution of adult males was more likely an artifact of previous fall distribution. Spring and fall proportionate representation of adult males was strongly correlated ($r = 0.95$, $P = 0.000$).

Bears also apparently avoided humans during spring. Our data suggest that during daylight hours bears tended to avoid an area averaging 500 m along

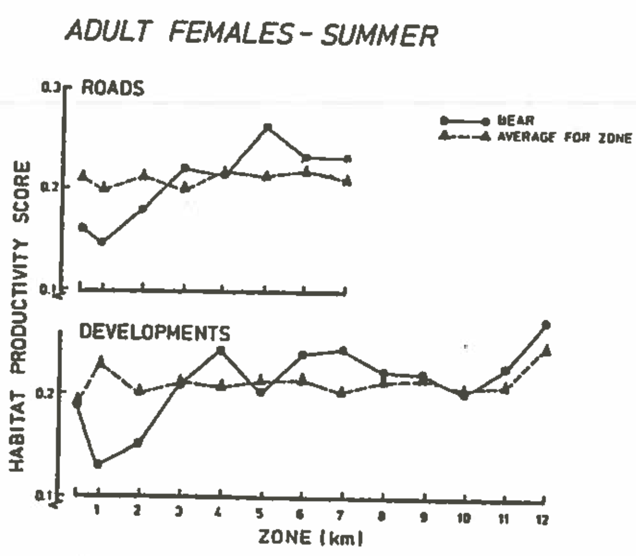

Fig. 13. Average summer habitat productivity score for adult female bear location and grid-point scan areas, for development and road 15-km analysis zones.

roads. Spring response to developments was evidenced by disruption of foraging out to 3 km. Other data collected while surveying spring bear use of ungulate carcasses in the Old Faithfull area (Mattson and Henry 1987) showed that only 6%–7% of carcasses within 5 km of the development were used by bears; 50%–100% of carcasses beyond 5 km had been used by bears. These observations were consistent in 1985 and 1986. Taken together, this analysis and the work of Mattson and Henry (1987) suggest a potentially strong avoidance of developments by grizzly bears during spring.

Summer.—Grizzly bears tended to avoid an area averaging 500 m along roads during summer. As during spring, the avoidance more likely occurred during daylight hours. Unlike spring, daytime disruption of foraging out to 2 km of roads was also evident. These 2 phenomena suggest a slightly stronger daytime bear response to roads during summer compared to spring. This is consistent with much higher vehicle traffic levels during summer.

During summer no spatial avoidance of developments was apparent for zones out to 2 km. Bear use was less than expected for zones 2–5 km and 7–9 km from developments; disruption of foraging was also apparent out to 3 km. This relatively complex pattern can be understood by looking at zone distribution of telemetry locations for individual bears. The 3 peaks in observed vs. expected use could be explained by a greater number of bears concentrating their activity in corresponding zones. Although most bears ranged across all zones, individuals could be distinguished by a greater tendency to range nearby (<5 km), at intermediate distances (5–7 km), and far from (>7 km) developments during summer.

Several interpretations of summer bear distribution with respect to developments were possible. However, we favored the following: bears tending to range closest to developments (<5 km) were very likely habituated to humans and human facilities. Further, the apparent greater number of management trappings among adult females and subadult males suggests that many of these bears were food conditioned. Bears tending to range beyond 7 km of developments were probably less often habituated to humans or conditioned to human foods located at developments. Significantly, 30% of Yellowstone Park was within 7 km of a front-country campground or development.

The summer pattern of bear habitat use around developments could have resulted from bear response to humans and human foods. Habitat productivity was more evenly distributed across zones during summer compared to spring and fall and grizzly bears did not key as strongly on the most productive habitat across or within zones. Thus, the tendency for individual bears to be segregated by distance from developments suggests differential response to humans rather than differential productivity-based habitat selection. This is even more probable given that zones of "under-utilized" habitat alternated with zones of peak occupancy progressively outward from developments. A likely inference is that bears ranging farther from developments tended to be wary of humans and purposely avoided developments as well as the more habituated bears ranging near developments.

Individual cohort patterns underlay the hypothesized general response of bears to developments during summer. Females with cubs-of-the-year apparently avoided developments more than other bear cohorts. Females with cubs appear to have been in a double-bind during summer, avoiding humans and other adult bears. Subadults also apparently avoided adult females during summer. Furthermore, subadult locations comprised a larger portion of total locations within vs. beyond 7 km of developments. Thus, subadults appear to have ranged closer to developments during summer in part because they tended to avoid adult females. The response of typically low status (subadults) or security-conscious (females with cubs) cohorts to adult females during summer may have partly reflected a response to adul[t] males; adult males would have been seeking out estru[s] females and would, consequently, be associated wit[h] them (Craighead and Mitchell 1982, Schleyer 1983)

Fall.—Adult males tended to occupy the most pro[-]ductive fall habitat; proportionate zone locations [o] adult males were related to zone fall productivit[y] scores. Adult females and subadult males, when a[l]lowed access, also tended to occupy productive fa[ll] habitat. However, avoidance of or displacement b[y] adult males apparently outweighed habitat preferen[ce] among these 2 cohorts during fall. These relationshi[p] would be expected with hyperphagia (Nelson et a[l.] 1983, Nelson et al. 1984) and from previous obse[r]vations of bear cohort interactions at garbage dispo[sal] sites and spawning streams (Hornocker 1962, Egb[ert] and Stokes 1976).

Our data suggested that grizzly bears tended [to] avoid an area averaging 3 km along roads during f[all] and that foraging tended to be disrupted out to 4 k[m]. This response of bears to humans on roads duri[ng] fall is problematic, given that vehicle traffic dropp[ed] markedly in Yellowstone Park around the 1st week of September (Yellowstone Natl. Park, unpubl. data). Fall zone productivity scores were lowest within 5 km of roads and average forest cover was comparatively low out to 4 km. Lack of cover combined with comparatively unproductive habitat may have caused the observed comparatively low levels of daytime bear use along roads during fall.

During fall a pattern of daytime bear use similar to that of summer was evident around developments. Our interpretation of this pattern was similar to that of summer: habituated bears tended to occupy zones within 3 km and especially within 1 km of developments. Use greater than expected within 1 km likely reflected the presence of food-conditioned habituated bears. If the presence of habituated bears accounts for bear use greater than or nearly equal to that expected out to 1 km, then bear use less than expected in the broader area out to 4 km could be attributed to avoidance of developments by other bears and lack of human-related foods so far distant from developments. The area out to 4 km also coincided with low average productivity scores and percent forest area. These habitat factors would have probably contributed to, rather than mitigated, a daytime avoidance response by grizzly bears.

CONCLUSIONS

Three phenomena were evident from our analysis: (1) bears selecting more productive habitat, (2) bears avoiding bears, and (3) bears avoiding humans. Our analysis further suggested that the relative strength of these phenomena varied with season and cohorts. During spring females apparently selected highly productive habitat and secondarily, responded to the human presence. Adult males were apparently more indifferent to habitat conditions and further removed from humans. During summer strong selection for highly productive habitat was not evident by any cohort; and avoidance of humans and other bears more evident. Subadults and females with cubs were apparently most likely to avoid other bears, and females with cubs most likely to avoid humans. During fall all cohorts were probably strongly motivated toward selection of highly productive habitat. Even so, adult males apparently displaced other cohorts from the most productive habitat. Secondarily, bears also avoided humans, but in areas inherently less productive. Because adult females and subadults tended to be distributed closer to roads and developments and accounted for a large portion of locations especially during spring and fall, these cohorts were likely responsible for a large part of observed avoidance of humans.

Avoidance of humans using roads and developments in Yellowstone Park probably exacted a cost on the grizzly bear population. Adult females and subadults apparently bore a disproportionate part of this cost. Knight and Eberhardt (1984, 1985) have suggested that viability of the Yellowstone grizzly bear population is in large part contingent on survivorship of adult females. Mattson (1987) has also suggested that adult females, unlike adult males, experienced an ongoing energetics crisis; weights, mortality, and fecundity of adult females were strongly related to year-to-year and geographic variation in habitat productivity. Avoidance primarily of developments during spring and roads and developments during fall aggravated what was already an apparently marginal energetic situation for adult females. Thus, we conclude that avoidance of roads and developments by grizzly bears in Yellowstone Park probably resulted in poorer condition adult females and, consequently, higher mortality rates and lower fecundity for the cohort. However, we did not determine the extent of this effect.

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GRIZZLY BEARS AND RESOURCE-EXTRACTION INDUSTRIES: EFFECTS OF ROADS ON BEHAVIOUR, HABITAT USE AND DEMOGRAPHY

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SUMMARY

(1) Roads are an integral part of the development of resource-extraction industries. We wanted to know whether grizzly bears were displaced by these roads from adjacent habitats. Over 7 years, twenty-seven grizzly bears were captured and radio-collared in 264 km^2 of the Rocky Mountains, containing active tree-felling and petrocarbon developments.

(2) Most bears used habitats within 100 m of roads less than expected. This is equivalent to a habitat loss of 8·7%. This is significant because many habitats close to roads contain important bear foods. Avoidance of roads was independent of traffic volume, suggesting that even a few vehicles can displace bears.

(3) Roads and nearby areas were used at night but avoided in the day. Yearlings and females with cubs used habitats near roads more than other bears. These areas may have been relatively secure because they were avoided by potentially aggressive adult males.

(4) Limited data indicated minimal demographic effects during our study, but roads increased access for legal and illegal hunters, the major source of adult grizzly mortality.

(5) When roads are developed for resource industries in grizzly bear habitat, the bear population becomes highly vulnerable unless vehicle access and people with firearms are controlled.

INTRODUCTION

Grizzly bears (*Ursus arctos* Ord) are considered to require wilderness and seclusion from man (Hamer 1974; Craighead 1976), but much of their habitat is being explored and developed by resource-extraction industries (forestry, mining, petrocarbons). Previously ranging throughout western North America, grizzly bears are now classified as a threatened species in the contiguous U.S.A., and there is concern that their requirements are largely incompatible with most resource development. Most published information concerns grizzly bears in areas without resource-extraction industries, such as national parks (see review in LeFranc *et al.* 1987).

There are many levels of bear–industry interaction, but the most immediate concerns the extensive network of roads upon which the industries depend. Roads increase access for hunters and poachers, the probability of vehicle–bear collisions, and the frequency of energy costly flight responses by the bears. Indirect population constraints can result from long-term displacement of bears from areas adjacent to roads. Roads often follow valley bottoms and pass through riparian areas which are frequently used by grizzly bears. If roads do displace bears, it leads either to increased pressure on similar habitats in undisturbed regions, or to the 'loss' of these essential but limited habitats. Some variation in bears' responses to roads has been predicted; adult females with young cubs may avoid

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HABITATS SELECTED BY GRIZZLY BEARS IN A MULTIPLE USE LANDSCAPE

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Abstract: The effects of sex, ageclass, and season on habitats and elevations selected by 56 radiocollared grizzly between 1979 and 1995 in the Flathead River drainage of southeastern British Columbia and the adjacent portion of Montana were evaluated using compositional analyses. Two habitat selection strategies were apparent in the population: mountain resident bears selected avalanche chutes at higher elevations during spring, while elevational migrating bears moved to low elevations and selected riparian habitats. During summer, both groups of bears showed selection for areas that had been burned by wildfire 50–70 yr previously. In autumn, riparian was the highest ranked habitat followed by forest and open forest. Regenerating cut-blocks and rock outcrops consistently ranked lowest. Results of this southern grizzly bear study differ from others in that bears were free to select habitats in both mountains and the wide valley and they showed strong selection for some low elevation habitats.

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Key words: British Columbia, forestry, grizzly bears, habitat selection, Montana, *Ursus arctos*.

Humans have had a tremendous effect on the distribution and abundance of grizzly bears in southern Canada and the United States. Within a century, the southern and eastern distribution of these bears contracted to rugged mountains and high plateaus where few people settled (McLellan 1998). Today, maintaining grizzly bears in southern areas is a major conservation challenge (Servheen 1990, Banci et al. 1994).

The remaining grizzly bears in Alberta and the lower 48 states of the United States are largely confined to parks and designated wilderness areas plus adjacent multiple-use lands of the interior mountain ranges. In contrast, only about 10% of the grizzly bears in British Columbia are confined to protected areas; the vast majority live on multiple-use lands (McCrory et. al. 1990, Herrero 1994). Yet, because most grizzly bears in the interior mountains live in British Columbia and it is through this province that bears in the United States and Alberta are connected to larger populations in the North, conservation efforts on British Columbia multiple-use lands are critical to all southern grizzly bears.

In an attempt to address conservation issues including the maintenance of grizzly bear populations, British Columbia has developed a grizzly bear conservation strategy, a series of land-use planning processes, and the Forest Practic-

The MONTANA STANDARD | mtstandard.com
WEDNESDAY, AUGUST 19, 2015

Grizzly bears kill more livestock in Montana than in all of 2014

ALISON NOON
Associated Press

HELENA — Growing numbers of grizzly bears venturing east from the Rocky Mountains are attacking more domestic cattle and sheep.

Montana's livestock-loss program has reimbursed ranchers for 42 animals killed by grizzlies so far this year — eight more than in all of 2014, not counting the 22 cattle lost this year to bears that have not yet been claimed.

One report came from as far east as Floweree, Montana, about 100 miles northeast of Helena, George Edwards of the Montana Livestock Loss Board said Tuesday.

Wyoming officials expect a less drastic increase in livestock attacks and the range of roaming by grizzly bears this year. "We're having what I guess you would call a steady increase in livestock depredation as grizzly population and area expand," said Brian DeBolt, Wyoming's large carnivore conflict coordinator.

This is only the third year Montana has offered financial relief to ranchers who lose livestock to grizzlies, but Edwards said the state has long been encouraging people to report bears' interactions with livestock.

The number of animals killed this year amounts to a spike amid a long-term downward trend of grizzly attacks on livestock along the Northern Continental Divide, state and federal officials said.

"These numbers vary from year to year anyway, and more reporting may be happening now because there's reimbursement," federal grizzly recovery coordinator Chris Servheen said. "But the big picture is that we try to mitigate conflicts."

Montana's Northern Rockies Wildlife Manager Graham Taylor said measures taken during the last few years to electrify fences and fortify food storage have helped to reduce the number of bear-livestock conflicts in parts of Montana despite a growing number of grizzlies.

90 ft/ac = threshold

RED SQUIRRELS IN THE WHITEBARK ZONE

Daniel P. Reinhart
David J. Mattson

ABSTRACT

Reports results of a study of interactions among red squirrels (Tamiasciurus hudsonicus), *bears* (Ursus *spp.*), *and whitebark pine* (Pinus albicaulis) *from 1984 through 1987 in north-central Yellowstone National Park and in the vicinity of Cooke City, MT. This paper deals with results that pertain to habitat relationships of red squirrels in the whitebark pine zone. Indices of red squirrel activity and abundance were highest in the mesic and wet habitat types. Pure whitebark pine stands were apparently not favorable habitat for red squirrels. In the whitebark pine zone, cones of other conifer species were needed to offset yearly variations in whitebark pine cone production. Optimal red squirrel habitat in this zone consisted of stands with high tree species diversity, basal area, and environmental favorability. Annual fluctuations in red squirrel densities reflected yearly whitebark pine cone production in stands with a high whitebark pine component. Bears may play a role in regulating red squirrel abundance in whitebark pine stands.*

INTRODUCTION

Red squirrels (*Tamiasciurus hudsonicus*) are commonly associated with coniferous forests. They range extensively in the boreal regions of North America from Alaska to Arizona and from northern Quebec to the Appalachian Mountains (Smith 1970). Red squirrels are typically diurnal, solitary, and active throughout the year. Their diet consists primarily of the reproductive products of trees, fungi, and shrubs within the forests they occupy (C. Smith 1968). Although red squirrels are well adapted to live on a variety of foods available during the growing season (Ferron and others 1986), in the Rocky Mountains they must rely on stored conifer seeds for half the year (Finley 1969; Rusch and Reeder 1978). Conifer seed cones represent storable, high-energy packages that are relatively resistant to spoilage (Weigl and Hanson 1980).

Red squirrels subsist on a seasonal food supply on a year-round basis by caching and storing conifer seed cones gathered within established, defended territories. Gathering and storing cones occupy up to 80 percent of their daily activity from August through November (C. Smith 1968). Individual territories are nonoverlapping and contiguous within forest habitats and are defended from other red squirrels regardless of sex by vocalizations and by chasing intruder squirrels (Rusch and Reeder 1978; C. Smith 1968).

A large, centralized midden is a major feature of a red squirrel territory. Middens are sites traditionally used to cache and feed on cones and consist of large amounts of cone clippings. They occasionally extend into springs, bogs, and creek bottoms where added moisture helps preserve cones in a closed, more storable condition (Finley 1969).

In high-elevation mountain forests of western North America, whitebark pine (*Pinus albicaulis*) trees produce annually fluctuating crops of large, edible seeds (Forcella and Weaver 1986). These seeds are extensively used by wildlife such as Clark's nutcracker (*Nucifraga columbiana*), bears (*Ursus* spp.), and red squirrels (Kendall 1981; Tomback 1982). The large, edible seeds of whitebark pine are apparently preferred over other conifers by red squirrels and are readily cached when available (Hutchins and Lanner 1982). Whitebark pine seeds are also an important fall and spring food for grizzly bears (*Ursus arctos*) within the Yellowstone ecosystem and are obtained almost exclusively by raiding squirrel caches (Kendall 1981). During 1984 through 1987 the Interagency Grizzly Bear Study Team (IGBST) studied the interrelationships of grizzly bears, red squirrels, and whitebark pine. Habitat relationships of red squirrels within the whitebark pine zone are presented here.

STUDY AREA

Our study area consisted of the Mount Washburn massif in north-central Yellowstone National Park, and an area in the Gallatin National Forest near Cooke City, MT (fig. 1). Both areas were located in higher elevations of the subalpine zone on moderately steep topography. Elevations ranged from 2,360 m (7,800 ft), just below the lower elevational limits of whitebark pine distribution, to 2,865 m (9,400 ft) at the upper limits of erect tree growth.

Most study area timber cover was mature to overmature with some stands of pole-sized, even-aged trees. Whitebark pine occurred throughout the study area and was variously represented from dominant to scattered individuals. Whitebark pine was more prevalent in the Mount Washburn area than in the Cooke City area, where lodgepole pine (*Pinus contorta*) was a more common dominant.

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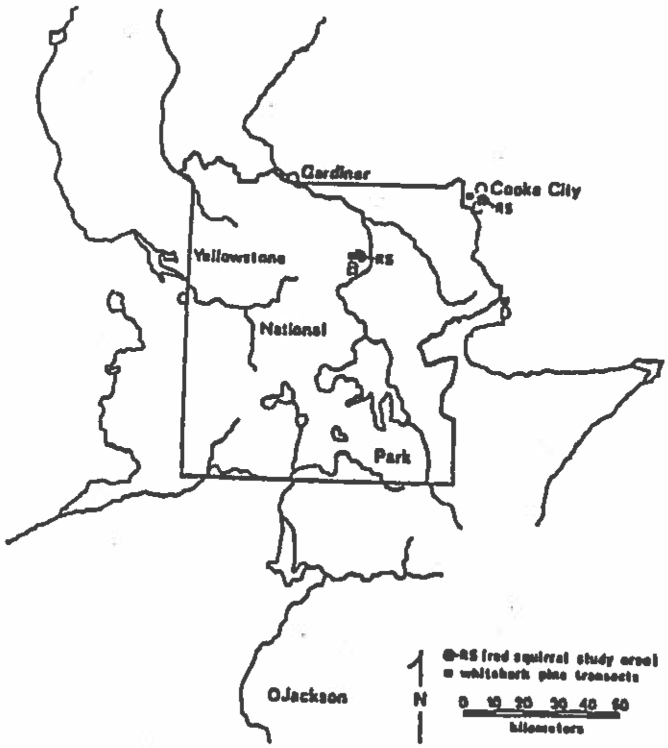

Figure 1—Location of red squirrel study areas (RS) and whitebark pine transects: Mount Washburn (B) and Cooke City (C).

The study area included five major habitat types described by Steele and others (1983). The *Pinus albicaulis* (PIAL) series habitat types prevailed at high elevations on west and south aspects. The *Abies lasiocarpa/Vaccinium scoparium-Pinus albicaulis* (ABLA/VASC-PIAL) and *Abies lasiocarpa/Vaccinium globulare-Vaccinium scoparium* (ABLA/VAGL-VASC) habitat type phases were the most common habitat types in our study area. The *Abies lasiocarpa/Vaccinium scoparium-Vaccinium scoparium* (ABLA/VASC-VASC) phase, *Abies lasiocarpa/Thalictrum occidentale* (ABLA/THOC), and *Abies lasiocarpa/Spiraea betulifolia* (ABLA/SPBE) habitat types occurred at low elevations. The wet site *Abies lasiocarpa/Calamagrostis canadensis* (ABLA/CACA) type was found near creek bottoms and seeps.

METHODS

We delineated homogeneous timber stands on USGS 15-ft topographic maps and 1:20,000 and 1:30,000 color aerial photographs. Line transects were laid out to intercept all stands so that no transects intersected and stand edge effect was minimized. Transects were laid out without bias toward timber stands or toward the monitored squirrel population. Transect lengths were determined from airphotos and corrected for slope.

Field work was conducted from mid-August to mid-September from 1984 through 1987. Beginning and end points were located using airphoto interpretation and marked with stakes. Two people walked all transects each year during daylight hours; one person maintained compass bearing and distance pacing, while the other person was responsible for observing and recording squirrel sign. Regular pauses were observed every 100 to 200 m in each stand for habitat evaluation.

All stands were identified by forest habitat type (Steele and others 1983) and forest cover type (Despain 1977; Mattson and Reinhart, this proceedings). In addition, between 5 and 28 systematically placed variable-radius overstory plots were taken in each stand (Mattson and Reinhart, this proceedings).

Red squirrel data were collected annually while walking line transects (Eberhardt 1978). Squirrel sign was referenced to transect locus and perpendicular distance from transect. All unduplicated sightings or vocalizations discerned from the transects and estimated to be within stand bounds were recorded. All individual squirrel middens observed from transects were noted and described as active or inactive based on the presence of cached cones, fresh cone clippings, or squirrels. Red squirrel activity was recorded between 0 to 60 m from transect lines. Bear activity and bear-excavated red squirrel middens were also noted.

We calculated two indices of relative squirrel abundance for habitat types and for habitat type-cover type combinations. We summed sightings and vocalizations and divided by total transect length to derive linear frequency of occurrence. Similarly, we divided total middens by transect length to derive linear frequency of middens.

Annual whitebark pine cone production for Cooke City and Mount Washburn study areas was obtained by counting cones on marked trees along predetermined whitebark pine cone transects (Blanchard, this proceedings).

RESULTS

Data were collected on up to 50 km of line transects per study year. Between 41 and 57 transects that sampled between 40 and 74 stands were walked annually on Mount Washburn. Between 15 and 22 transects surveyed between 51 and 65 stands near Cooke City.

Annual whitebark pine cone production varied widely in the study areas (fig. 2). Whitebark pine cone production was highest in 1985 and lowest in 1986. Cone crops in 1984 and 1987 were intermediate. Cooke City cone data were missing in 1984 and therefore extrapolated using simple linear-regression. Actual cone production in 1987 was believed to be higher than the cone counts indicated because of earlier than normal cone maturation and harvest and late cone surveys (Blanchard, this proceedings).

Several patterns were evident by linear counts of vocalizations plus sightings and active middens (table 1, fig. 3):

1. Relatively little squirrel activity occurred in PIAL series habitats on Mount Washburn. These were mostly pure near-climax whitebark pine stands.

2. Moderate amounts of squirrel sign were found on the drier ABLA/SPBE type and in the ABLA/VASC-PIAL phase.

3. A higher incidence of red squirrel activity occurred in more mesic habitats represented by the ABLA-THOC habitat type and the ABLA/VAGL-VASC and ABLA/VASC-VASC phases and in the wetter sites of the ABLA/CACA habitat type.

We calculated annual variation of squirrel density indices for the major study area habitat types (table 1). On Mount Washburn (fig. 3A), annual variation in squirrel abundance generally reflected annual variation in whitebark pine cone production. This pattern was most evident in the ABLA/VASC-PIAL phase but was also apparent in the other more mesic habitat types. At Cooke City (fig. 3B), sequential years' variation of squirrel densities was not as pronounced as on Mount Washburn with the exception of the ABLA/VASC-PIAL phase where variation did reflect the whitebark pine cone crop.

There were differences in the extent of variation among years between the two indices used to measure squirrel abundance (fig. 3). Linear densities of vocalizations and sightings varied more than linear densities of active middens. There was also an exponential increase in the density of vocalizations plus sightings relative to the increase in the density of active middens ($r^2 = 0.959$, $P < 0.001$) (fig. 4).

Table 1—Mean densities (n/km) and coefficients of yearly variation of active red squirrel middens for habitat types of the two study areas

Habitat type	Midden density: Mount Washburn $\bar{X}$	C.V.	Cooke City $\bar{X}$	C.V.
ABLA/CACA	3.64	0.506	2.35	0.719
ABLA/THOC	3.20	0.233	1.63	0.355
ALBA/VAGL-VASC	2.60	0.079	1.92	0.250
ABLA/VASC-VASC	2.78	0.243	—	—
ABLA/VASC-PIAL, LP cover type	3.80	0.389	4.34	0.737
ABLA/VASC-PIAL, WB cover type	1.15	0.548	1.38	0.188
ABLA/SPBE	1.53	0.580	—	—
PIAL series	0.11	0.200	—	—

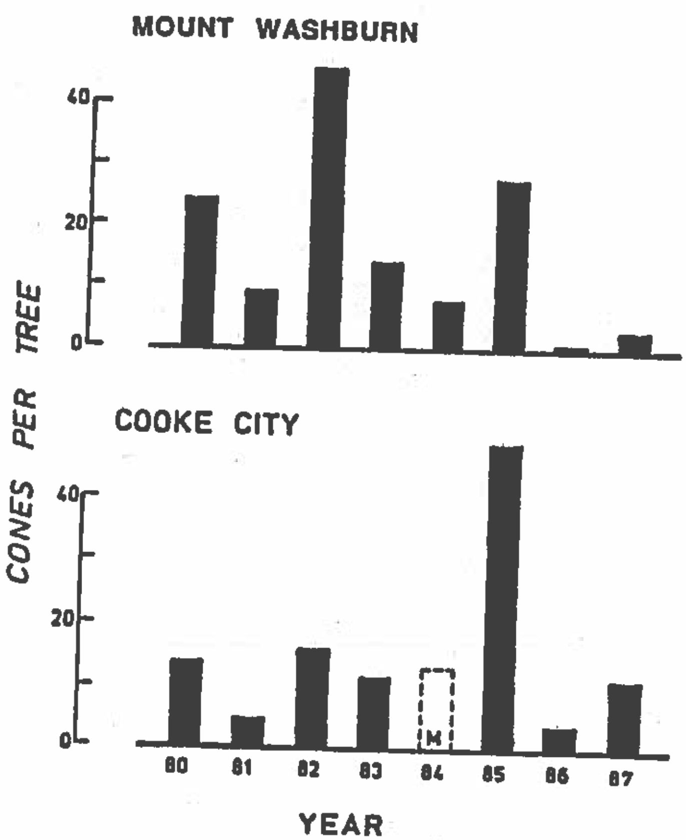

Figure 2—Whitebark pine cone production, 1980-1987, for the Mount Washburn and Cooke City study areas. Cone production for Cooke City in 1984 was extrapolated.

Average linear frequency of middens for different habitat types was positively related to average timber basal area ($r^2 = 0.675$, $P < 0.001$) (fig. 5). The ABLA/VASC-PIAL habitat type-whitebark pine cover type deviated the most from this relationship. Lodgepole pine cover types of the ABLA/VASC-PIAL phase fit the general relationship of basal area and squirrel density. At an average basal area of less than 67.7 m²/ha (90 ft²/acre), no resident squirrels occurred. Mean basal area for the PIAL series defined this extreme end point.

We also related a synthetic environmental variable, "site favorability," to mean squirrel midden abundance (fig. 6). Site favorability was an index that positively weighted direct solar radiation and negatively weighted wind exposure and elevation. Mattson and Reinhart (this proceedings) more fully described this variable. Squirrel abundance was lowest on the coldest, highest, and most wind-exposed habitat types ($r^2 = 0.792$, $P < 0.001$). Variation from this relationship was associated with overstory species diversity and higher basal areas of whitebark pine and Douglas-fir (*Pseudotsuga menziesii*). Habitat types with less squirrel densities included the PIAL series, which consisted of almost pure whitebark pine stands, and the ABLA/VASC-VASC phase, which consisted of predominantly pure lodgepole pine stands. The lodgepole pine cover type of the ABLA/VASC-PIAL phase and the ABLA/SPBE habitat type showed higher squirrel densities than expected by site favorability index. Higher levels were associated with moderate overstory diversity and relatively high basal areas of whitebark pine and Douglas-fir, respectively.

90%

 1 sqm = 1.33 sq ft

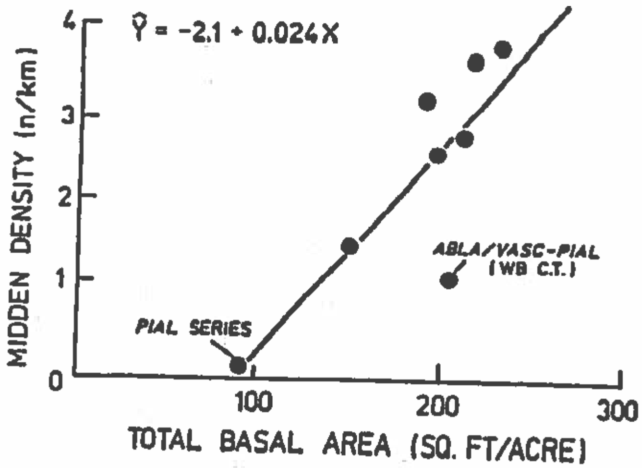

Figure 5—Relationship of active midden density and total timber basal area for the Mount Washburn study area.

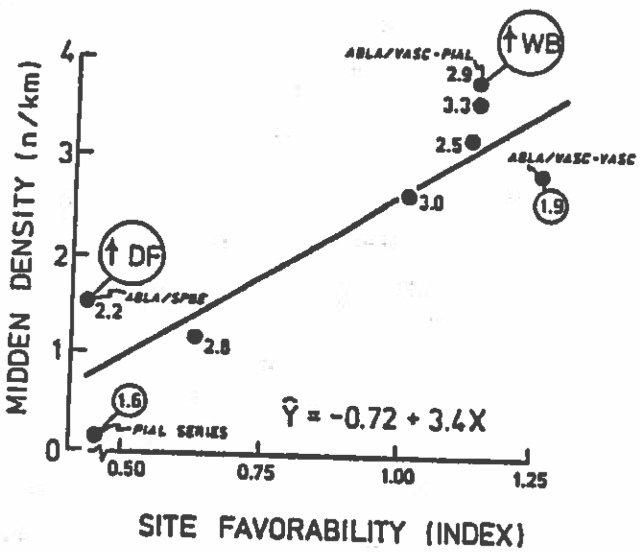

Figure 6—Relationship of active squirrel midden density and site favorability index for the Mount Washburn study area. Numbers at each datum are overstory diversity ($e^{H'}$; Shannon and Weaver 1963) for the corresponding type.

DISCUSSION

Line transects have been used in previous studies to describe the relative abundance of wild populations (Burnham and others 1980; Eberhardt and others 1979; Hayne 1949). Indirect evaluation techniques have been useful measures of animal abundance when used to compare data between areas and time periods, or to associate habitat parameters with wildlife populations (Halvorson 1984). The following criteria should be met to reduce bias and variability in auditory and visual line transects of red squirrels (Eberhardt 1978; Halvorson 1984; Hayne 1949):

1. Sample design includes standardized methods that are repeatable.
2. Transects are laid out without bias toward the monitored population.
3. Time of day or season in relation to animal activity patterns does not vary over the course of the sampling period.
4. The effects of topography and cover on animal response to the observer are known.
5. Monitoring of a population is undertaken for a time period long enough to cover full cycles of population abundance.

This study of red squirrel populations appeared to have met these criteria. Red squirrel vocalizations could be heard between 0 to 60 m from transect lines, and usually occurred when the observer entered a red squirrel territory (C. Smith 1968). Red squirrels and middens were sighted between 0 to 40 m from the transect lines. There were no apparent differences in the frequency of squirrel calls or sightings related to time during daylight hours; stand boundaries and red squirrel territories were discrete so that topography changes were not critical to our evaluation. This study encompassed 4 years that included high, low, and intermediate whitebark pine cone crops. Although more years are needed to fully monitor red squirrel population trends (Halvorson 1984), some aspects of red squirrel habitat relationships can be addressed.

The high correlation of vocalization plus sighting densities with midden densities suggests that these two indices reflected the same phenomenon, and tends to corroborate the validity of each as a measure of squirrel abundance. The greater frequency of vocalization plus sighting densities relative to midden densities could have been a reflection of our greater sensitivity to red squirrel activity because of the greater detection range of vocalizations relative to middens. The exponential increase and greater variation of vocalizations and sightings with respect to middens could also reflect positive acoustical feedback similar to ruffed grouse (*Bonasa umbrellus*) behavior (Rogers 1981). With increasing squirrel densities (midden densities), there could have been an exponential increase in vocalizations triggered as a positive response to one squirrel's initial call. We suspect that this second explanation holds, and so considered squirrel midden abundance to be a more reliable indicator of squirrel density in our study area.

The whitebark pine zone apparently constitutes an extreme of the red squirrel niche. Pure whitebark pine stands, represented by the PIAL series habitat types, were not hospitable habitats for red squirrels. Factors that may contribute to the lack of red squirrels in pure whitebark pine stands include less total overstory basal area and species diversity, highly variable cone crops characteristic of whitebark pine, and the high, cold, harsh environments associated with these stands. The more mesic and wetter habitat types supported more red squirrels. These habitats had more overstory diversity, which in turn offered red squirrels other species' cone crops when whitebark pine seeds were not available. Lodgepole pine was an important conifer species to red squirrels. Although less preferred by red squirrels compared to some other tree species (Finley 1969), lodgepole pine played an important role in red squirrel habitat by providing a more consistent source of serotinous and thus more storable cones (C. Smith 1968).

Annual variation in red squirrel densities apparently reflected general whitebark pine cone crops in stands with a moderate to high proportion of whitebark pine. This was most evident in the ABLA/VASC-PIAL phase of both the Cooke City and Mount Washburn study areas. Although cone crops of other conifer species in mixed stands were not measured in this study, they apparently played an important role in the red squirrels' food supply, especially in years of poor whitebark pine cone mast (Finley 1969). In general, squirrel densities in all habitat types were more sensitive to whitebark pine crops in the Mount Washburn study area where whitebark pine was more prevalent than in the Cooke City study area. Two factors may explain greater yearly fluctuations in red squirrel densities in stands with a substantial amount of whitebark pine:

1. The food supply associated with large whitebark pine cone crops may allow the temporary establishment of more territories and squirrels in areas that did not previously support red squirrels.
2. Bear depredation of red squirrel caches may compound the effects of variable whitebark pine crops by further disrupting the squirrel population social status, by competing for food, and by occasionally eating red squirrels outright. Squirrel remains show up in grizzly bear scats containing whitebark pine seeds (Knight and others 1987).

Regulatory factors have been identified for red squirrel populations in other study areas. C. Smith (1968) suggested that territoriality allowed individual red squirrels the optimum conditions for harvesting, storing, and defending a seasonal food supply throughout the year. He further demonstrated that territory size was related to food supply, or was inversely proportional to habitat quality. Kemp and Keith (1970) found a strong correlation between white spruce (*Picea glauca*) cone crops and red squirrel population levels. However, M. Smith (1968) showed that red squirrel populations could survive a white spruce cone crop failure by caching surplus cones during good mast years.

Red squirrel populations in our study areas may be influenced by bear use and flexible habitat requirements of squirrels. Our study area included the edge of occupied red squirrel habitat. In the whitebark pine zone this edge varied with whitebark pine cone production. In years of unusually large whitebark pine crops, red squirrels occupied pure whitebark pine stands (Kendall 1981). However, this occupancy was probably shortlived. We found little sign of permanent red squirrel occupancy in stands with a high percentage of whitebark pine. Generally, with increased site favorability and species diversity, middens were characterized by increasing amounts of cone debris that indicated a longer history of occupancy. Red squirrels apparently established transient territories in whitebark stands during years of large cone crops because of the high forage quality of whitebark pine seeds. We are not sure how this was realized, but it was probably by the immigration of juveniles or extension of ranges by established squirrels into adjacent whitebark pine stands. Squirrels probably do not survive poor mast years in nearby pure whitebark pine stands because of frequent poor crops, the lack of alternative foods, and depredations by bears that possibly deprive them of an additional year's food. Ognev (1940) described a similarly dynamic situation for the European squirrel (*Sciurus vulgaris*) in the range of Asian stone pines (subsection Cembrae). He described transient territories and even mass "migrations" following years of crop failures.

More research is needed to better understand the relationships among whitebark pine, red squirrels, and bears, as well as how specific silvicultural treatments affect this system. Longer term study is required to assess red squirrel population responses to variable whitebark pine cone crops. In mixed and pure whitebark pine stands, red squirrel densities should be monitored, as should cone mast of all conifer species stratified by age and size classes. Study of red squirrel territory sizes with respect to different habitats or whitebark pine crops, as well as territory stability with respect to site favorability would provide valuable insight into red squirrel population regulation in this zone. More data are needed to assess the interaction between bears and red squirrel populations in the whitebark pine zone. This may be approached by relating levels of midden use by bears to annual variations in red squirrel densities and whitebark pine cone crops.

MANAGEMENT IMPLICATIONS

Timber management can potentially affect red squirrel population densities in the whitebark pine zone. Whitebark pine is not considered to be a valued commercial timber species (Arno and Hoff 1989). However, timber harvests do occur in stands that contain whitebark pine, primarily in stands of higher commercial value in the lower part of whitebark pine's elevational distribution. Basal area reduction by timber harvest in the whitebark pine zone will almost certainly reduce squirrel densities. Our results suggest this effect. Other studies in Alaska (Wolf and Zasada 1975) and Ohio (Nixon and others 1980) have also documented reduction in squirrel densities following reduction in basal area of seed-producing trees.

The strong link between red squirrels and grizzly bears (Kendall 1981; Mattson and Jonkel, this proceedings) in the whitebark pine zone merits the attention of resource managers. Management of grizzly bear habitat in the whitebark pine zone is partly contingent on management of red squirrel habitat and populations. Because of squirrel habitat requirements, management for both bears and squirrels logically revolves around maintenance of diverse-species, high-basal-area stands on favorable, more mesic sites of the zone. Forest managers should be cautious when applying silvicultural practices in whitebark pine forests to "enhance" grizzly bear habitat. Leaving seed-bearing whitebark pine trees in shelterwood cuts would reduce red squirrel densities by reducing overstory diversity and basal area. Planting whitebark pine seedlings following clearcutting may benefit long-term management of these stands, but will have little positive effect until these slow growing trees are mature enough to bear cones. Both practices would increase human access and activity. Increased risk of bear displacement and mortality would outweigh any gains achieved by overt forest manipulation.

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Management and Conservation Article

Hazards Affecting Grizzly Bear Survival in the Greater Yellowstone Ecosystem

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ABSTRACT During the past 2 decades, the grizzly bear (*Ursus arctos*) population in the Greater Yellowstone Ecosystem (GYE) has increased in numbers and expanded its range. Early efforts to model grizzly bear mortality were principally focused within the United States Fish and Wildlife Service Grizzly Bear Recovery Zone, which currently represents only about 61% of known bear distribution in the GYE. A more recent analysis that explored one spatial covariate that encompassed the entire GYE suggested that grizzly bear survival was highest in Yellowstone National Park, followed by areas in the grizzly bear Recovery Zone outside the park, and lowest outside the Recovery Zone. Although management differences within these areas partially explained differences in grizzly bear survival, these simple spatial covariates did not capture site-specific reasons why bears die at higher rates outside the Recovery Zone. Here, we model annual survival of grizzly bears in the GYE to 1) identify landscape features (i.e., foods, land management policies, or human disturbances factors) that best describe spatial heterogeneity among bear mortalities, 2) spatially depict the differences in grizzly bear survival across the GYE, and 3) demonstrate how our spatially explicit model of survival can be linked with demographic parameters to identify source and sink habitats. We used recent data from radiomarked bears to estimate survival (1983–2003) using the known-fate data type in Program MARK. Our top models suggested that survival of independent (age ≥ 2 yr) grizzly bears was best explained by the level of human development of the landscape within the home ranges of bears. Survival improved as secure habitat and elevation increased but declined as road density, number of homes, and site developments increased. Bears living in areas open to fall ungulate hunting suffered higher rates of mortality than bears living in areas closed to hunting. Our top model strongly supported previous research that identified roads and developed sites as hazards to grizzly bear survival. We also demonstrated that rural homes and ungulate hunting negatively affected survival, both new findings. We illustrate how our survival model, when linked with estimates of reproduction and survival of dependent young, can be used to identify demographically the source and sink habitats in the GYE. Finally, we discuss how this demographic model constitutes one component of a habitat-based framework for grizzly bear conservation. Such a framework can spatially depict the areas of risk in otherwise good habitat, providing a focus for resource management in the GYE.

KEY WORDS Demography, Greater Yellowstone Ecosystem, grizzly bear, hazard models, known-fate analysis, road density, secure habitat, source–sink dynamics, survival, *Ursus arctos*.

The Greater Yellowstone Ecosystem (GYE) grizzly bear (*Ursus arctos*), listed as a threatened species in 1975, was formally delisted by the United States Fish and Wildlife Service (USFWS) in 2007 (USFWS 2007). The bear was relisted by court order in November 2009. Today, this population of grizzly bears lives in close proximity to humans and is what Scott et al. (2005:384) refer to as a "conservation-reliant species," that is, a species that is at risk from threats so persistent that it requires continuous management to maintain population levels.

Humans are the primary agent of death in grizzly bears. Indeed, rates of human-caused mortality determine the trajectories of most grizzly bear populations (Eberhardt et al. 1994, McLellan et al. 1999, Harris et al. 2006). Accordingly, understanding bear–human relationships and modeling the mortality risk in human-dominated landscapes have received recent attention, leading to development of increasingly comprehensive, spatially explicit hazard models. For example, building on early studies that emphasized the effects of roads on grizzly bear survival (Archibald et al. 1987, McLellan and Shackleton 1988, Mattson and Knight 1991, Mace et al. 1996, Mace and Waller 1997), recent hazard models also consider differences in land management policy, proximity to humans and human developments, terrain features, and vegetation cover, as well as sex, age, and management history of individual bears (Boyce et al. 2001, Merrill and Mattson 2003, Johnson et al. 2004, Nielsen et al. 2004, Haroldson et al. 2006). Moreover, these models have the potential to provide managers with spatially explicit assessments of risks, thereby focusing management activities (Nielsen et al. 2006).

Risk assessments are typically constructed using data from histories of radiomarked individuals or the locations of dead bears (Boyce et al. 2001, Merrill and Mattson 2003, Johnson et al. 2004, Nielsen et al. 2004, Haroldson et al. 2006). Methods to model survival from marked individuals are well established, allow for direct comparisons among habitats where bears survive and where they die, and constitute one component necessary to parameterize demographic models (White and Garrott 1990, White and Burnham 1999). Models using known mortality locations allow for an alternative approach when telemetry data are unavailable. These models compare mortality sites to random or telemetry locations but require assumptions about reporting rates and the spatial accuracy of the death sites (Merrill and Mattson 2003, Nielsen et al. 2004).

Despite progress in modeling grizzly bear mortality risk, important challenges remain. Most notably, in the GYE, a

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Grizzly

grizzly deaths 59 in GYE Tuesday, December 22, 2015 10:00 PM

From: "George Wuerthner" <gwuerthner@gmail.com>

To: "Ann Harvey" <aharvey@wyom.net>

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A grizzly bear swims across the outlet of Shoshone Lake in Yellowstone National Park where the number of ecosystem-wide bear deaths hit a record in 2015. Wildlife managers say more mortalities are expected with a larger population, but some activists are unsettled by the loss of 59 grizzlies. (Angus M. Thuermer Jr./WyoFile)

A record 59 grizzlies died in the Yellowstone ecosystem in 2015

by Angus M. Thuermer Jr. | DECEMBER 22, 2015

265 SHARES

Conflicts with hunters and livestock were among the reasons a record 59 grizzly bears died in the Yellowstone ecosystem in 2015, the federal government's grizzly coordinator said last week.

In addition to running into hunters and being removed for killing stock, grizzlies also faced a dry year and were seen more often in developed areas, said Chris Servheen, grizzly bear recovery coordinator for the U.S. Fish and Wildlife Service. He leads the effort to establish an enduring population in the Yellowstone region.

The number of deaths "was the highest number of grizzly mortalities in the Yellowstone Ecosystem since 1970," Servheen said in an email. He put the number in perspective, writing that the losses are "not a big deal in terms of population-level impacts.

"Remember," he wrote, "that there are three times as many bears in the ecosystem today as in 1970." An estimated 717 grizzlies live in the ecosystem today, according to the Interagency Grizzly Bear Study Team, but some question the accuracy of that figure.

Grizzly deaths are recorded according to sex and age. The number of females older than two years is an important component of the population. Consequently, managers have set an annual limit for adult female mortalities at 7.6 percent of the population.

In 2015 adult female grizzly deaths exceeded that figure by 0.1 percent, Servheen wrote. Adult males died at 11.7 percent, well below their 15 percent limit.

"Bottom line is that annual mortalities fluctuate in natural systems and individual years will vary," Servheen wrote.

Numbers are key part of Endangered Species Act delisting

The health and size of the population are critical factors as the federal government begins to remove Endangered Species Act protection from the Yellowstone-area population. Wyoming, Idaho and Montana could subsequently institute a grizzly hunting season.

Fifty-five of the deaths in 2015 were human-caused. Investigators are probing the death of 19 Yellowstone-area grizzly bears, according to the mortality table. "Investigation" is a label applied to probes of grizzlies believed killed by hunters, poachers or nefarious actors.

14 livestock
12 food

Fourteen bears were killed or otherwise removed from the population for conflicts with livestock and 12 for getting human food or for property damage, the 2015 mortality table shows. Five bears were euthanized through management actions, four died as a result of collisions with vehicles, two were natural deaths and three bears died of unknown causes.

The 2015 mortality figure of "known and probable" deaths exceeds the previous annual high of 55 that was set in 2012, grizzly bear advocate and watchdog Louisa Willcox wrote WyoFile in an email. There also are unrecorded bear deaths, she said, and they could bring the 2015 tally up to 90 bears.

Although the federal population estimate was set at 717, it covers a range that could be as low as 642, Willcox said. That led to her worst-case estimate.

"Bottom line: there could be as few as 552 bears in the ecosystem," she wrote. If 90 bears out of 642 were killed, that amounts to 12 percent of the official population number and would bring the ecosystem count to "below the basement level of 600."

Six hundred is the fewest bears that the U.S. Fish and Wildlife Service would allow — after delisting — before it would prohibit "discretionary mortality." U.S. Fish and Wildlife director Dan Ashe referenced that limit in a letter he sent to state game directors in September.

An agency spokeswoman said the 600-bear minimum likely would never be reached after Endangered Species Act protections are removed. "The goal would be to manage for approximately 674 grizzly bears to ensure a sustainable and resilient population that utilizes the entire available habitat in the Greater Yellowstone Ecosystem," Serena Baker wrote in an email. "We do not anticipate population numbers to dip down to 600 bears."

Members of the Interagency Grizzly Bear Study Team also say the population survey could under-estimate bears by 40 percent. That wide range perplexes some, including Wyoming Wildlife Advocates. That nonprofit advocacy group asked Ashe in November for a "definitive GYE grizzly bear survey."

Federal estimates spread over a range of plus or minus 472 bears, wrote Kent Nelson, director of the group. "At this point IGBST's 'best available science' starts looking more like a wild-ass guess," Nelson wrote Ashe.

"There is a far better alternative to the chaotic situation," he wrote. That would constitute "a survey of the GYE grizzly population using DNA hair analysis."

The current estimates are based on mathematical modeling, following observations, including those made from aerial surveys.

Clarification: The official 717 count is for the "Demographic Monitoring Area," that covers about 20,000 square miles across most, but not all, of the Yellowstone ecosystem. The IGBC mortality chart includes bears killed throughout the ecosystem. Officials have said 10 Yellowstone ecosystem grizzlies died in 2015 outside the DMA — Ed.

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SECTION 3.3

GRIZZLY BEARS AND TIMBER HARVEST

J. S. Waller and R. D. Mace

Two events that probably had a large impact on the South Fork grizzly bear population were the construction of Hungry Horse reservoir and timber harvest. Hungry Horse dam, constructed between 1948 and 1953, flooded 9,712 ha of riparian and upland habitat. Accelerated timber harvest began during the early 1950's with the removal of approximately 90 million board feet (mbf) of timber that would soon be flooded by Hungry Horse reservoir. In 1947 the maximum allowable cut (MAC) on the Flathead National Forest (FNF) was 65 mbf. New silvicultural technologies, and the increasing postwar demand for timber, increased the FNF's MAC to 127 mbf. In 1963 144 mbf was harvested on the FNF, nearly double the 1953 harvest of 75 mbf. In 1898 only 3 sawmills operated in the area with timber harvested primarily from private lands. Private timber reserves supplied local mills until the second world war. By 1953 20 mills operated in the area, and increased to 36 mills and 4 plywood plants by 1965. The forest road system expanded with the increased timber harvest. In 1939 there were 458 km of roads in the FNF, and by 1965 there were over 2,763 km of road. After the completion of the west-side reservoir road in 1953, roads were built to the heads of every major drainage in the study area from Doris Mountain near the northern terminus of the Swan Mountains to the northern boundary of the Bob Marshall Wilderness. Expansion of the road system into the Bunker Cr. drainage on the northern boundary of the Bob Marshall was controversial and hotly contested during the mid 1950's (Shaw 1967).

From the inception of the South Fork Grizzly Project, the effects of roads on grizzly bears were recognized as being an important area of research. By 1990 it was apparent that timber harvest units were a large component of the grizzly bears' environment, and thus a suitable subject for research as well. In September 1990 a graduate student was employed to document the nature and extent of cutting unit use by grizzly bears. This work culminated in 1992 with a thesis entitled "Grizzly bear use of habitats modified by timber management" (Waller 1992).

This study employed a sample of 22 radio-collared grizzly bears to document the extent to which grizzly bears used harvested habitats on a seasonal and annual basis, and how this use compared to the availability of harvested habitats. Use sites within harvested stands were sampled and compared to random sites within the same stand to determine if grizzly bears were selecting unique microsites within stands or if use sites were representative of the stand as a whole.

Thesis results indicated that grizzly bears significantly avoided cutting units, during all seasons, at the study unit level of selection. However, study animals used cutting units in proportion to their availability within their seasonal 95% minimum convex polygon home ranges. No differences in use of cutting units by age or sex class were observed. Use of cutting units increased during the summer, and clearcuts were used less than other harvest types. Grizzly bears were more likely to use cutting units harvested 30-40 years ago than older or newer cutting units. Also cutting units at higher elevations were more likely to be used than those at lower elevations.

Also in 1992 the SFGP released it's Progress Report for 1992 which addressed annual patterns of grizzly bear selection for or against cutting units by elevation class. Again, only univariate tests were conducted (Mace and Manley 1993). Results of this analysis differed only slightly from those in Waller's thesis. No preference or avoidance of specific cutting unit types was observed. Females were found to avoid cutting units at lower elevations. Cutting units less than 12 years old were used less than expected.

In 1996, we published the results of our research concerning the interaction between grizzly bears and roads (Mace et al. 1996). This multivariate analysis incorporated habitat and elevation to assess the seasonal interactions between grizzly bears and roads at 3 levels of selection. One of the habitat classes in the analysis was cutting units. This analysis found that cutting units were avoided at the 2nd order of selection (within a composite home range). However, we observed stronger selection for cutting units within seasonal home range polygons; logistic regression coefficients were positive for cutting units for 67%, 79%, and 54% of radio collared bears during spring, summer, and fall respectively.

In 1997 we published a paper addressing univariate habitat selection, and again, cutting units were one of the habitat types in the analysis (Waller and Mace In Press). Cutting units were found to be among the least preferred habitat types for both sexes during spring and fall within 95% home ranges. Conversely cutting units were among the most preferred habitat types for both sexes, within 95% home ranges, during summer.

During 1996, we attempted to publish a paper describing in greater detail the factors affecting how grizzly bears select cutting units. This publication failed the peer review process due to shortcomings in the data. Specifically, reviewers questioned the accuracy of the U.S. Forest Service records used to classify cutting units by harvest method and scarification type. No field verification of this database was performed, or was possible due to the ages of the cutting units involved. Further, the functional relationship between U.S.F.S. classification and actual ground condition was not clear. Several silvicultural systems were used on the FNF, such as clearcutting, seed tree cutting, and shelterwood cutting. Although these cutting units were classed differently, the actual condition may have been functionally the same. We made an attempt to classify cutting units by current condition using satellite imagery, but we were forced to pick one dominant cover type to represent the cutting unit. In reality, cutting units could be mosaics of several cover types, and thus have different values to grizzly bears. No relationship was found between current dominant overstory and bear use.

Another serious shortcoming that has affected other analysis efforts is the small telemetry sample sizes involved. By 1994 we had amassed 2,248 useable aerial telemetry locations on 20 individual grizzly bears, but only 254 (11%) occurred within cutting units, an average of 2 locations per bear per year. There were 1,503 cutting units within the study area, but bears were relocated in only 188 of these units (12%). One may perceive this as avoidance of cutting units, however cutting units comprise only 15% of the study area. Given these figures, it is clear that bi-weekly aerial telemetry flights were insufficient to accumulate the telemetry sample sizes necessary to analyze fine scale patterns of habitat selection.

The error associated with aerial telemetry locations further compounds the problem. About 50% of the locations in cutting units were within 75 m of the edge of that unit. Our telemetry was accurate to 75 m, thus for 127 locations classed as being in a cutting unit, we were uncertain as to whether or not the bear was actually in the cutting unit or not. In these cases the resolution of our habitat mapping exceeds the resolution of our telemetry. However, it appeared that grizzly bear distance from, or into, a cuting unit is as expected relative to the availability of distances (Fig. 3.3.1).

Despite these problems, certain aspects of this database appeared robust, and recurred in the analyses described above. The first of these is the apparent avoidance of cutting units at large scales or lower orders of selection. As selection order increased, from landscape or geographic levels to seasonal selection within home ranges, avoidance of cutting units decreased. This probably reflects the selection that occurred at lower orders and not high Type II error rates. Although the number of telemetry points was low, the number of individuals was high enough to minimize Type II errors (Alldredge and Ratti 1986).

The data indicated, and personal observations confirmed, that use of cutting units increased during the summer when huckleberries (*Vaccinium globulare*) became available. Some cutting units supported large patches of huckleberry, but there is no research that explained or predicted the spatial distribution or productivity of these patches. We have also found a consistent negative relationship between the age of cutting units and the amount of use they received. Cutting units less than 12 years old were much less likely to be used than older units.

We found that certain cutting units seemed to have seasonal concentrated use by grizzly bears. To date we have been unable to attribute this use to any factors within our databases. We suspected that concentrated use was a function of abundant food resources (these cutting units seemed to have lots of huckleberries), security (not necessarily related to proximity to open road, rather freedom from human disturbance), and the cutting units' spatial location within the study area. This last factor deserves some discussion. We believe that use was also related to a cutting units topographic position. Cutting units that had high security, abundant food, and occurred along major drainages or ridgetops received more use from resident females and males that traveled through the corridor. Also units that occurred at the intersection of several home ranges could be expected to be used by more bears than those within the core home range of a resident female.

Grizzly bears have survived and successfully reproduced within the study area despite 50 years of timber harvest (Mace and Waller 1997b). However our studies of timber harvest/grizzly bear interactions are observational and no companion study in adjacent wilderness is available to compare survival and reproductive parameters. No empirical studies of the response of bear foods to timber harvest have been conducted. Observational studies (Zager 1980, Waller 1992, Anderson 1993) suggest wide variation in responses exist. Timber harvest in other ecosystems may have a more severe effect on bear food abundance than in our study area (Anderson 1993). Ecosystem specific food studies, combined with baseline population data, would help managers deduce the effects of various land management strategies on resident grizzly bear populations.

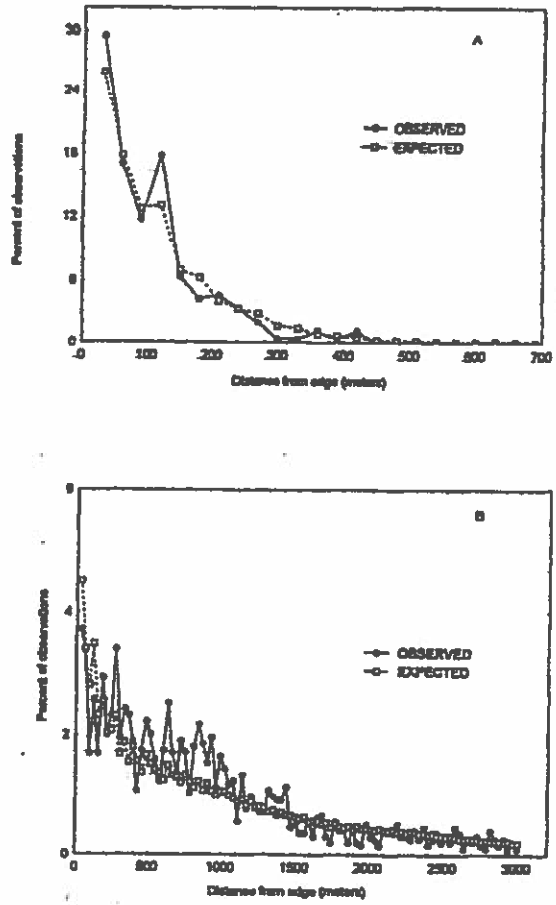

Figure 3.3.1. Distribution of observed and expected (available) distances to edge of cutting units from; A) within cutting units, and B) outside cutting units, Swan Mountains, Montana.

Grizzly bear use of open, closed, and restricted forestry roads

Robert B. Wielgus, Pierre R. Vernier, and Tina Schivatcheva

Abstract: We investigated grizzly bear (*Ursus arctos*) selection of three road types in the northern United States and southern British Columbia from 1986 to 1991. We hypothesized that grizzly bears select against open (public use allowed), restricted (forestry use only), and closed roads (no public use allowed) in that order. We analyzed use of roads for 11 bears (five females and six males) in an area containing open and closed roads and 11 bears (seven females and four males) in an adjacent area containing restricted roads. We used χ^2 and log–linear models to test for selection of habitat type and distance to road categories. Ten of 12 females and 5 of 10 males (15 of 22 bears) selected against ($P < 0.05$) low-elevation interior cedar–hemlock and for ($P < 0.05$) high-elevation Englemann spruce (*Picea engelmannii* Parry ex Engelm.) – subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.). After accounting for habitat, 4 of 5 females and 3 of 6 males (7 of 11 bears) selected against open roads and 3 of 5 females and 0 of 6 males (3 of 11 bears) selected against closed roads. No females ($n = 7$) or males ($n = 4$) (0 of 11 bears) selected against restricted roads. Our results are inconsistent with the hypothesis that bears select against open, restricted, and closed roads in that order. Most females and males selected against open roads, most females selected against closed roads, and no bears selected against restricted roads. The type of human activity along roads plays a role in bear responses to roads, and this aspect should be incorporated into future bear–road studies.

Résumé : Nous avons étudié l'utilisation par l'ours grizzly (*Ursus arctos*) de trois types de chemins dans le Nord des États-Unis et le Sud de la Colombie-Britannique de 1986 à 1991. Notre hypothèse était que les ours grizzly évitent, dans l'ordre, les chemins ouverts (au public), les chemins à accès restreint (limités aux forestiers) et les chemins fermés (au public). Nous avons analysé l'utilisation des chemins par 11 ours (cinq femelles, six mâles) dans un territoire incluant des chemins ouverts et fermés et par 11 ours (sept femelles, quatre mâle) dans un territoire adjacent avec des chemins à accès restreint. Nous avons utilisé le test du χ^2 et des modèles log–linéaires pour les tests de sélection du type d'habitat et de distance par rapport aux routes des différentes catégories. Dix des 12 femelles et 5 des 10 mâles (15 des 22 ours) utilisaient moins les peuplements de pruche et thuya de l'intérieur et à basse élévation ($P < 0,05$) et plus les peuplements d'épinette d'Engelmann (*Picea engelmannii* Parry ex Engelm.) et de sapin subalpin à haute élévation (*Abies lasiocarpa* (Hook.) Nutt.) ($P < 0,05$). En tenant compte de l'habitat, 4 des 5 femelles et 3 des 6 mâles (7 des 11 ours) ont évité les chemins ouverts et 3 des 5 femelles et aucun des 6 mâles (3 des 11 ours) ont évité les chemins fermés. Aucune femelle ($n = 7$) ni aucun mâle ($n = 4$) (0 des 11 ours) a évité les chemins à accès restreint. Nous résultats réfutent l'hypothèse que les ours évitent, dans l'ordre, les chemins ouverts, à accès restreint et fermés. La plupart des femelles et des mâles ont évité les chemins ouverts, la plupart des femelles ont évité les chemins fermés et aucun ours a évité les chemins à accès restreint. Comme le type d'activité humaine le long des chemins influence le comportement des ours, il faudrait en tenir compte lors de nouvelles études sur le comportement des ours en relation avec les chemins.

[Traduit par la Rédaction]

Introduction

The Selkirk Mountains Grizzly Bear Ecosystem (SMGBE) includes parts of southeastern British Columbia, northern Idaho, and northeastern Washington. Grizzly bears within the U.S. SMGBE are classified as threatened by the U.S. Fish and Wildlife Service (Servheen 1990). Bears within the B.C. SMGBE are classified as vulnerable by the Committee on the Status of Endangered Wildlife in Canada (Banci 1991) and threatened by the Grizzly Bear Conservation Strategy of British Columbia (B.C. Ministry of Environment, Lands, and Parks 1995*a*, 1995*b*; Wielgus 2002). Forestry activities are the major anthropogenic activity in the area. Wielgus et al. (1994, 2001) and Wielgus and Bunnell (1995, 2000) studied population dynamics and habitat use of grizzly bears in the SMGBE from 1985 through 1991 and found that population growth rate was marginal because of human caused mortalities near open roads (for a brief review of road – carnivore mortality relationships see Introduction in Gloyne and Clevenger 2001). Forestry roads were also cited as one of the biggest impacts on bear habitat use in the Grizzly Bear Conservation Strategy (B.C. Ministry of Environment, Lands, and Parks 1995*a*, 1995*b*). The

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 DOI: 10.1139/X02-084

Bears - decline since 2007

50% unreport - 90 bears 158

Fwd: Grizzly Times: Heavenly Bears, Grizzly Deaths, Louisa Willcox, 12.24.2015 Thursday, December 24, 2015 12:31 PM

From: "Louisa Willcox" <wildgriz1@gmail.com>
To: "Louisa Willcox" <wildgriz1@gmail.com>
Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Reply All Forward Actions

Happy Solstice, friends of grizzly bears,

Here is my latest blog, along with a link to a background piece (that has a lot of links in it) that tries to -breaking number of Yellowstone grizzly bear deaths this year. I also respond to the spinning and the bullshit coming from Servheen and van Manen of the IGBST in the last few days. David had a hand in the backgrounder as well.

http://www.grizzlytimes.org/#!blank/icili

Many thanks to Sara/Raen at GOAL, Bonnie and Kiersten at SC, Kent and Roger at WWA, Kelly and Bethany at WEG, Tim et al. at EJ, Andrea at CBD, Jonathan at WWP, Tom Mangelson and Penny at Cougar Fund, and the many others swinging for the Bear! They need you more than ever!

May you have peace this holiday season,

Louisa

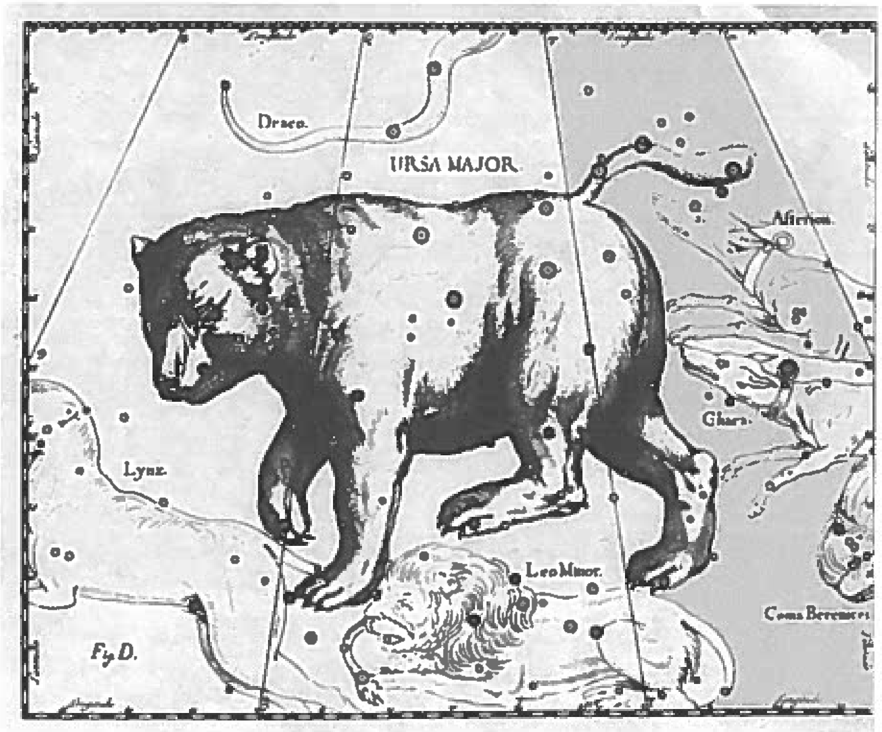
http://www.grizzlytimes.org/#!Heavenly-Bears-Grizzly-Deaths/c1ou2/567be8270cf2ee60dd7494e1

Heavenly Bears, Grizzly Deaths

December 24, 2015

|

Louisa Willcox



Stars and the heavens capture our imagination this season. No constellation is more famous than the Big Dipper, which is also known as Ursa Major, the Great Bear. In French, Grande Ourse. Italian, Ursa Maggiore. German, Grosse Bar. Ursa Major and its neighbor Ursa Minor, the Lesser or Little Bear, are the first two constellations listed in the earliest star catalogues.

Ancient peoples saw bears in these constellations, creating stories that varied widely throughout the Northern Hemisphere – the result of long nights of star gazing. The Big Dipper points to the North Star in Ursa Minor, and never sinks below the horizon at night.

Like bears that have long been seen as guides and teachers, these constellations provide literal direction.

Some Native American people saw the bowl of the Big Dipper as the body of a bear, and the three stars of the handle as her cubs. The Big Dipper has been interpreted as a bear lying on its back in winter. Crawling from its den in spring. Standing on its hind legs in summer. Tracking the seasons in its changing position in the night sky.

Stories of these constellations share a common theme: the richness of our connection with bears and nature. The Mother Bear has long been a symbol of care and nurturing, and her stories are full of generosity of spirit.

One of my favorites is the Greek myth about Ursa Major and Ursa Minor that centers on Callisto, one of the maidens of Artemis, goddess of the forest and the hunt. (Her name shares the same root word as the Latin name for bear, Arctos). Callisto was seduced by Zeus and bore a son, Arcas, who grew up to be a hunter. In revenge, Zeus' jealous wife Hera turned Callisto into a bear. Coming upon her son one day in the forest, Callisto rushed to greet him. Not recognizing his mother, Arcas took aim and was about to shoot her, when Zeus saw what was happening. He turned Arcas into a bear and, to save them both, flung them into the heavens where they were transformed into stars. She became Ursa Major, he Ursa Minor.

I wish I had the power of the Greek gods to spare bears from killing born of ignorance. This year, 54 Yellowstone grizzlies were killed by humans, shattering previous records. The leading cause was big game hunters, which is especially disturbing because there is not yet a legal hunt on grizzly bears. That happens next year if the federal government removes endangered species protections for grizzly bears. A proposed rule to delist grizzly bears is expected in January.

What will happen to Yellowstone's magnificent grizzly bears if hunting is legalized when there are already too many human-caused deaths?

The Grizzly Dead

According to the federal government, 54 of the 59 Yellowstone grizzly bears reported dead th year were killed by humans (link). This breaks the record for annual grizzly bear deaths by an cause since data started to be assembled in 1959. And it breaks my heart.

Applying a federal estimator of unknown but probable bear deaths, there most likely are another 30 plus dead bears in Greater Yellowstone. This yields a total of roughly 90 dead, or over 12% of the estimated population of 717 grizzly bears -- and a 30% increase above the next-highest year, 2010, when 43 bears were killed. A full rundown of the body count and wha it means can be found here (link).

The numbers of this year's dead are overwhelming and under-reported in the media. I know I am not alone in wishing for the power of a god to shield innocent bears from bullets.

Of Foul Play and Thuggishness
Of the bears killed this year, 19 are being investigated as possible poaching incidents (link). This is almost three times the next highest number of potential poaching incidents recorded ir 2012, when 7 deaths were under investigation.

It is almost certain that these deaths were caused by hunters (or by poachers, although the line between hunters and poachers is often blurred). In the past, deaths under investigation fe into the categories of hunter-related incidents, self-defense kills, and black bear hunters mistaking a grizzly for a black bear.

A discussion of how out of whack this year is can be found here (link).

What is going on? We may never know for sure, with so few eyes and ears in the backcountr as federal budgets and the number of backcountry personnel shrink.

But this could well be more of the notorious "Shoot, Shovel and Shut up" behavior that landec grizzly bears on the endangered species list in the first place. In other words, armed thugs tired of waiting for delisting are looking for opportunities to illegally kill bears.

A recent article in the Jackson Hole News and Guide gives a glimpse of the mindset involved (link). Two years ago, in Wyoming's remote Thorofare area, one party of hunters shot into a group of five grizzly bears feeding on the carcass of an elk they had killed. They killed a 17 year old radio-collared bear, Number 764, with .44 and .357 magnum slugs. The hunters had watched the situation for many minutes and had the chance to walk away. This was not a surprise, defense of life situation. It was an act of raw aggression. The case was not prosecuted. Almost none are.

Another incident occurred in 2010 on Mountain Creek in the Teton Wilderness (link). A grizzl bear was killed at an outfitter camp. The protocol for dealing with bears that get near camps like this one is to try to scare them away with noise, dogs and shooting cracker shells. A worker who shot the involved bear in the chest and abdomen said later he intended to "hit it ir the ass." "Son of a bitch wouldn't leave," he said.

Fear, aggression, and lack of understanding and heart. These are the kind of ungenerous anc perverse connections with bears that seem to lie at the root of today's killing spate. The polar opposite of the relationships represented in the Callisto story, which are all about an intimate and compassionate connection between humans and bears.

To think it could get worse if grizzly bears are delisted next year and made the victims of spor hunting.

Ursa Major: Iroquois Tale
Here's a different take on a bear hunt, attributed to the Iroquois. The Bear emerges from the stars in the Corona Borealis. He is pursued through the summer skies by seven hunters: Robin, Chickadee, Moose Bird (Grey Jay), Pidgeon, Blue Jay, Owl, and Saw-Whet (a kind of owl). As autumn nears, the four hunters farthest from the Bear lose the trail, with the stars setting one after the other. At last Robin fatally wounds the Bear with an arrow. The blood of the Bear colors the fall leaves red. One drop of the Bear's blood falls on Robin, coloring his breast red.

The death of the bear in this story explains the cycle of the seasons. Yes, there is violence bu it is not mean-spirited. It is part of the fabric of life and the ecology of the human imagination that ties Robin and the other birds to the Bear and the vibrant hardwood forests of the northeast.

If you truly lived by the ethos of such a story, shooting into a group of innocent bears would b an anathema.

Losing True North

The agencies responsible for managing Yellowstone's grizzlies have responded to this year's spike in potentially illegal mortalities with stunning silence. The topic of these deaths was a nc -issue at recent meetings in Jackson and Missoula, which were instead a stage to glorify agency "successes" and promote delisting (link). Essentially, the agencies are committed to expediting delisting and hunting bears no matter what. It seems easier to legalize poaching than try to deter it, which, if so, begs the question why the agencies are so eager to placate people who behave like criminals.

The government, charged with restoring imperiled species on behalf of all of us, seems to ha lost its way. I have written previously about the heartless government mindset. The metaphor that came to mind was that of a zombie in service of some relentless master (link).

The US Fish and Wildlife Service (FWS), that leads recovery of Yellowstone's grizzly bear population, has been enslaved to the agenda of state politicians who see bears only as thing to be dominated and killed (link). Despite their mandate – and what could be a more compassionate mission than to save species – the FWS is now catering to the thugs.

Further, all of the government agencies are banded together in pursuit of the age-old tactic of avoiding the problem by attacking their critics, including scientists, advocates, and the 41 Indian Tribes that are opposed to delisting. At the recent meetings of agency managers, the Tribes, which have been raising objections over killing and hunting grizzly bears on spiritual and cultural grounds, were criticized by the government as being out of touch with reality (link

The Tribes have not forgotten the direction of True North, of course. They object to delisting because it would give authority for managing grizzly bears to the states, which are yet bastior of the ethos of Manifest Destiny that drove the genocide of Indian people and the slaughter o millions of buffalo, wolves and grizzly bears in the name of progress.

The debate over grizzly bears highlights the battle we are engaged in today, which is over stories: killing and dissociation versus reverence and respect.

Unbearable Killing

Government data puts the lie to agency claims that the population can absorb high levels of mortality. The Yellowstone grizzly bear population is no longer growing, and more likely has been declining since 2007 (link). This trend is probably explained by high rates of mortality in the wake of the loss of two former key native grizzly bear foods, cutthroat trout and whitebark pine (link). Bears have turned increasingly to foraging on meat, mostly cows and big game, which draws them into mounting conflicts with ranchers and hunters (link).

As the US Fish and Wildlife Service has long recognized, most bear-human conflicts are avoidable. The solutions are not starry eyed, but practical. They include paying attention and being prepared to encounter bears in the backcountry (link). Carrying bear pepper spray (link Keeping clean camps. Dealing responsibly with dead game to help keep grizzly bears alive.

These are some of the tools of coexistence. Our choice to use them, or bullets, depends on the story we choose to tell ourselves.

Ursa Major: Zuni Tale

The Great Bear guards the land from the frozen gods of the north. In winter, the land is ravaged by the frozen breath of the ice gods as the bear sleeps. In the spring, when the bear wakes, she drives the frozen gods back and the land is refreshed.

This Zuni story gets to the heart of the meaning of the bear throughout our shared history: renewal and transformation. An animal that seemingly dies underground in winter and emerges with new life in spring is, indeed, a miracle. To people who watched bears disappea into the earth when it snowed and reappear when the plants sprouted, bears represented the changes of the seasons, and the rebirth of life.

It is still amazing: no matter how much scientists have learned about hibernation and the general lifeways of bears, they are still in awe at the power and mystery of the bear (link).

Today, we have the power of life and death over the Great Bear. If unchecked, an armed and hostile few, aided by the government, will continue on the path of aggression and the grizzly bear in Yellowstone will likely be pushed back to the brink of extinction. The interests of the majority who want to see bears alive and flourishing around the nation's oldest park could be sacrificed for those of a death-oriented minority.

And we could pay a bigger spiritual price. By turning our back on the stories that Ursa Major reminds us of each night, we reject ancient, life-affirming connections with the earth and the cycles of the seasons.

What kind of world will the grizzly bear wake up to next spring? What will we look to for direction? Find Ursa Major and you can always find True North.

As daylight slowly returns to the Northern Hemisphere, may light shine in our hearts also.

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- Why Delisting is a Bad Idea: http://www.grizzlytimes.org/#!delisting-a-bad-idea/c15sd
- Orienting to Grizzly Bears: http://www.grizzlytimes.org/#!taking-our-bearings/c11sy
- Cool Video: The Changing World of Yellowstone Grizzly Bears: https://m.youtube.com/watch?feature=share&v=VogRHZr0bNQ

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Delete Reply Reply All Forward

Fwd: Grizzly Times: Don't Delist, Risk Yellowstone Grizzly Bears' Future, Louisa Willcox Thursday, March 10, 2016 10:29 AM

From: "Louisa Willcox" <wildgriz1@gmail.com>
To: "Louisa Willcox" <wildgriz1@gmail.com>
Bcc: sjjohnsonkoa@yahoo.com

Full Headers Printable View

Hi Friends of Grizzly Bears,

Here is more background on why delisting is a terrible idea... Still no federal register notice published yet.

But with FWS essentially saying they will ignore any comments that "just say no" to delisting without justification, I thought it was important to provide ample rationale. There is a lot more to say, but this is a start...

Will let you know as more details emerge, Please be in touch if you have questions!

Best, Louisa

http://www.grizzlytimes.org/#!Dont-Delist-Risk-Yellowstone-Grizzly-Bears-Future/c1ou2/56e18ea70cf2e27c763fff0e

Don't Delist, Risk Yellowstone Grizzly Bears' Future

March 10, 2016

|

Louisa Willcox

As Yellowstone grizzly bears begin to reemerge from their dens after winter hibernation, they awake to a debate over what may be their first sport hunt in over 40 years. This was triggered by last week's proposal b US Fish and Wildlife Service (FWS) to remove federal endangered species protections.

Grizzly bears awaken too to a world of mounting threats, including a warming climate, ever more humans, poorly managed livestock, sloppy and incautious big game hunters, and isolation from other bear populatior

It is sad, but true, that without the vital safety net provided by the Endangered Species Act (ESA), Yellowstone's vulnerable grizzly bears will likely be pushed back to the brink of extinction. Here I briefly summarize the major reasons why delisting is premature and needlessly risks the future of the grizzly bear i and around our nation's oldest park.

Yellowstone's current population of roughly 650 to 750 grizzly bears is much smaller than the 2000+ animal widely considered by experts to be necessary for long-term viability. Altogether, the five remaining grizzly bear populations in the lower-48 states number perhaps 1500, a mere 1-2% of the 100,000 grizzly bears tha once roamed the contiguous U.S. in a range that was formerly 100 times larger.

The federal government plans on deliberately perpetuating this precarious situation, even though it means trucking bears into Yellowstone every ten years to deal with genetic problems, and trusting state wildlife management agencies that have notoriously anti-carnivore track records.

We can do better. Yellowstone grizzly bears can be reconnected naturally to the more robust grizzly bear populations that live in Canada and lands surrounding Glacier National Park. But with mounting numbers of ranchettes, second homes, and hunters prospectively in pursuit of a grizzly bear trophy, the window of opportunity to link these grizzly populations is closing fast.

Caught Between Love and Aggression

The grizzly bear has been called "uncle," "grandmother," and "healer" by native peoples around the world, whereas the European-given Latin name, *Ursus arctos horribilis*, bespeaks a more negative, fear-based relationship.

Today, while more people embrace protecting wild animals and their ecosystems, views of grizzly bears are still conflicted. Just as families flock to Yellowstone and Grand Teton parks to catch a glimpse of a grizzly bear in the flesh, ranchers outside the parks pressure state officials to kill them to protect their cows. More fundamentally, the debate about grizzly bear delisting is about competing values, one oriented to life, the other death.

With the passage of the Endangered Species Act (ESA) in 1973, we as a nation rejected the ethos of domination that had resulted in the slaughter of wolves, bison, grizzly bears, and other species. We chose t embrace instead an attitude of respect and reverence for nature. Without the ESA's protections, including a prohibition against hunting, grizzly bears would likely have been relegated to just a few bears hanging on in the confines of Yellowstone Park.

But under the ESA's umbrella, grizzly bear numbers have probably doubled in Yellowstone since protection were instituted in 1975 (link). Population growth has been particularly slow because grizzly bears have one the lowest reproductive rates of any terrestrial mammal; a female in Yellowstone is lucky to replace herself with another reproductive female in her lifetime.

That the population has increased is cause for celebration. But bears are not out of the woods yet. Their future lies in our hands and in our practice of tolerance. Codifying respect for nature, the ESA has helped resolve our conflicted views about grizzly bears, but all bets are off if protections are removed.

An Unraveling Ecosystem, Leading to More Grizzly Killing

As scientists teach us, and as Native peoples know full well, the grizzly bear serves as a window into the complexity of entire ecosystems. The bear eats everything from ants to bison plus hundreds of plants in between. It knows when and where foods are most palatable, and it monitors them constantly for their nutritional quality, teaching their cubs to do the same. To win the seasonal war of calories, in preparation foi hibernation and winter birthing, the grizzly bear has to be a champion forager, which means keenly observir the subtlest details of the natural world.

We humans also have long watched what the bears ate, and followed suit. Foods that fatten bears sustain u as well: salmon, acorns, bison, elk, moose, berries, and pine seeds. In Yellowstone, grizzlies have historica depended on just four key foods for most of their energy and nutrients: seeds from whitebark pine, meat fro elk and bison, army cutworm moths, and cutthroat trout (link).

Tragically, since the early to mid-2000s, two of these critical bear foods have been essentially wiped out (link). Trout in Yellowstone Lake have been victims of drought, climate warming and predation by a nonnati fish. Mature cone-producing whitebark pine have been clobbered by the spread of a non-native fungal disease called blister rust and by an unprecedented climate-driven outbreak of bark beetles.

That leaves only two of the historically most important bear foods: elk and army cutworm moths. Yet most e populations have declined dramatically from highs reached during the 1990s and early 2000s, and moths ar imperiled by the projected disappearance of their alpine haunts during the next 50 to 100 years (link).

Meanwhile, bears have been compensating by eating more meat, especially from cows and the remains of hunter-killed elk. Despite the protestations of government "experts," dandelions and mushrooms don't cut it (link). Unfortunately, with the turn to meat, trouble with livestock operators and hunters has mounted, resulting in dramatic increases in the numbers of grizzlies dying each year because of meat-related conflicts (link). In fact, mortality rates are now at unsustainable levels.

Grizzly bears reminds us of what John Muir famously wrote: you can't "...pick out anything by itself [without finding] it hitched to everything else in the Universe."

There is a bottom line to all of this. Now could not be a worse time to remove ESA protections, as the Yellowstone ecosystem unravels. Yellowstone's grizzly bears need access to a lot more wild country to compensate for the loss of critical foods. They also need continued protections, incentives, and resources offered by the ESA.

Absent federal control and oversight, the states have little inclination and few resources to deal with mountir conflicts. Worse yet, these states intend to use a sport hunt and freer killing of bears involved in conflicts to reduce the size and distribution of Yellowstone's grizzly bear population.

Indeed, the central problem with delisting is that grizzly bears would be managed by anti-carnivore states.

State Management: of Domination and Handshake Agreements
Wildlife management in western states continues to be organized around controlling nature and killing large carnivores to produce a "harvestable surplus" of elk, deer, and other large herbivores. More to the point, wildlife managers in Idaho, Wyoming, and Montana are locked down in service of a politically influential minority who place top priority on opportunities to hunt big game (link). The interests of outdoor enthusiasts who prize anything other than hunting are not represented on the commissions or among the leaders of the state wildlife management agencies.

State managers commonly see large carnivores as tacit competitors for big game hunting licenses, which a the cash cow of these agencies. This despite the fact that there is no evidence that carnivores typically harn big game populations -- and plenty showing that excessive hunting does have major negative impacts, alon with climate change and drought.

Nonetheless, sport hunting has been used during recent decades by state managers to drive down populations of mountain lions and wolves, and accounts for roughly 70-80% of adult carnivore deaths in the Northern Rockies. State managers will almost certainly treat grizzly bears in the same ways as they do othe large carnivores -- which will preclude ever securing connections between ecosystems.

This is especially true given grizzly bears' inherent difficulty colonizing new habitats, due to females' tenden to stay in or near their mothers' range. (This lack of resilience contrasts with that of wolves and mountain lions, which reproduce at higher rates, and readily colonize areas hundreds of miles away.)

For these and other reasons, grizzly bears will be acutely vulnerable to the effects of sport hunting. Moreove the first bears to be killed will be those on the periphery of ecosystem best positioned to connect with other bear populations, as well as the highly popular and tolerant bears that frequent roads inside National Parks and occasionally range into non-park jurisdictions.

One big problem with the plans developed by state agencies to manage grizzly bears after delisting is that there is no binding commitments to do anything other than hunt bears. Despite some laudatory language or coexistence, all suggestions are voluntary.

The same is true of the Conservation Strategy (CS), developed to guide the monitoring of bears and bear habitat on public lands once ESA protections are removed. As FWS admits, the CS cannot compel any agency to do anything (link). It is a 100 plus page handshake agreement.

One of the biggest problems facing grizzly bears is the lack of any enforceable limits on mortality once delisting has occurred. What will happen if grizzly bear deaths exceed prescribed levels? The post-delisting plans do not compel ANY response. In fact, state laws don't limit but rather promote killing grizzly bears.

Even if the states were inclined to do more for grizzly bears after delisting, they lack most of the relevant authority. According to the federal government, over 40% of habitat currently occupied by grizzlies in the Greater Yellowstone lies outside an antiquated Primary Conservation Area (PCA) that was delineated decades ago primarily to serve political purposes.

After delisting, no habitat protections would apply in the extensive areas excluded from the PCA. Moreover, most areas occupied by grizzly bears are federally-administered public lands over which the states have no direct control.

In short, nothing in state management is about compassion for grizzly bears, which will get anything but a safety net after delisting. The fact that there is no free board and huge uncertainty regarding the size of the population exacerbates the problem.

Biased and Unreliable Numbers
You often hear from government officials how we have grizzly bears coming out our ears and that the population has grown at a rapid clip for decades.

Although some growth has likely occurred, it is much more modest than advertised. According to federal data, the population is probably declining as a result of high death rates linked to deteriorating habitat conditions (link). Moreover, recent research has shown that the methods used by Yellowstone's grizzly bear managers to assess the status of the population are unreliable and fatally biased (link).

The government's refusal to release the raw data upon which population estimates are based is making matters worse. These data have been paid for by taxpayers, and should be made available for independent review. Until then, the claims of scientists operating under a government monopoly should be treated with skepticism.

Dismissing the Spiritual Concerns of Nearly 50 Indian Tribes
The Tribes have emerged as another major critic of the government's science and management of grizzly bears. Native people across western North America saw grizzly bears as relatives, teachers and guides vita to their cultural and spiritual health.

Not surprisingly, the proposal to delist and permit sport hunting of grizzly bears is an anathema to most Indians. So far, nearly 50 Tribes, from Canada to Mexico, have passed legal resolutions opposing delisting and trophy hunting of grizzly bears (link).

As sovereign nations, Tribes are demanding that the federal government formally consult with them to address their concerns about delisting. Reasonably enough, they seek a moratorium on delisting until an adequate consultation process has been completed. The Tribes are also articulating an alternative vision fo recovery of grizzly bears, involving restoration of bears on lands tribes own or have legal claims to.

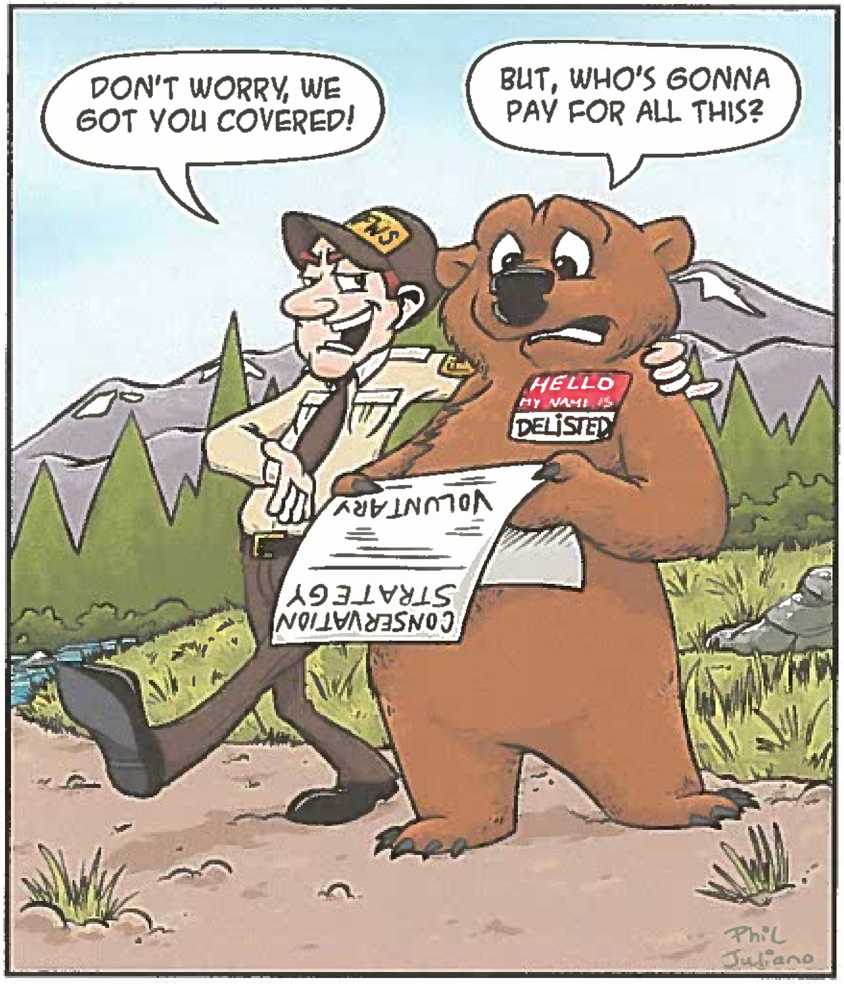
But so far, state and federal agencies have exhibited a disturbing lack of respect for the Tribes. Which is no surprising given the long history of racism among federal and state bureaus, and the deference of wildlife managers to largely white male hunters, typically at the expense of the broader public interest.

We Can Still Achieve Grizzly Bear Recovery

We can still achieve lasting recovery for our remaining grizzly bears, and in a way that respects the interest: of all Americans. We have ample wild habitat capable of sustaining a contiguous grizzly bear population fro Yellowstone to Canada (link), but only if we protect these wildlands now and expand programs that foster coexistence between the people and grizzly bears living in connective habitat. We do not need to truck bear around to address genetic problems – bears can deal with the issue naturally, if we let them.

The grizzly bear is as an ESA success story even if bears in Yellowstone are not delisted any time soon. Science shows that grizzly bears are still threatened throughout the Northern Rockies, and will probably remain so for the indefinite future. But by sharing space with them as they seek the food that they need in ever-larger areas, we will insure that grizzly bears will be here for generations yet unborn to marvel at.

With their ability to awaken after a long winter of seeming death, the grizzly has long embodied the promise of transformation. In fits and starts, as a society we have been of transforming our relationship with grizzly bears to one that is more life-affirming. But now is not the time to gamble with their future.



Money and politics have driven decisions about the fate of Yellowstone's grizzly bears for the last 50 years. You often hear that more is known about Yellowstone grizzly bears than any other population of bears. But the truth is that managers and researchers here have benefitted from ample resources to support research and monitoring primarily because of the controversies that surround this population, not because of any greater curiosity or competence on the part of those involved.

Money will continue to matter after the removal of federal endangered species protections for Yellowstone's grizzly bears, because the government will rely on implementation of the expensive post -delisting Conservation Strategy (CS) to maintain the population. According to the delisting rule published last week (hereafter, the Rule), inadequate funding to implement the CS could trigger a status review of the population and possible relisting (link).

While on one hand the US Fish and Widlife Service (FWS) touts the CS as a key part of "adequate regulations" for protecting Yellowstone's grizzlies, the agency at the same time admits that the CS cannot compel any land or wildlife management agency to do anything. (link). Everything in the plan, including funding, is voluntary.

How can both be true? Well, they can't. Here, the government speaks out of both sides of its mouth, telling all sides what they want to hear.

Even if management agencies want to implement the CS, there is no reliable source of future funding for implementation, which amounts to about $3.8 million per year, not accounting for inflation (link). Agencies can't obligate funds -- Congress and state legislatures jealously guard that duty. In the Rule's discussion outlining which agency is supposed to do and spend what, the FWS reinforces this basic truth, saying that the: "[CS] neither obligates nor implies a requirement for the identified party to implement the action(s) or secure funding for implementing the action(s)".

The fact is that implementation of the CS relies on funding from no fewer than eight different entities, any one of which could withdraw funding at any time. The likelihood of funding shortfalls is all the greater because successful implementation of the CS requires an astounding 50% increase of annual budgets from pre-delisting levels of around $2.5 million-- to roughly $3.8 million. This comes at a time when both federal and state agencies face an unprecedented funding crisis, especially the US Forest Service. More on this later.

Furthermore, the FWS relies on 3 Indian tribes--the Shoshone Bannock, Northern Arapaho, and Eastern Shoshone—to participate in funding and implementing the CS. These very same tribes face enormous financial challenges, and have passed resolutions opposing the delisting decision. What are the chances that the tribes will fund a plan they do not support and cannot afford?

Why Managing Grizzly Bears Post-Delisting Is So Expensive
Grizzly bear recovery costs a lot because of the expense involved in monitoring bears and their habitat using all of the requisite radio-collars, airplanes, field checking, etc. Also, it is not cheap to prevent and manage human-bear conflicts, including buying bear-resistant dumpsters and replacing them when they wear out, as well as educating the many thousands of Yellowstone's visitors about how to recreate safely in bear country. Adequate funding is especially important in the case of Yellowstone's grizzly bears because this population is genetically so vulnerable that it will require perpetual life support in the form of expensive importation of bears to address genetic concerns.

And monitoring what is happening with the population and its habitat is particularly critical if, as proposed, the government loosens restrictions, turns increasingly to killing bears to resolve conflicts, and allows trophy hunting for the first time in 40 years. Delisting will lead to a smaller population, thus adding risk to a situation that is already fraught in light of the increasingly excessive human-caused mortalities that have occurred during most of the last 10 years. A breathtaking 61 grizzly bears died in 2015, 55 of them human caused – possibly an unsustainable 12% of the population (link).

If hunting and otherwise killing more bears were not in the cards, it might be possible to spend less money on monitoring.

The Problem of Accountability
When the FWS last attempted to delist Yellowstone's grizzly bears in 2007, they had no accounting system in place to allow the involved agencies or the concerned public to determine when funding gaps had occurred and how large they might be. Nothing has been done to remedy the problem since then.

Worse, members of the Interagency Grizzly Bear Committee (IGBC), which oversees management of listed grizzly bear populations in the lower 48 states, spent much of last winter's meeting in Missoula arguing about the purpose and duties of the committee. The identity crisis seems far from over (link).

It is true that there are many in state and federal agencies who have good intentions when it comes to fostering co-existence between grizzly bears and humans. These good intentions that have been expressed in various documents focused on a post-delisting world. But the road to extinction is paved with good intentions. The Endangered Species Act requires more.

The 2007 Delisting: A Cautionary Tale
The story of what happened when grizzly bears were delisted in 2007 provides a cautionary tale. There are many readers who probably know that the FWS' 2007 delisting rule was overturned in federal court in 2009, because the rule pretty much ignored all of the science highlighting the threats posed to Yellowstone's grizzly bears by losses of whitebark pine, a key grizzly bear food source that was all but wiped out by an unprecedented climate-driven outbreak of mountain pine beetle.

But most do not know that, during the two years that Yellowstone grizzlies were delisted, the agencies blew through a windfall of $2 million and still fell far short of funds to implement the Conservation Strategy.

Here is what happened. A strident opponent of the Endangered Species Act and avid supporter of grizzly bear delisting, then Montana Senator Conrad Burns, served as Chair of the Interior Appropriations Committee. In the days when congressional earmarks were as common as mud, he was able to earmark $1 million/year for the first two years after delisting to support grizzly bear management (link). Knowing that inadequate funding would be a problem jumped on by those who opposed delisting, Burns' intent was to make this issue disappear for a while.

But it didn't. As I pointed out earlier, there was no central recordkeeping of how the funds were spent. After repeatedly being denied requests for whatever records the agencies had kept, I secured a response through a request from then Montana Senator Max Baucus. Even with the extra cash, the funding gaps were striking. The Forest Service showed a funding shortfall of at least $0.5 million during these 2 years post-delisting management, and Montana was $170,000 or so short (link). The problem was likely worse, but records from other agencies were so incomplete as to be incomprehensible. Burns' $2 million funding buffer proved far from enough.

Since that time, congressional earmarks were banned because of their widespread abuse. They no longer provide an option for filling the gaps, which are likely to be greater this time around.

Government Agencies are Strapped More Than Ever
Delisting comes at a time when funding for agencies such as the Forest Service has been tanking, with support for management of wildlife habitat hit hardest. By contrast, fire management and related extractive uses such as "forest restoration" logging now get the lion's share of funding. The Bridger Teton National Forest budget has declined by 30% (link), and the future is not likely to bring improvements.

State wildlife management agencies are in no better shape. Even though Wyoming was relatively flush until recently due to energy-related revenues, it is loath to spend on conservation of grizzly bears, which are seen a competitors for their cash cow, big game such as elk (link).

In light of the States' zeal to keep the grizzly bear off the endangered species list once they wrest control away from the federal government, there is little chance that funding shortfalls could trigger a relisting, no matter how bad the problem. Meanwhile, given the larger economic forces at play on both the state and federal levels, funding shortfalls will likely only increase.

Hunting Grizzly Bears Won't Generate Net Revenue
You hear from some quarters that hunting grizzly bears will generate revenue for the states that will offset the cost of management. This is bunk.

Wyoming officials have announced that they will charge nonresidents a fee of $6,000 for a tag to hunt a grizzly bear and residents a fee of $600 (link). It is not yet clear what Montana and Idaho will do: they could follow Wyoming's lead, or possibly the example of Alaska or British Columbia. In Alaska, the costs of a brown bear tag for residents are $25, for nonresidents $500, and for "aliens" $650. In British Columbia a tag for a resident is $80 and a nonresident $1,050. Given the level of harvest, none of these tag fees come close to covering the costs of bear management in either Alaska or British Columbia.

Given that the northern Rockies states will, combined, be sport hunting no more than a couple of dozen grizzlies, license-related income will only be a trivial fraction of grizzly bear-related expenses, outweighed by the rising costs of management outlined in the CS.

To the extent that a hunt has economic value, the lions share goes to the outfitter – and outfitted hunts start at $15,000. But right now in Greater Yellowstone, outfitters are increasingly dependent on watching rather than killing wildlife – and this is the overall trend in recreation and public demand regionally and nationally. The fact is that hunting is an industry in decline. Since 1998 hunting has declined by over 40% in Greater Yellowstone (link), and the trend is expected to continue. In any case, while you can still justify subsistence hunting of birds and big game, killing carnivores is about little more than gratifying the ego and libido.

By contrast, alive, wildlife is worth over a billion annually (link), and provides the base of the economic and cultural well-being of the region.

Rather than generating revenue, hunting grizzly bears will give the Northern Rockies states a black eye. It will come at the cost of the growing outfitting industry that depends on something other than killing. Further, by hunting bears at a time when the ecosystem is unraveling (link), states are risking the future of the Great Bear. Hunting will invite an even more expensive emergency response if and when relisting is necessary.

Grizzly Bear Trust Fund?
To fill the funding gap, people inside and outside the government have been talking for the last 25 years about creating a trust fund for managing grizzly bears, and possibly other large carnivores such as wolves. No matter how you cut it, large carnivores are expensive, with high costs entailed by both monitoring and reducing conflicts. It makes sense to establish a stable source of funding not subject to the vagaries of Congress and state legislatures.

But no one has sorted out how to do this. No billionaire grizzly bear fan has decided to part with several millions to make this idea a reality. Given the government's chronic accountability problems, I doubt that this idea can be realized unless it is made truly separate from the government, with a rigorous system of transparent record-keeping.

Funding is important to sustaining Yellowstone's grizzly bear population. It is time for the government to come clean and admit that the funding is not in place to manage grizzly bears after delisting and fulfill the terms of the Conservation Strategy. Nor is there a system of accountability in place. Sport hunting and the promotion of ever more bear killing will increase risk for Yellowstone's grizzlies. With this risk comes a demand for rigorous monitoring at a time when the government is increasingly short on funds.

What happens if the needed funds are not forthcoming? A likely scenario over time is that we will know less and less about the status of bears and their habitat. As is the case now, the government will likely continue to hold its monopolistic death grip on Yellowstone's grizzly bear data as a means of preventing close scrutiny of its science. Meanwhile, the states will probably continue unsustainable levels of sport hunting until population problems are so obvious that they cannot be denied. At which point, interventions are hideously expensive – but more important, too little, too late.

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