

A review of the Grizzly Bear Recovery Plan: draft Recovery Plan Supplement: Habitat-Based Recovery Criteria for the Northern Continental Divide Ecosystem.

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I have worked as a research ecologist on grizzly bears and mountain caribou in British Columbia for 40 years, I have studied grizzly bears using VHF and GPS telemetry plus DNA based sampling in 7 population units in this province. Most relevant to this review, I have studied grizzly bear population ecology on the northern boundary of the US Northern Continental Divide Ecosystem (NCDE) for 39 years. There, I have monitored the fates of almost 200 different individuals using radio-telemetry. Working so close to the NCDE, I am well aware of the progress of grizzly bear research and management south of the border. Over these decades, I have been impressed not only by the accumulation of knowledge on bear ecology and their requirements in the NCDE, but also how the information as resulted in science-based management actions, that in turn, has led to the recovery of this population.

The basis of the NCDE Habitat-based recovery criteria is to maintain conditions for bears as good or better as those in 2011 when the grizzly population was rapidly recovering with the logic that the situation that enabled the bear population to expand should be sufficient to maintain the population into the future. This logic appears rational to me provided the important conditions do remain similar.

I have one comment that is largely editorial in nature that I hope will increase clarity and a few others that are more functional that I think should be at least considered or mentioned.

The editorial comment:

1. Each habitat criterial measurement varied greatly among BMUs in 2011 (2014 in Appendix B). Although the plan suggests that criteria will be measured for each subunit, and changes and rate of changes will be limited for each subunit, this constraint is not clear in the italicized statements. For example, on Page 5, I think it should read (I've

identified the addition by capitalizing, but change to lower case if you agree):

“The percent/amount of secure core habitat and open and total road densities on Federal lands WITHIN EACH SUB-BEAR MANAGEMENT UNIT AND within the recovery zone is maintained at or above baseline levels that existed in 2011”.

I think this is important because of the guideline that existing roads can be closed to accommodate building new roads, which could keep road densities and secure core habitat measures the same. But closed roads are usually much easier for people to walk, ride a horse or a bicycle on than if no road had ever been built. If road densities could be averaged over the entire recovery area, then it would be possible to end up with closed roads, that are relatively easy to walk or ride on, almost everywhere. This would not be like conditions in 2011 when many subunits have very few if any open or closed roads but are largely wilderness. The actual difference in human use of areas behind closed roads to areas that have never been roaded should be measured and accommodated, if the goal is to maintain conditions similar to what was found in 2011.

Ecological Comments:

1. (Page 5). As is stated on Page 2 (the first page of text), bear populations are primarily affected by the availability and quality of food sources and the levels and types of human activities, or more specifically the lethality of the human activities for bears. Road density, either OMRD or TMRD, can control the distribution of people in vehicles but may not affect the number of vehicles or people using the road network. The amount of use on the road network may affect bear populations as traffic volume has been shown to affect displacement and no doubt the chances that someone will kill a bear. The relationship between the amount of use a road network receives and the number of bears that people end up killing is unlikely linear but likely positive. The number of people on the road network in the future will also likely impact the amount of human use of secure core habitat areas. I think that the likelihood of a change in the amount of human use of the road network and secure core areas compared to the 2011 benchmark should be mentioned and suggestions made on how such changes will be accommodated.
2. Page 6. I do not follow the logic that it would be fine to add one campground per BMU per decade because that rate of increase (one per decade) occurred when the grizzly

bear population was increasing. It's will not the rate that campground are added (number per decade) but the number of campgrounds (and camps/campground) that will affect bears. Just because the bear population grew when the number of campgrounds went from, for example, 1 to 2 in a decade, does not mean the bear population would be fine with 2 to 3 in the next decade or 12 to 13 a century from now. I'm not suggesting that more campgrounds cannot be added as the behaviour of people in the campgrounds is also very important (i.e garbage and firearm rules), but the logic behind the of rate of addition, I don't find correct. I agree with the suggestion to evaluate each development proposal.

3. Again, on Page 2 the plan states that bear populations are primarily affected by the availability and quality of food sources. The relationship between high-caloric foods (particularly salmon and berries) and grizzly bear density has been shown and this relationship was highlighted in the Conservation Strategy for the Grizzly Bear in the Greater Yellowstone Ecosystem. In that strategy, 4 high caloric foods, whitebark pine, winter-killed ungulates, cutthroat trout, and army cutworm moths will be monitored. There is no mention of monitoring high-caloric foods in the NCDE plan. However, in Appendix A, Table 1, it states that bear body condition and stable isotope signatures will be used as a surrogate of habitat quality as well as any implications to changing climates. This methodology was discussed in the NCDE Draft Grizzly Bear Conservation Strategy of 2013.

There is little doubt that there will be some relationship between average body condition of individuals and a measure of habitat quality, but this relationship is complex, affected by many factors, and has yet been shown. Even in the Greater Yellowstone Ecosystem, where many bears were captured and measured (an average of about 30 bears/year not including management bears), an apparent decline in body fat (the suggested metric) of adult females to a level where they were unlikely to produce offspring was thought to be based on an insufficient sample size and additional research was required to determine if this downward trend was real or an artifact of small sample size. Relationships between changing diets, changing abundance of various foods, changes in both black and grizzly bear densities (i.e. inter and intra specific competition), and spatial and seasonal trends in body condition for each age, sex, and reproductive status of females is complex and monthly samples of bears captured and measured may need to be well distributed spatially resulting in a need to handle many bears. If this method is to be

used, I think a table of body conditions for the benchmark, “2011 era” (not year, but group of years) by month, BMU (or groups of BMUs), sex, age class, and reproductive status of adult females should be available to judge the appropriateness of this measure, similar to the tables on road densities and levels of recreation sites. In the NCDE Draft Grizzly Bear Conservation Strategy of 2013, it is stated that “if mean annual projections of October female body fat are greater than one standard error below baseline values, we can conclude that the habitat and food base for the year was poor”. This statement may be fine, but we should see the baseline data or how many females were measured in October, and what was their age (lone adults will be fatter than subadults), reproductive status (lone adults will be fatter than those with nursing cubs), and area they were captured (females eating in cattle boneyards on the east front will be fatter than those in the alpine in the center of GNP). Such a table may provide insight to the appropriateness of using body fat as a surrogate for changes in habitat conditions.

I think changes in mean annual $\delta^{15}\text{N}$, as suggested in the Conservation Strategy, will be difficult to interpret without more research on what bears are actually feeding on and what these foods mean to their fitness and population size. The Conservation Strategy suggests correctly that a decline $\delta^{15}\text{N}$ means less meat in the bears' diet and insinuates, perhaps incorrectly, that this change is not good for the bears. A reduction in $\delta^{15}\text{N}$ may mean a great year for berries and bears focused their feeding on these fruits and got very fat and were doing well. After all, populations with an abundance of fruit (fruits don't run away) are found at much higher densities than those that must struggle to find a dead ungulate or catch and kill one themselves. The use of isotopes to infer changes in habitat quality may be misleading without knowledge of what the bears are actually feeding on.

If population trends are to be measured using Kaplan-Meier methods (needing lots of females captured and collared) as suggested in the Conservation Strategy, then why not use the bear locations to map and measure the actual high-caloric foods the bears are eating as well as measuring body condition and stable isotope ratios? Not only would these be direct measures of the important foods, but would lead to further understanding of the relationships between these foods and body condition, isotopes, and individual performance (cub production and survival) which would enable better predictions of the effects of changing climate. If bear body condition does deteriorate over the decades,

future managers will be pleased if there are measurements that allow determining probable mechanisms of their declining condition – they will be frustrated if there are no measurements.

Finally, using the telemetry locations to build a reliable, habitat quality basemap (i.e. functional habitats that relate to animal fitness) could be used in combination OMRD, TMRD, human settlement and recreational use maps. A functional habitat map will enable road closures and security areas to be in areas most important to bears while not encumbering people with road closures where a high road density does not matter much to bears. Over time, with a good, representative sample of bears with GPS collars, such a map will become apparent using simply the raw GPS locations – they will be piled on top of each other in good habitats. A statistical analysis, however, may help separate the influence of human use from habitat quality, but it may not even be needed. Then, with an understanding of the relative importance of each season on bear numbers, the critical habitats to the population can be identified and increasingly isolated from people – helping both bears and human safety.