Peer Review of the Scientific Findings in USFWS Species Status Assessment Evaluating the Status of the North American Wolverine (Gulo gulo luscus)

Reviewer 3
December 2017

Introductory Remarks
Overall the review appeared to be well done although much longer than necessary and there were a few places that did not make sense. I do not believe that the results of Webb et al. (2016) were fully integrated into this draft, possibly because major sections were written before the Webb et al. paper became available. Some of the comments about population demography were not written by someone grounded in population ecology, and would be best deleted. Nevertheless, I agree with the conclusions of the report that there is no basis for pursuing ESA protection for wolverines in the USA, even though this is not stated explicitly, it is an obvious conclusion.

Available Data:

1. Please identify any oversights or omissions of data or information, and their relevance to the assessment. Are there others sources of information or studies that were not included that are relevant to assessing the viability of this species and not repetitive of other information or studies already included? What are they and how are they relevant?

There is a new paper accepted in *Behavioral Ecology* but it would not have been available when this was written. Otherwise, to my knowledge there were no substantial omissions.

2. Provide advice on the overall strengths and limitations of the scientific data used in the document. Is the information presented in the SSA report explicit about assumptions and limitations of, and concerns regarding, the data, and are these appropriately qualified or explained? Are there concerns that the Service did not identify, and if so, how relevant are these concerns to the assessment of the North American wolverine? Are there any inconsistencies in how the data are presented or assessed?

It would appear that the snow model has not been completely abandoned even though we now have 3 studies showing that it does not restrict the distribution of wolverines. Yet, there may be places in the mountains where late-spring snow is indeed important, and such a proviso would be reasonable. I think that the thorough review of the literature is a strength. There are particular sections identified below (under General Comments) that are in error and should be fixed, e.g., the demography section.

Analysis of Available Data:

3. Have the assumptions and methods used in the SSA report been clearly and logically stated in light of the best available information? If not, please identify the specific assumptions and methods that are unclear or illogical.

Generally I believe that the assumptions have been well identified. I found that the effective population size section and the demography section had flaws but these would not affect overall conclusions relative to the status review.

4. Are there demonstrable errors of fact or interpretation? Have the authors of the SSA report provided reasonable and scientifically sound interpretations and syntheses from the scientific information presented in the report? Are there instances in the SSA report where a different but equally reasonable and sound interpretation might be reached that differs from that provided by the Service? If any instances are found where this is the case, please provide the specifics regarding those particular concerns.

Yes, there are errors and I have identified these in my detailed comments below.

5. Provide feedback on the inclusion and portrayal of uncertainty in the SSA report. Have the scientific uncertainties presented and the analyses conducted been clearly identified and has the degree of uncertainty been appropriately characterized? If not, please identify any specific concerns.

Forecasting climate change scenarios is always burdened with uncertainty, but this was not inappropriately identified. I do not have specific concerns about the manner in which uncertainty was dealt with in the status review.

6. Does the SSA report adequately consider what the species needs to maintain viability in terms of resiliency, redundancy, and representation?

I believe that resiliency was confused with resistance, but again, this had no bearing on the overall conclusions.

General Comments

Page 22, paragraph 2, line 5: that not who—who is for human subjects only.

Page 28, two lines from bottom of page: grammar—also had been found. . .

Page 29 appears to be overkill—probably not necessary for this document.

Pages 28-36 is an exhaustive discussion of snow. But the fact is that although wolverines will use snow to advantage in some habitats, recent results from Alberta (Webb et al.) demonstrate that it is not necessary. Again, this seems excessive when a paragraph would suffice.

Page 38: last sentence in first paragraph: grammar—also may be. . .

Page 42: "Evaluation of genetic material can provide an understanding of population dynamics" This statement is not true. Yes, genetic data can give insights into possible bottlenecks and other mechanisms that might have restricted genetic variability. But it is simply not true that this gives and understanding of population dynamics. Replace the word insight for understanding and I'd be more comfortable with the claim. Even then there are too many unknowns and alternative explanations to make this a very solid statement. I suggest dropping this initial sentence.

Pages 43-44: I think that that the mathematical geneticist Ewens (1990) has a more lucid discussion of effective population size, which depends largely on the structure for the definition. The Ne presented here is narrow in context of the population structure of wolverines and the many factors that could be determining the actual effective population size.

Page 53, line 1: also may affect. . .

Page 54, 2nd line below table: dens usually are located. . . Rainbow Lake, Alberta is a high road density area but with a sizable wolverine population (Webb et al. 2016; Scrafford et al. 2017).

Page 61, last paragraph: If the population is persisting, $\lambda = 1$ over reasonable time scales. Yes, numbers go up and down but this is trivial and should not be reported here. The following sentence is utter nonsense: "Estimated (logistic) rates of population growth (λ) were found to be lower for trapped populations ($\lambda = 0.878$) as compared to untrapped populations ($\lambda = 1.064$) (Krebs et al. 2004, p. 499)." Lambda is a measure of geometric population growth, not a logistic rate of population growth. Likewise, the following sentence cannot be justified because the data are insufficient to determine additive versus compensatory mortality. And again the sentence makes no sense because dispersal is a mechanism that can yield density-dependent compensation.

Page 62, records of fur returns for wolverines exist from 1821 and for BC and Alberta there is no trend in harvests for nearly 200 years. This is as strong a statement about persistence as we can find! At a

finer spatial scale, however, harvests in some localities in southeastern BC would appear unsustainable.

Page 65, end of 2nd paragraph: 6% of the contiguous USA? This is confusing and could use a couple more words of explanation.

Page 90: "Although it has been assumed that wolverines have an obligate relationship with snow for natal denning, the key variables or combination of variables, that defined this relationship have not been empirically analyzed." What's more, the results of Webb et al. (2016) call to question this assumption because we know that wolverines can den successfully in areas w/o late spring snow. Reference to Webb et al. should appear in the next to last paragraph of page 91 as well.

Page 93, resiliency is the ability to rebound after stochastic perturbation in contrast to resistance that is the ability to withstand these perturbations.

Literature Cited

Ewens, W. J. 1990. The minimum viable population size as a genetic and a demographic concept. In Convergent Issues in Genetics and Demography, ed. J. Adams, D. A. Lam, A. I. Hermalin, P. E. Smouse, pp. 307-16. Oxford: Oxford Univ. Press.