



United States Department of the Interior

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MAY 30 2014

Memorandum

To: Assistant Regional Director, Ecological Services

From: Regional Director, Region 6 *Norman E. Walsh*

Subject: Wolverine Final Listing Determination Recommendation

I am writing in response to your undated memorandum that I received on May 17, 2014 (herein referred to as the May Memo), conveying the recommendation for the final listing determination for wolverine. I appreciate the work that the Ecological Services team in Montana and the Regional Office staff have done to make a recommendation on this important decision.

While there is a growing body of science that indicates that earth's climate is warming, and a growing recognition of this trend, uncertainty exists about how a warming climate will be manifested in different areas, how precipitation levels and patterns will be affected at local scales, and how these changes will impact wildlife habitats and populations. As is our policy, we convened a peer review of the proposed listing rule to gain feedback on the information used and conclusions drawn in our review. As you noted in the May Memo, one area emerged in which there was disagreement among the peer reviewers: the degree to which Copeland et al. (2010) accurately represents wolverine habitat and the degree to which McKelvey et al. (2011) (which relies on Copeland et al. (2010)) is a valid estimate of the potential effects of climate change on wolverine habitat and populations (May Memo, pages 8-9). Given the disagreement among peer reviewers and the comments received on this topic during the public comment periods, we extended the final rule decision by six months and engaged scientific experts to help us explore and better understand the issue of climate change impacts to wolverines in the lower 48 states.

In the May Memo (page 4) you indicate that that in the proposed rule you identified one primary threat to the wolverine (climate change) and that other threats were secondary, and only rose to the level of a threat in that they may work in concert with climate change impacts to affect the status of the species. On page 5, as you evaluated "the present or threatened destruction, modification, or curtailment of habitat or range," you indicated that at this time you believe that only climate change represents a potential threat to wolverine habitat. In regard to the rest of the statutory "5 factors" you recommended that the inadequacy of regulatory mechanisms to regulate climate change be considered a threat. You further recommended under factor E that small population size alone is not a threat, but may be so when considered cumulatively with climate change.

I have reviewed the May Memo, the proposed rule, the 7 peer reviews, many comment letters received from the public and state wildlife agencies, and the Wolverine Science Panel Workshop Report 4/2014 in order to assess the recommendation I will make to the Director on the whether or not the wolverine warrants protection under the ESA. I assessed what the best available information indicates about: wolverine status and trend, whether climate is changing within the range of the wolverine in the lower 48 states, and what the impacts of a climate change might mean for wolverines in the foreseeable future. I then address agency policy and my understanding of the term "foreseeable future" as used in the ESA. This memo lays out my thoughts relative to your recommendation.

Wolverine Status and Trend

In the proposed rule, we found that wolverines were likely extirpated or nearly so from the entire contiguous United States in the first half of the 20th century, largely based on human persecution. In the absence of that persecution, in the second half of the century, and continuing to the present, wolverine populations have grown and expanded in the North Cascades and Northern Rocky Mountains (78 FR 7871-7872, relying on Aubry et al. 2007, Table 1). I am aware of no information that indicates this population growth and expansion has ceased. In fact, as we discussed in our proposed rule, in recent years, individual wolverines have been documented in Colorado (2012) and the Sierra Nevada range in California (2008) indicating some dispersal to unoccupied range is occurring (73 FR 7871). However, on page 12 of the Appendix to your May Memorandum, you state that:

"There is also reason to believe (although with high uncertainty) that populations may still be expanding in the southern portion of the currently occupied area in Wyoming. Conversely, we have also seen several long-distance dispersal events of wolverine leaving the Greater Yellowstone area (including the wolverine that went to Colorado). These emigration events may indicate that habitat in this area is becoming filled, and wolverines are seeking new areas with open territories. The hypothesis that wolverines are still expanding and may continue to expand is as much speculation as is the current population level, whereas future impacts to wolverine habitat due to climate change are demonstrated by actual scientific analysis."

I acknowledge uncertainty exists in both areas of analysis to which you refer (dispersal and climate impacts to habitat). However, I note that in the case of dispersal, we cite two verified instances of a wolverine found in habitat that had long been unoccupied, supporting a hypothesis that dispersal is occurring and may lead to actual range expansion, whereas at this time I have found no data to show or support that wolverine population impacts due to habitat change are currently occurring. The scientific analysis to which you refer is a predictive model to estimate potential future impacts. To make a final listing recommendation, I must evaluate the degree to which we can reliably estimate future impacts.

Several peer reviewers addressed the issue of distribution and expansion of range as treated in our proposed rule. Aubry (May 11, 2013; page 1) stated "Yes" to the question of whether our proposed rule contained an accurate description of "...historic and current distribution of the

species.” Similarly, Squires (May 3, 2013; page 2) stated that our proposed rule accurately portrayed the current distribution of wolverines, including the southern Rocky Mountains and Sierra Nevada mountains, and that “the document also correctly stated that current wolverine populations appear to be moderately expanding as evidenced by recent long distance dispersals of individuals to Colorado and California and a potential expanding distribution of other populations.” Schwartz (May 4, 2013; page 2) commented specifically on our treatment of distribution in the proposed rule and stated the proposed rule did a good job noting that there is not a population in the Sierra Nevada as no females are yet known to exist there. He did not dispute the known presence of a male.

Lastly, during the time period that I was preparing this memo to you, I received from your staff information that indicated a recent verified occurrence of a wolverine in the Uintah mountains at the southern border between Wyoming and Utah (email from J. Shoemaker, May 23, 2014). While the trail camera photos show a 2008 date, the email transmittal indicates the camera date stamp is inaccurate, that the photos are from April of 2014, and that analysis is continuing to determine if the animal is marked in any way that would confirm its origin.

We acknowledged in our proposed rule, that with no systematic census across the range of the species in the U.S., the current population level is not known with certainty. As was stated in the proposed rule, our best estimate of current population abundance was based on knowledge of occupied habitat and average densities: 250-300 wolverines in the lower 48 states (78 FR 7868). Since the proposed rule was published, Inman et al. (2013) published an estimated available habitat capacity to be approximately 644 wolverines (95% CI = 506-1881) and estimated that current population size is currently approximately half of capacity. This estimated current abundance level (322) is similar to our rough estimate of population abundance of 250-300 wolverines in our proposed rule.

Accordingly, considering all of the information we have received and summarized, we have no evidence to suggest that wolverine populations are contracting and conversely, there is evidence to suggest that wolverine populations are continuing to expand both within the area currently inhabited by wolverines as well as suitable habitat not currently occupied and/or occupied with a few individuals. Furthermore, recent work suggests that habitat within the current range of the wolverine is not limiting. Finally, while predictive models on climate change have been used to suggest future impacts to wolverine habitat will occur, we currently have no evidence to suggest that wolverine habitat is decreasing due to climate change. Conversely, both the Inman et al (2013) paper and evidence of wolverine movement in to the southern portion of the range suggest that wolverine populations have and will continue to expand into unoccupied habitat.

Is Climate Changing Within the Wolverine DPS

There is significant evidence that the climate within the larger range of the wolverine is warming which will no doubt have impacts on both snowfall and snow persistence in parts of that range. However, at this time, there is enough uncertainty about specific variation of snowfall and persistence at a fine scale within the models to draw definitive conclusions about how climate change will specifically impact wolverine habitat. In addition, we do not have the sufficient resolution of predictive climate models to make definitive conclusions about how the climate will

change at the scale of specific wolverine den sites. As discussed in more detail below, there is strong support for the existence of an obligate relationship between wolverines and deep spring snow at the den site. However, support for the obligate relationship between wolverine and deep snow at an individual wolverine's home range or the species range in general is lacking.

Accordingly, the conclusions drawn about the reduction of wolverine habitat based on the available models is speculation.

Our proposed rule and the May Memo rely on McKelvey et al. (2011) as the best available scientific information and as the most sophisticated analysis available of how climate change may impact wolverine habitat because the researchers incorporated both temperature and precipitation into their models. While it is correct that McKelvey et al (2011) is the most sophisticated analysis of the impacts of climate change at a scale specific to wolverine, as noted above, the scale is not fine enough to deal with the site specific characteristics of wolverine dens. Wolverine dens typically occur at high elevation and on north facing slopes. The conclusion of habitat loss for wolverines based on loss of spring snow was based on analysis of snow at the overall range of the wolverine and did not scale it down to areas specifically selected by wolverines for den locations. This is not a criticism of the work done by McKelvey et al as it does represent the best analysis to date. The authors themselves concluded "Although wolverine distribution is closely tied to persistent spring snow cover (Copeland et al, 2010), we do not know how fine scale changes in snow patterns within wolverine home range may affect population persistence" (McKelvey et al 2011). Accordingly, the lack of this finer scale analysis coupled with other issues discussed in this memo does not support the conclusions in our proposed rule that wolverine habitat will decline at the predicted rates suggested in McKelvey et al (2011).

We received comments from Idaho Department of Fish and Game (dated November 25, 2013) which stated that McKelvey et al. (2011) did not address the issue of complex topography in wolverine habitat in their model, and Idaho questioned whether we addressed or acknowledged those assumptions in the proposed rule. For example, Idaho stated

"Even in those areas where general trends in SWE [snow water equivalent] are declining, further analyses show that these declines are primarily at low-mid elevations while snow accumulation is stable to increasing at higher elevations (Selkowitz et al. 2002, Howat and Tulaczyk 2005, Mote et al. 2005, Regonda et al. 2005, Mote 2006, Nolin and Daly 2006, Brown and Mote 2009.) For example, in the western U. S. Regonda et al. (2005) concluded that low elevation basins (<= 2500 m) exhibited the strongest decline in SWE while there was little discernible trend at high elevation stations. It is thought that this is due to the fact that temperature plays a larger part in the amount of snow at low-mid elevations, while the amount of precipitation plays a larger role at high elevations (Mote 2006)."

Idaho comments that the studies they cite indicate that the general trends in loss of deep snow we characterized in the proposed rule may not be reflective of what is actually occurring in wolverine habitat because of the complex land topography throughout wolverine habitat. Without consideration of both scale and topography, conclusions based on the models may be an overestimation of the impacts at the specific scales and sites used by wolverines. Landscape

features such as slope and aspect can ameliorate shifts in means and extremes of temperature at the micro environmental scale and topographically complex area can provide potential climate change refugia (Moritz and Agudo 2012).

Given uncertainties raised by two peer reviewers as well as state fish and wildlife agencies about the applicability of the climate models to wolverine, I asked Dr. Stephen Torbit, Assistant Regional Director for Science Applications in the Mountain-Prairie Region to review the state of the science regarding downscale climate models. In that review, Dr. Torbit discussed climate modeling with Dr. Andrea Ray with the National Oceanic and Atmospheric Administration (NOAA) Earth Systems Research Laboratory in Boulder, CO. Dr. Ray concurred that great difficulty still exists in predicting changes in precipitation with the climate models, especially compared to the more confident predictions for temperature (Torbit, Pers. Comm. May 2014).

To illustrate the point, Dr. Ray provided Dr. Torbit with a copy of a report that NOAA had conducted for the Colorado Water Conservation Board assessing future water availability based on snowfall in the upper Colorado River Basin. The model that formed the basis of the report predicted that above 8,000 feet, 70-80% of the 1950-1999 mean snowpack is maintained through the end of the century and above 10,000 feet, 80-90% of snowpack is maintained (Torbit, Pers. Comm. May 2014). The relevance of this report to our analysis about snowfall associated wolverine habitat is the fact of the changing science associated with climate models as well as contradictions between models. As Dr. Torbit states based on his discussions, "Newer techniques reveal that colder air temperatures at higher elevations will tend to maintain all precipitation as snow, even in the early and late season.... Some newer analysis suggests that the higher elevations of Colorado and the northern Rockies could receive even more snow than historical records show because of a warming climate" (Torbit, Pers. Comm. May 2014). While no comparable assessment exists for the northern portions of the wolverine DPS, the conclusions of the report demonstrate that the science associated with climate models is continuing to change, which further highlights the uncertainty of our conclusions based on McKelvey et al (2011).

Based upon his review of the McKelvey et al study and his conversations with Dr. Ray, Dr. Torbit concluded:

"Our conclusion is that the modelling efforts that support the listing recommendation are not at a sufficiently reduced scale to clearly articulate the impact to existing or potential wolverine habitat, based on persistent snow-cover. We concur with McKelvey et al. (2011) that "Although wolverine distribution is closely tied to persistent spring snow cover (Copeland et al. 2010), we do not know how fine-scale changes in snow patterns within wolverine home ranges may affect population persistence." We need more information regarding the fine-scale habitat needs of wolverine, including the impact of reduced snow-cover on potential den sites" (Torbit, Pers. Comm. May 2014).

Due to the uncertainty of existing climate models, the changing state of the science regarding climate modeling and the fact that the McKelvey et al model did not analyze impacts to wolverine habitat at a sufficiently precise scale, I cannot support the conclusions in your May memo. While I

fully believe that the climate is warming within the range of the wolverine, I do not believe that the existing scientific information supports our conclusion that this warming will result in a 31% (mid-century) to 63% reduction in wolverine habitat in the foreseeable future.

Do Wolverines Have an Obligate Relationship with Deep Snow Cover?

Because the literature generally does not reflect any studies that tested whether wolverine have an obligate relationship with deep snow cover, we convened an expert science panel earlier this spring to provide further guidance on this issue. We included climatologists and remote sensing experts to help us understand their perspective about climate change within wolverine range, as well as biologists/ecologists who had experience with wolverines or other mammals. During this panel, we surveyed participants regarding each of their beliefs about whether the relationship between wolverines and deep snow was obligate at the scale of the den site, the scale of an individual home range, and the scale of the species' range, and this information is presented in the final summary report of the panel: Wolverine Science Panel Workshop Report 4/2014.

Participants were asked to spread 100 points among the categories of non-obligate, leaning non-obligate, leaning obligate, and obligate. If all 100 points were placed in any one category that would indicate that the participant believed strongly and had little uncertainty that the stated category described the nature of the relationship. While the summary report from the science panel (Wolverine Science Panel Workshop Report 4/2014) reflects scores from all members, including those with climate and remote sensing expertise, I reviewed the data reflecting only the opinion of the five biologist/ecologist participants in the expert panel. I reasoned that their collective experience and knowledge about wolverine and mammalian ecology would provide the most helpful insight into this question about wolverines and their connection to deep snow cover (beyond the opinion of those participants whose expertise lies in climatology or remote sensing). The results of the questions posed to those five panelists are shown in Appendix 1 to this memo and are summarized as follows:

Deep Snow at Three Scales

Is the relationship between wolverines and deep snow obligate at the scale of the den site?: The scores of five biologists indicated most were quite certain that the relationship was obligate at this scale, with one of the five indicating a strong belief that the relationship was leaning toward obligate.

Is the relationship between wolverines and deep snow obligate at the scale of a home range?: The five biologists' scores indicated uncertainty, but a preponderance of points were spread among the categories indicating a belief that the relationship was non-obligate and leaning non-obligate.

Is the relationship between wolverines and deep snow obligate at the scale of the species' range?: The biologists spread points widely indicating uncertainty about the strength of the relationship between wolverines and deep snow at the species' range scale? The lowest median score was in the "obligate" relationship

category and the median scores for the other three categories were very similar to each other.

Contiguous¹ Snow at Two Scales

Is the relationship between wolverines and contiguous snow obligate at the scale of a home range: Biologists' scores were spread widely with median scores very similar among all four categories, indicating generally a lack of certainty as to whether the relationship between wolverines and contiguous snow at this scale was obligate or non-obligate. The highest median score was in the category "leaning non-obligate."

Is the relationship between wolverines and contiguous snow obligate at the scale of the species' range: Biologists spread points widely indicating uncertainty about the strength of the relationship. Median scores among all four categories were very similar. The highest median score was in the "obligate" category, driven primarily by one participant's score.

In summary, the experts expressed opinions that wolverines need deep snow for denning sites, but were much less certain that they needed it at the home range or species range scale.

Therefore, based on the literature cited in the proposed rule (Pulliainen 1968; Copeland 1996, Magoun and Copeland 1996, Magoun and Copeland 1998, Banci 1994, Inman et al 2007c, Copeland et al 2010), the opinion of expert ecologists with mammalian experience in this type of habitat, and the peer reviews, I believe the conclusion that wolverines select for den sites likely to have deep snow that will persist until **some point** into the spring is reasonable, although I am uncertain that it is necessary for snow to persist specifically until **May 15** in order for den sites to be used.

If Deep Snow does not persist as Long, What can we conclude?

I next turned to look at the penultimate question: if snow melts more quickly as we anticipate from McKelvey (2011), will that result negatively impact wolverine in the foreseeable future through a loss of habitat?

Den Sites

The primary hypothesis put forward in the proposed rule (78 FR 7875) is a loss of areas with persistent spring snow cover will result in a loss of potential wolverine den sites, or failure of den sites, negatively impacting future abundance and trend. Three factors must be considered here:

1. Is the correlation between den sites and persistent spring snow cover until May 15 in as little as one of seven years reliable evidence that dens must have snow through May 15?

¹ Contiguous snow refers to a continuous, not patchy, distribution of snow across the landscape in question.

2. Is there evidence that indicates den sites are currently scarce or lacking, or that they will become so?
3. Do we have any reliable information on the causal mechanism that would explain the need for persistent spring snow cover and den success?

Snow cover until May 15

Den sites are correlated with snow (Copeland et al. 2010) and experts in the science panel expressed an opinion that wolverines require deep snow for den sites. However, the predictions from McKelvey et al. (2011) about future habitat loss rely on the Copeland model (Copeland et al. 2010) to describe what habitat is and then to predict how much of it will be lost. The habitat described in the Copeland model includes areas that retained snow until May 15, in as few as one of seven years. In other words, if an area retained snow in only one of seven years, it was still included in the model describing habitat, and 97.9% of the sample of den sites fell within this area. That means that some proportion of those den sites fell within an area that did not retain snow each year. This causes me to question the reliability of a conclusion that snow persisting until May 15 is a necessary condition. In addition, two of our peer reviews (Inman, Magoun) and public commenters questioned whether snow persisting until May 15 was the correct metric to assess habitat, as young are born primarily during February, they are most susceptible to cold stress while small and relatively undeveloped, and wolverine females may exit the den earlier than May 15 (Inman, December 2, 2013; page 3; Hagener, May 8, 2013; page 7 (citing to Inman et al. 2012a)). The state of Oregon commented specifically that available data on dates of den abandonment from Magoun and Copeland (1998, Table 1) indicated known abandonment in Idaho ranged from 4 March to 30 April (Anglin, May 6, 2013; page 1). Copeland et al. (2010) stated that denning begins in early February to mid-March, and den abandonment occurs in late April and May. If natural variation occurs across the range, or if wolverines routinely abandon dens before 15 May, then there is additional uncertainty that snow persisting until 15 May is the best way to measure wolverine habitat loss.

Will den sites be limiting?

I am aware of no evidence that indicates den sites are currently scarce or lacking, or that they currently limit wolverine reproduction. Further, I have not found any information that we could use to predict at what level of reduced spring snow coverage den sites would become limiting. Inman et al. (2013) estimated available habitat capacity to be approximately 644 wolverines (95% CI = 506-1881) and that current population size is currently approximately half of capacity. This estimated current abundance level (322) is similar to our rough estimate of population abundance of 250-300 wolverines in our proposed rule. The current estimated abundance level, significantly below estimated carrying capacity, for a population that is still increasing, suggests to me that den sites are likely not currently limiting wolverine reproduction and population abundance.

Causal mechanism between snow cover and den success

We do not appear to know at this point with any reliability what the causal relationship is between the feature of deep persistent spring snow and wolverine dens. The May Memo presented several

hypotheses to explain the correlation between den sites and snow, such as den structure, security from predators, or a thermal buffer for kits in the den. During our science panel, we heard these hypotheses discussed as well, with most experts concluding that no information is currently available to really test those hypotheses. (Wolverine Science Panel Workshop Report 4/2014, Appendix 6).

All of these hypotheses seem possible and worth testing, but I am unaware of any available evidence determining how and to what degree climate change will negatively impact wolverine dens, den success, or other habitat. The May Memo concludes that "the precise mechanism behind the relationship between wolverines and deep snow is less important than the fact that deep snow appears to be an obligate habitat feature for this species." I disagree and believe that the precise mechanism is very important to our conclusions about wolverine habitat loss given the potential for variation of snowfall across the species range. It is difficult to determine beyond speculation how and how soon climate change and earlier snowmelt will likely influence or limit availability of den sites, habitat, and ultimately wolverine abundance, trend, and viability in the foreseeable future without biological information that demonstrates the causal mechanism, if any, behind this correlation.

The only studies I am aware of that tried to test a hypothesis about potential limiting factors for wolverines is Persson (2005.) In this study, the author tested the hypothesis that wolverine reproduction was affected by winter food availability. Persson (2005) found that provision of additional food resources to wolverines, when compared to a control group not receiving supplemental food, resulted in higher reproduction. He suggests that female wolverine reproduction is determined by their condition in winter, which is determined by past year's reproductive costs and food availability.

In his proposed rule peer review comments, Copeland (undated; page 2) also touched on food availability as a limiting factor as he stated his belief that wolverine densities are highly variable and tied to food availability. He points to current differences in population densities between Glacier Park and central Idaho that he believes are most likely related to food availability. He hypothesized that Glacier Park provides a year-around higher availability of carrion and therefore higher densities of wolverines.

In summary, the pertinent question that remains is if and when a decrease in deep, persistent spring snow will limit the availability of den sites, therefore causing a population decline in the foreseeable future. It is my observation that the available information does not yet allow us to predict if and when that will occur.

Impact on wolverine populations into the Foreseeable Future

The May Memo opines that due to climate change "within the foreseeable future, wolverine habitat in the DPS is likely to decline significantly." As referenced in that memo, foreseeable future is defined as a timeframe in which impacts can be reasonably expected to occur. Specifically, in the May Memo, you assert that foreseeable future for wolverine is the end of the 21st century and project an expected "habitat loss of 31% by mid-century and 63% by late-century" from McKelvey et al. (2011). The May Memo further concludes that as a result of this projected

lesser amount of spring snow, that (1) wolverine year-round and denning habitat will decrease, (2) wolverine movement would be restricted, (3) genetic diversity would therefore decrease, and that (3) the metapopulation “may be in danger if connectivity continues to decline due to the inability for sub-populations to rescue one another,” leading to a conclusion that the species should be considered threatened under the ESA.

I address each of these issues in turn, as taken together they form the basis of your recommendation that the species is threatened.

Does Snow Decline Equate to Year-Round Habitat Decline?

To begin to assess the question of habitat decline, I looked at the information regarding wolverine relationship with areas of deep, persistent snow cover. The May Memo states that “...wolverines are dependent on habitats that maintain persistent, deep snow cover into late spring for both year-round use and for denning.” I reviewed the proposed rule, the literature references, the 7 peer reviews, and the biologists/ecologists’ opinions expressed at the science panel, to understand what we know about wolverine use of habitats that maintain persistent snow cover into the spring.

Copeland et al. (2010; page 235) does not specifically define “persistent spring snow cover” but in practice uses the presence of snow persisting from 24 April to 15 May in at least one of seven years during the period from 2000 to 2006. They estimated persistent spring snow cover using MODIS satellite data, and the resulting mapped area represents their bioclimatic model describing wolverine habitat (Copeland et al. 2010, Figure 1). They indicated that of the total sample of 562 dens from North America, Finland, Norway, and Sweden, 97.9% of den sites occurred in pixels that were snow covered through May 15 in at least one of the seven years (that is, they were within the modeled habitat). Further, their results indicated that not all, but 95% of summer and 86% of winter telemetry locations of wolverine, were within the modeled habitat area they described as having persistent deep snow cover.

However, the state of Idaho presented data that indicated only 68.6% of Idaho’s verified wolverine observations (312 of 415) were within Copeland et al.’s habitat model (Idaho Fish & Game Comments, November 25, 2013, p. 2). Recent publications have suggested that factors beyond those included by Copeland et al. (2010) such as land cover (e.g., vegetative type), topography, human footprint, and snow depth should be incorporated into predictive models to accurately describe wolverine habitat because these factors appear to also influence primary wolverine habitat use (Inman et al. 2013, Fisher et al. 2013). These recent publications appear to support the idea that wolverines generally use areas of higher elevation, steeper terrain; more snow, fewer roads, less human activity, and that generally can be expected to have snow cover persist into the spring. Note however that Inman et al. (2013) used snow cover on May 1, not snow cover until May 15, as a variable in their best-fitting model. Lastly, Copeland himself (November 26, 2013; page 2) stated his belief that there are other factors beyond snow that influence wolverine distribution.

Taken together, the available body of literature, our peer reviews, and public comment appear to indicate that:

1. Wolverines use areas with deep snow;
2. Wolverines are observed outside of the area that has snow until May 15;
3. Areas were included in the Copeland et al. 2010 predictive habitat model that may have had May 15 snow in as little as one of seven years studied; and
4. Factors other than snow cover on May 15 may also influence wolverine use.

Therefore, while McKelvey et al. (2011) projects a loss of 31% and 63% of areas with snow cover persisting until May 15, it is not clear to me that this actually represents an equivalent loss of habitat. That is, while it may be likely that habitat will decrease over time due to earlier snow melt, if wolverines also use areas outside of the area covered with snow until May 15, this reduction in snow cover on May 15 may not equate linearly to an equivalent loss of wolverine habitat; McKelvey et al. (2011) may overestimate the loss. In addition, as discussed above, if the obligate relationship with deep snow is only at the den site and not across the overall range of a wolverine and the species in general, specific snow variation due to elevation and topography also calls in to question the conclusion that overall snow loss across the range of the species will equate to a specific loss of wolverine habitat.

Restriction of Movement, Connectivity, and Genetic Diversity

The proposed rule and the May Memo also hypothesize that loss of habitat due to earlier melting snow will equate to loss of connectivity and therefore decreased genetic diversity. McKelvey et al. (2011) concluded that continued warming trends may create small and isolated populations, among which the energetic costs of traveling will be high. However, they also stated that while contiguous areas of spring snow cover are predicted to become smaller and more isolated over time, large (>1000 km²) contiguous areas of wolverine habitat are predicted to persist within the study area throughout the 21st century for all model projections (McKelvey et al. 2011, page 2882 and page 2894). By the late 21st century their dispersal modeling predicts that habitat isolation at levels associated with genetic isolation of populations becomes widespread.

Currently available information, as discussed in the proposed rule, indicates wolverines are known to travel through habitats that may be unsuitable for long term survival; in fact, this propensity was cited as complicating our analysis of present and past range (78 FR 23:7869). In recent years, individual wolverines have been documented in Colorado (2012), the Sierra Nevada range in California (2008) and Wyoming (2014) indicating some dispersal to known unoccupied range is occurring, and quite likely necessitated travel through lower elevation areas that do not retain deep snow. Males are commonly believed to make longer dispersal movements than females, with the longest known female movement being measured at 233 km during a 44 day period (78 FR 23: 7871).

Vangen et al (2001) studied dispersal of wolverines in Sweden and Norway, using 61 marked juveniles. Their data indicated dispersal distances of up to 178 km and showed the capacity for long distance dispersal on the part of both sexes, even though few of the individuals moved more than 5 home-range diameters. Vangen et al. (2001, page 1647) reflect on other dispersal distances

reported in the literature from Idaho (two males dispersed 168 and 199 km; Copeland 1996) and Alaska (one male dispersed 378 km; Gardner 1985) and concluded that both sexes have the capacity to establish themselves far away from their natal areas, thereby ensuring recolonization and gene flow between subpopulations. They hypothesize that vacant wolverine habitats are most likely explained by factors other than low dispersal capacity, such as turnover in the population due to human caused mortality. Note that while Vangen et al (2001) was not cited in the proposed rule, ostensibly because is cited date from Sweden and Norway, I included it as part of my review as it speaks to wolverine's capacity for long distance dispersal and therefore I believe is relevant.

Given the available body of literature, the proposed rule, and your memo, it is reasonable to predict that if warming trends continue, and areas with deep snow become smaller and more isolated, connectivity and genetic exchange among wolverine populations will decrease over time. The question for us to answer in making this determination is whether the best available scientific information indicates that reduced connectivity and genetic exchange will happen within the foreseeable future.

Current Impacts from Climate Change

In your May memo, you note that climate change may already be having an impact on wolverine: "Although the wolverine population is likely to still be expanding in the southern portion of the Greater Yellowstone Area, the impacts to habitat from climate change are likely already being felt in northern portions of the DPS where populations have been established since the 1950's." In the proposed rule, we found that wolverines were likely extirpated or nearly so from the entire contiguous United States in the first half of the 20th century, largely based on human persecution. In the absence of that persecution, in the second half of the century, and continuing to the present, wolverine populations have grown and expanded in the North Cascades and Northern Rocky Mountains (78 FR 7871-7872, relying on Aubry et al. 2007, Table 1). I am aware of no information that indicates this population growth and expansion has ceased within its existing range and as has been noted in this memo, we have seen individual expansion to Colorado, California and most recently Wyoming.

We acknowledged in our proposed rule, that with no systematic census across the range of the species in the U.S., the current population level is not known with certainty. As was stated in the proposed rule, our best estimate of current population abundance was based on knowledge of occupied habitat and average densities: 250-300 wolverines in the lower 48 states (78 FR 7868). Since the proposed rule was published, Inman et al. (2013) published an estimated available habitat capacity to be approximately 644 wolverines (95% CI = 506-1881) and estimated that current population size is currently approximately half of capacity. This estimated current abundance level (322) is similar to our rough estimate of population abundance of 250-300 wolverines in our proposed rule.

Accordingly, it seems largely speculative that populations in the northern part of the DPS are already feeling the impacts of climate change. While one could speculate that dispersers to the southern portion of the DPS are occurring due to habitat loss in the northern part of the DPS, one could just as easily conclude that these dispersers are the result of an increasing population with dispersers looking to colonize largely unoccupied habitat. This, coupled with the Inman et al

(2013) publication, suggests that there is no evidence to suggest that there is any contraction of habitat at this time due to climate change.

Foreseeable Future

The Endangered Species Act defines a “threatened species” as any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. In your May Memo, you recommend that we issue a final rule that would designate the wolverine in the lower 48 states a threatened species. An important part of any such decision is whether the best available scientific and commercial information indicates that endangerment will occur within the foreseeable future. Thus, considerable attention has been given to what is meant by the term “foreseeable future.”

In Memorandum 37021 to the Service Director dated January 16, 2009 (which is known as M-Opinion 37021), the Department of Interior Solicitor outlines the meaning of foreseeable future as “the extent to which the Secretary can reasonably rely on predictions about the future in making determinations about the future conservation status of the species.” (M-Opinion 37021 at p. 14). The M-Opinion concludes that foreseeable future “extends only so far as the Secretary can explain reliance on the data to formulate a reliable prediction.” (M-Opinion 37021 at p. 1). In providing guidance to the Service on this point, the M-Opinion states that when the point is reached that the conclusions concerning the trends or the impacts of a particular threat are based on speculation, rather than reliable prediction, those impacts are not within the foreseeable future. (M-Opinion 37021 at p. 14).

In the May Memo, you reference a 31% loss of snow by mid-century and a 63% loss of snow by late century based on McKelvey et al. (2011). The May Memo then concludes that this loss of snow will result in a commensurate loss of wolverine habitat and therefore have a significant impact on wolverine populations resulting in the need to list the species. While I agree we can conclude a warming climate is occurring and that this trend will likely result in earlier snowmelt, I do not agree that we can conclude this will necessarily or reliably result in a commensurate loss of wolverine habitat.

In considering what factors might constitute threats, we must look beyond the mere exposure of the species to the factor to determine whether the species responds to the factor in a way that causes actual impacts to the species. If there is exposure to a factor, but no response, or only a positive response, that factor is not a threat. If there is exposure and the species responds negatively, the factor may be a threat and we then attempt to determine how significant a threat it is. If the threat is significant, it may drive or contribute to the risk of extinction of the species such that the species may warrant listing as threatened or endangered as those terms are defined by the Act. This does not necessarily require empirical proof of a threat, but it does require information about the negative response that is more substantial than speculation.

As discussed in more detail above, it is my best professional judgment we can only reliably predict a commensurate decline in wolverine habitat if we believe that wolverine have an obligate relationship with snow for all life stages. While there seems to be general agreement that wolverine are closely associated with snow for denning, there is far less agreement about the need

for snow to persist specifically until May 15 or contiguous snow over an individual wolverine's home range as well as across the range of the species. If we cannot with certainty predict that a loss of snow is akin to a commensurate loss of wolverine habitat, any conclusions that a loss of snow correlates to a reduced wolverine population is even less certain. Accordingly, I do not believe we have sufficiently linked climate change to a loss of habitat that will result in a wolverine population decline within the foreseeable future.

Secondary Threats

This response memo addresses the primary threat of climate change raised in your May memo. However, in that memo, you indicated that "secondary threats identified in this document were considered to be threats only when operating in concert with climate change. These secondary threats included genetic and demographic effects of small population size and the effects of harvest, both intentional permitted trapping and incidental trapping as a non-target species."

Since I do not accept the underlying premise that climate change is in fact a threat to wolverine, I also do not believe that the identified secondary threats are threats to the species. As I do not accept the conclusions that wolverine populations will decline in the foreseeable future due to habitat loss associated with climate change, I do not believe the genetic and demographic effects will be realized. Regarding harvest, I do not foresee the limited legal harvest currently occurring in Montana (≤ 5 animals per year) to be a threat as the population appears to have continued to increase while sustaining this level of legal take. Regarding incidental take associated with legal harvest activities, I also do not view it as a threat to the species since documented incidental take is extremely low and wolverines have seemingly increased with this potential mortality source in existence. However, I understand that the Association of Fish and Wildlife Agencies and wolverine range states are working to implement "Best Management Practices" to limit the incidental take of wolverines associated with otherwise legal harvest of other furbearers which should further reduce potential incidental take, even with increased trapping associated with now legal wolf trapping in Idaho, Montana and Wyoming. While I believe this is a positive development, due to the fact that implementation is not complete, I did not rely on this development when making my final conclusion that the wolverine is not warranted for listing.

Inadequate Regulatory Mechanism: Climate Change

The assessment we used in the proposed rule to only consider the inadequacy of existing regulatory mechanism rather than the lack of regulatory mechanisms is consistent with the specific language of section 4(a)(1)(D) of the ESA and is the approach that the Service is following when considering regulatory mechanism, including those associated with climate change

However, more importantly, as outlined in this memo, I do not believe that climate change poses a threat to wolverine or its habitat in the foreseeable future such that the wolverine warrants listing under the ESA. Our interpretation of the ESA for assessing regulatory mechanisms under Factor D is to evaluate the inadequacy of existing regulatory mechanisms in the context of how they address the threats identified for the species or its habitat under Factors A, B, C, or E. Based on the conclusion that climate change is not a threat, because the predicted impacts of climate change to wolverine populations are not reliable in the foreseeable future, and we have determined that there

are no threats to the wolverine under the other factors, then an evaluation of the inadequacy of existing regulatory mechanisms is not necessary.

Summary

As stated in your May memo, our proposed rule to list the wolverine as threatened identified one primary threat to the wolverine (climate change) and other threats as secondary, only rising to the level of a threat to the extent that they may work in concert with climate change impacts to affect the status of the species. The reduction of persistent spring snow due to climate change was cited as the specific threat. The degree to which wolverine populations will be impacted by a change in the amount or extent of deep snow limiting the availability of year round habitat and den sites is the fundamental question that informs whether the species is likely to become endangered in the foreseeable future. Your hypothesis is that such a change in climate will in fact cause habitat loss, den site loss, and ultimately population impacts leading to wolverine being a species likely to be endangered within the foreseeable future. However, after review of the available information, I am unable to make a reliable prediction about how climate change will impact wolverine habitat into the foreseeable future for the following reasons.

- (1) Considering all of the information we have received and summarized, we have evidence to believe that wolverine populations are continuing to expand both within the area currently inhabited by wolverines as well as suitable habitat not currently occupied and/or occupied with a few individuals.
 - a. Recent dispersers in to Colorado, California and Wyoming suggest that the species is continuing to expand its range.
 - b. Since the proposed rule was published, Inman et al. (2013) published estimated available habitat capacity to be approximately 644 wolverines (95% CI = 506-1881) and estimated that current population size is currently approximately half of capacity.
- (2) There is strong support for the existence of an obligate relationship between wolverines and deep spring snow at the den site. However, support for the obligate relationship between wolverine and deep snow at an individual wolverine's home range or the species range in general is lacking.
 - a. The scores of five experts indicated most were quite certain that the relationship was obligate at the den site.
 - b. The experts' scores indicated uncertainty about an obligate relationship at the scale of home range, but a preponderance of points were spread among the categories indicating a belief that the relationship was non-obligate and leaning non-obligate.
 - c. Experts spread points widely indicating uncertainty about the strength of the relationship between wolverines and deep snow at the species' range scale. The lowest median score was in the "obligate" relationship category and the median scores for the other three categories were very similar to each other.

- (3) There is significant evidence that the climate within the larger range of the wolverine is warming which will no doubt have impacts on both snowfall and snow persistence. However, at this time, we do not have the sufficient resolution of predictive climate models nor certainty in those models to make definitive conclusions about both the amount and persistence of snowfall at the scale of specific wolverine den sites.
- a. McKelvey et al (2011) is the most sophisticated analysis of the impacts of climate change at a scale specific to wolverine; however, the scale is not fine enough to deal with the site specific characteristics of wolverine dens.
 - b. Wolverine dens typically occur at high elevation and on north facing slopes. The conclusions of habitat loss for wolverines based on loss of spring snow was based on analysis of snow at the overall range of the wolverine and did not scale down to areas specifically selected by wolverines for den locations.
 - c. Uncertainty in the ability of the models to predict with certainty both snowfall amounts and/or persistence in areas most important for critical life stages (i.e. denning)
 - d. There is no evidence to suggest that den sites for wolverines will be a limiting factor in the foreseeable future.

Based on all of my analysis of the available information, I conclude that our primary concern about the future of wolverines is associated with the availability of suitable den sites. Accordingly, while I understand the basis of the predictions in the McKelvey et al model, I do not accept that a loss of snow across the range of the wolverine will result in a commensurate reduction in suitable wolverine habitat. Furthermore, due to the uncertainty of climate models, and the fact that we do not have the fine scale modeling available to make accurate predictions about the continued availability of den sites, in my best professional judgment, I cannot accept the conclusion about wolverine habitat loss that form the basis of our recommendation to list the species. Accordingly, I cannot support the recommendation that we list the wolverine as threatened.

On several occasions in the past, before and after we issued the proposed rule, I had spoken to representatives of state wildlife agencies about the wolverine. As you know, after the proposed rule we received various comments from state wildlife agencies within the range of the wolverine and all states with the exception of Colorado (which only spoke to the 10j designation) asserted that wolverine should not be listed for various reasons. I note that no state wildlife agency director has brought up the topic of the potential wolverine listing to me since the July, 2013, Western Association of Fish and Wildlife Agencies meeting. At the time of the expert science panel in April, 2014, I conversed with some of the state wildlife agency staff present. Our conversations included only information regarding the topics being discussed by the panel; I engaged in no conversations about our ultimate listing decision, nor did anyone at that meeting attempt to engage me in such a conversation. I emphasize that while state agencies are our

primary partners in conservation, the determination I have come to as stated in this memo about the wolverine's status under the Endangered Species Act is mine alone, and has not been influenced in any way by a state representative.

Because the range of the wolverine in the lower 48 states also crosses two other administrative regions (FWS Regions 1 and 8), I asked my counterparts in those two regions to share with me their recommendation about the proposed listing of the wolverine. The Region 8 Regional Director and the Region 1 Regional Director responded via memorandum on May 15, 2014 and May 16, 2014, respectively. Both memoranda indicate that these Regional Directors do not support issuing a final rule adding the wolverine to the list of threatened species for reasons similar to my own, including a concern about the degree to which we can reliably predict impacts to wolverine populations from climate change.

In closing, I thank you and all involved Ecological Service staff for your thoughtful work on this action. However, I do not believe that the available information indicates that listing as threatened is warranted. Please prepare a withdrawal of the proposed rule for transmittal to the Director.

Literature Cited beyond what was in the proposed rule:

Fisher, J. T., S. Bradbury, B. Anholt, L. Nolan, L. Roy, J. Volpe, and M. Wheatley. 2013.

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Inman, R.M., A.J. Magoun, J. Persson, and J. Mattisson, 2012a. The wolverine's niche: linking reproductive chronology, caching, competition, and climate. *Journal of Mammalogy* 93:634-644.

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Moritz, C. and R. Agudo. 2013. The future of species under climate change: Resilience or decline? *Science* 341: 504-508.

Persson, J. 2005. Female wolverine reproduction: reproductive costs and winter food availability. *Canadian Journal of Zoology* 83:1453-1459.

Ray, A.J., J. J. Barsugli and K.B. Averyt Eds. 2008. *Climate Change in Colorado: A Synthesis to Support Water Resources Management and Adaptation*. University of Colo.-NOAA. Boulder, Colo 53 pp.

Vangen, K.M., J. Persson, A. Landa, R. Andersen, and P. Segerström. 2001. Characteristics of dispersal in wolverines. *Canadian Journal of Zoology* 79:1641-1649.

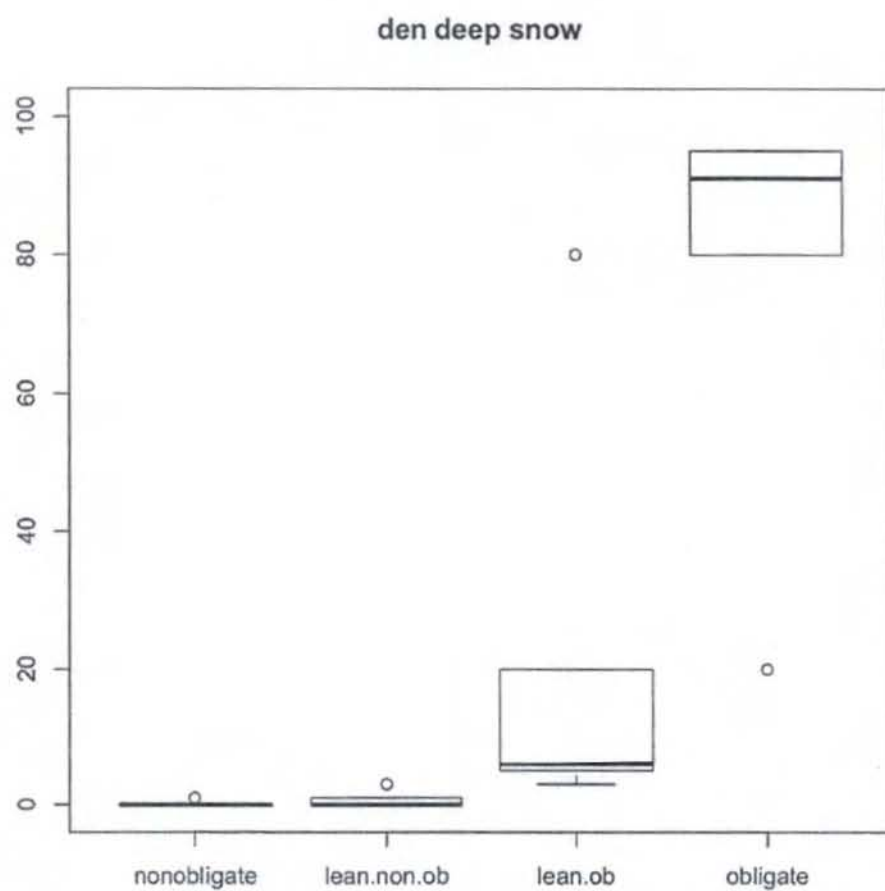
Woods, T., S. Morey, and M. Mitchell. 2014. *Wolverine Science Panel Workshop Report*.

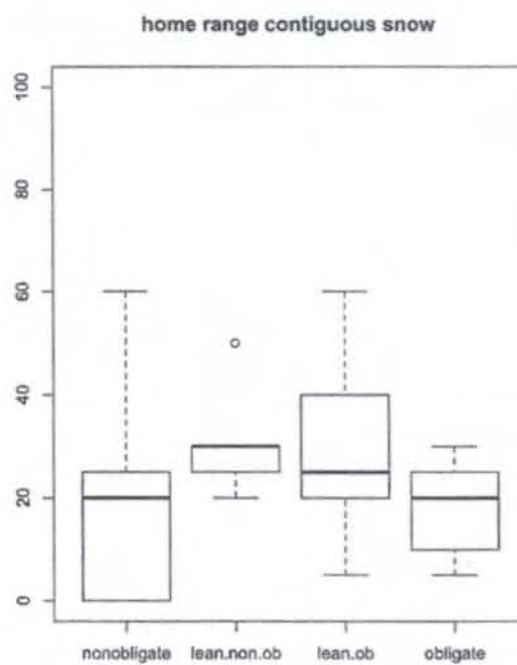
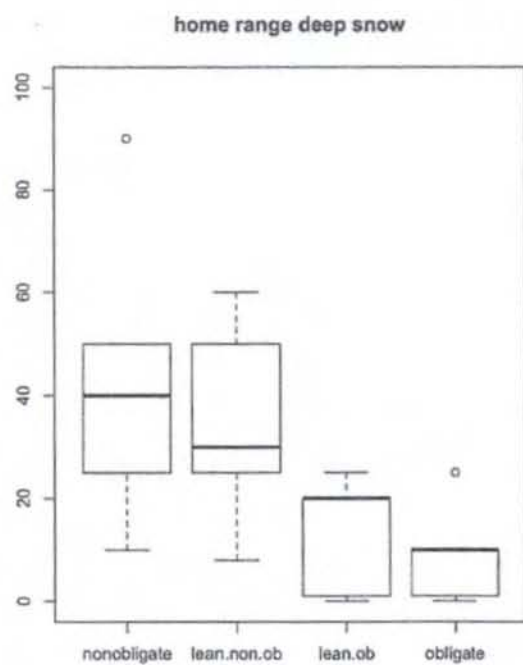
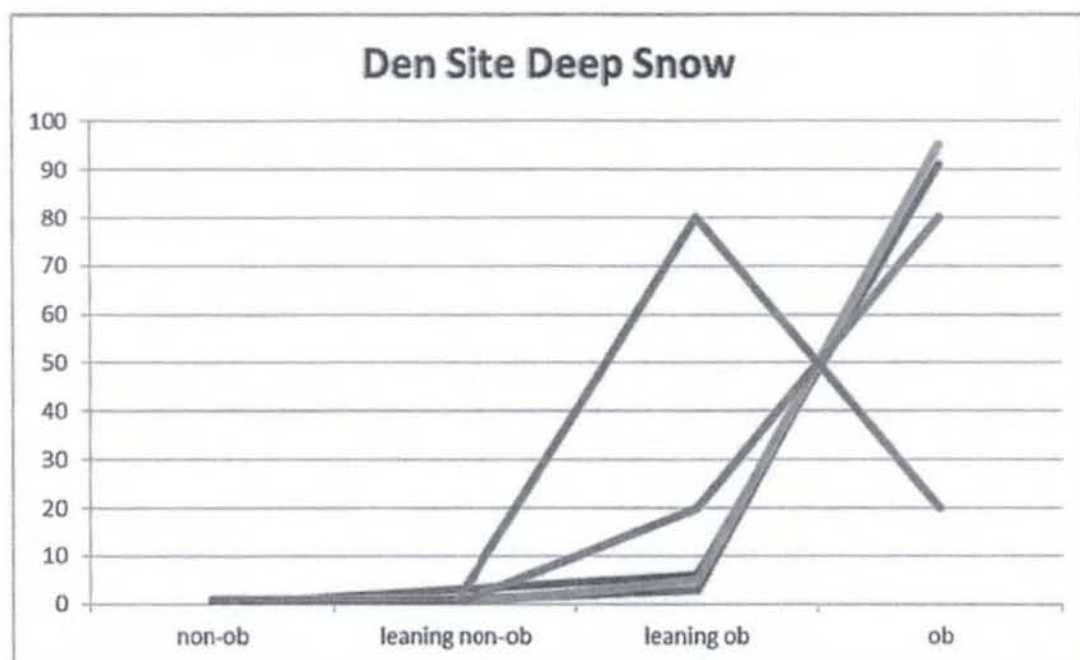
Workshop hosted by U.S. Fish and Wildlife Service. April 3-4, 2014, Venue, Spokane, WA.

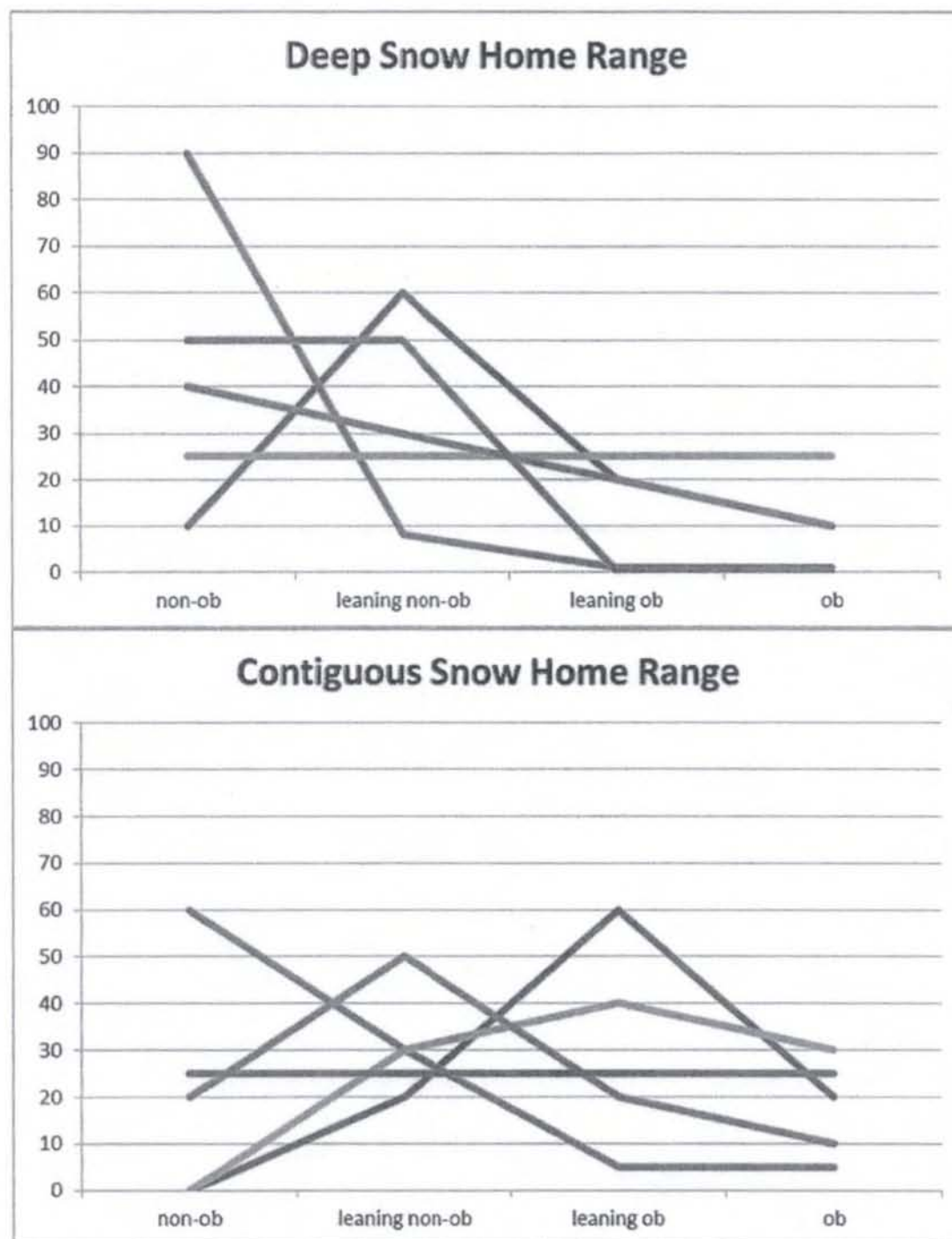
APPENDIX 1

Graphs Prepared by Teresa Woods

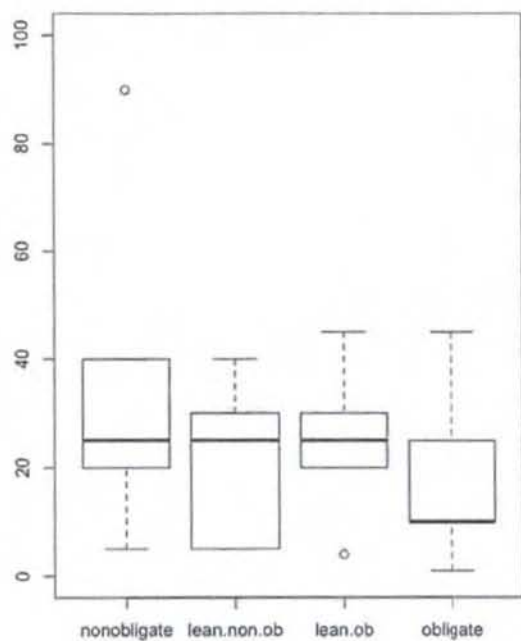
Grouped responses of Drs. Bob Garrott, Montana State University, Steve Buskirk, University of Wyoming, Dan Pletscher, University of Montana, Retired, Eric Lofroth, British Columbia Ministry of Environment, and Oz Garton, University of Idaho to workshop questions about the relationship between wolverines and deep snow and contiguous snow at both home range and range-wide scales. The details about each question, including score sheets and wording can be found in the report and its appendices. Individual responses are indicated by colored lines. Please note that other experts participated in the workshop and also answered these questions; the full set of responses can be found in the report.



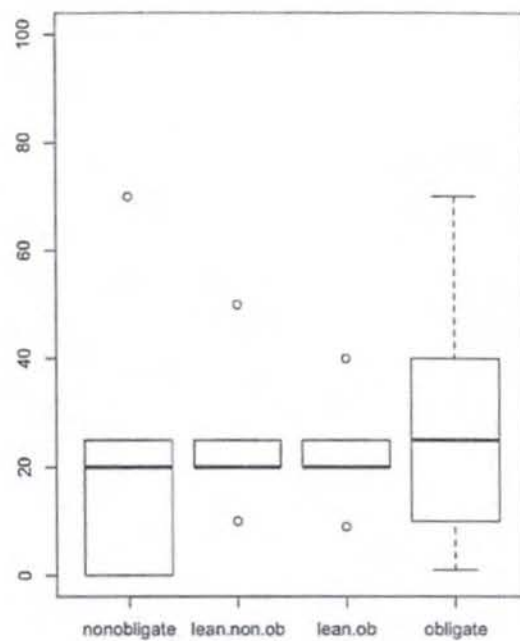




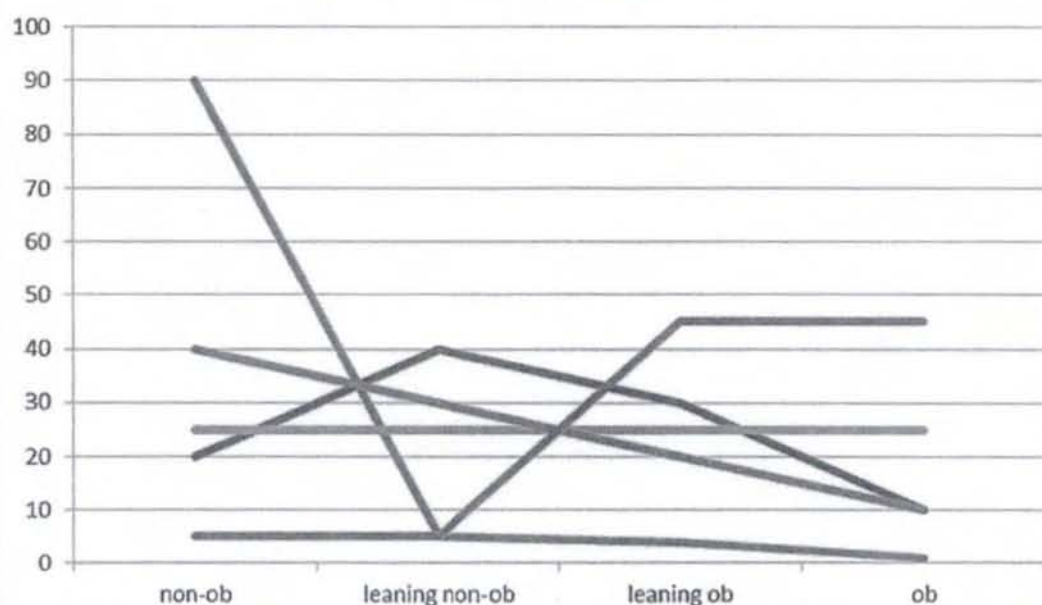
species range deep snow



species range contiguous



Species Range Deep Snow



Species Range Contiguous Snow

