From: Grizzle, Betty
To: Conor McGowan
Subject: Comment submitted re wolverine
Date: Wednesday, January 11, 2017 4:26:02 PM
Attachments: Wolverine Foundation_Submitted Public Comment_Nov 2016.pdf

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Conor - I assume you are receiving my earlier emails with attachments and I hope those documents have been helpful.
I am sending you another file (see attached), public comment submitted in November 2016 from the Wolverine Foundation, which provides their assessment of current information on wolverine abundance and distribution, among other comments.

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THE WOLVERINE FOUNDATION

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The Wolverine Foundation is a 501(c)3 non-profit organization dedicated to advancing wolverine science and research. We exist to facilitate wolverine research through small grants; to serve as a fiscal sponsor for scientists; and to conduct general education about wolverine life history and ecology. We do not have a position on listing or other policy issues: instead, we are interested in seeing the best science applied to any management decision. Because we spend our time immersed in wolverine science, we appreciate the opportunity to comment on and clarify the current state of wolverine research and conservation.

We provide comments below on three of the topics about which the USFWS is currently seeking input: Biological, commercial trade, or other relevant data concerning and threats (or lack thereof to this species and regulations that may be addressing those threats; Additional information concerning the historical and current status, range, distribution, and population size of this species, including the locations of any additional populations of this species; and Any information on the biological or ecological requirements of the species, and ongoing conservation measures or efforts for the species and its habitat.

1. **Biological, commercial trade, or other relevant data concerning any threats (or lack thereof) to this species and regulations that may be addressing those threats.**

A threat of highest immediate concern in the lower 48 wolverine distribution is human caused mortality of wolverine. Trapping harvest in Montana, although currently managed by a conservative female subquota, is not sufficient to ensure persistence in the fragmented populations in this state. In addition, the clear lack of defensible information on population size and trend does not justify the season. Elsewhere, mortalities from roads, rails, accidental trapping and other resource management conflicts impact the resilience of wolverine populations (Krebs et al 2004). Each mountain range within the wolverine meta-population in the U.S. Rockies holds a limited number of females. Removing even a single one of these females reduces the reproductive potential of that range, reducing the number of young available to disperse to other

ranges, and limiting genetic diversity in an already-small meta-population. The removal of an adult wolverine from a range that is separated from other core areas may reduce the reproductive potential of that range for an undetermined and possibly substantial amount of time, given the uncertainty over how long it will take for another dispersing animal to reach the range; the current absence of wolverines from several ranges in the U.S. Rockies after an apparent natural die-off of breeding adults illustrates this point (Heinemeyer and Squires 2015; see discussion below).

Even if trappers had a way to distinguish between territorial adults and juveniles, trapping of juvenile animals also poses a risk to the population, because recolonization of periodically vacant mountain ranges is essential to the continuance of the population. Dispersing juveniles maintain genetic connectivity and the reproductive potential of the population by establishing themselves in vacant territories. Given the long distances that young wolverines must often travel to reach a vacant territory, and the random nature of encountering a mountain range with a vacant territory, every juvenile is essential to the population in the Rockies.

While trapping of wolverines may be sustainable further to the north, where the animals are distributed more contiguously over the landscape, we believe trapping is a risk in a meta-population situated at the southern edge of distribution. The multi-state survey and connectivity analysis proposal (WAFWA 2015) dwells at length on landscape connectivity and on the prospect of reducing roadkill mortality by identifying locations to build road-crossing structures. We support reducing mortality in any way possible, but believe that the simplest way to do this - and the easiest way to amplify the effects of making the landscape safe for dispersing juveniles - is to put an end to intentional human-caused trapping deaths, thus increasing the number of juveniles within the meta-population. Trapping wolverines in the lower 48 is a threat to reproductive potential, connectivity, and the maintenance of genetic diversity.

Summary of points:

- Reduction of mortality from all sources is of paramount importance in the face of habitat loss and infrastructure development.
- Wolverines have low reproductive rates and large territories; in a meta-population with widely separated patches of occupied habitat that support limited numbers of animals, the removal of any reproductive adult has a potentially negative effect on the population as whole.

- Likewise, the removal of juveniles is problematic because these young animals recolonize distant vacant territories and carry genes across the population.
- Concerted and expensive efforts to reduce accidental road mortality should be complemented by the easier, less expensive, and logical step of continuing the current closure of the trapping season.

2. Additional information concerning the historical and current status, range, distribution, and population size of this species, including the locations of any additional populations of this species.

Despite claims from various stakeholders that the wolverine population is either increasing (Tri-State Op-Ed September 5, 2014; Federal Register 2014 p. 47532), or decreasing (environmental advocacy groups), there are no current data on population trajectory for wolverines in the lower 48. The much-cited Aubry et al (2007) paper discusses historical range, not current population trajectory; the authors propose that a trapping-and-poisoning-related extirpation following Euro-American colonization of the West preceded a wolverine recolonization of vacant habitat over the course of the second half of the 20th century. This hypothesis is supported by genetics work which shows that certain haplotypes have disappeared entirely from the U.S. Rockies since the 19th century, while others have appeared and become dominant (McKelvey et al 2014).

While recolonization of historical habitat has certainly involved an expansion of both occupied habitat and population from c. 1930 to the present, the assertion that wolverine populations are still expanding either spatially or numerically requires a dramatic leap across a wide chasm of uncertainty. We currently possess no information on population numbers prior to the extirpation, which makes statements like “wolverines are at the highest population in 80 years” meaningless (Tri-State Op-Ed, September 5, 2014). The baseline against which we should assess the robustness of the population should not be the point at which we wiped them off the landscape, but a point at which we know that they are producing enough kits to sustain the meta-population over time.

We also possess no reliable data on current population numbers or population growth rate, although genetics work suggests that in 2009, there were between 28 and 52 members of the effective population (that is, individuals who are contributing genetically) (Schwartz et al 2009). We don't know how much habitat is occupied, or which areas serve as core source populations

for the rest of the region. We have demographic data for a few mountain ranges (e.g. Glacier National Park, the Madisons, the Gallatins) but know little about how mountain ranges, which are the individual population nodes within a large and dynamic meta-population, cycle through occupancy and vacancy through time. In short, we know far too little to project either population growth or decline except insofar as it is linked to the availability of habitat, which is almost certain to decline in quality and availability over the coming decades (McKelvey et al 2011).

The idea that wolverine populations are "expanding" to reoccupy former range could be deceptive. Despite the assertions of the U.S. Fish and Wildlife Service (USFWS) in its decision to withdraw the proposed rule in 2014, and reiterated by the states in comments submitted during the current comment period (MTFWP 2016 p. 13), single dispersing males in Colorado and California do not represent reoccupations of former range, as they cannot establish populations in those areas. Colorado's sole male wolverine, M56, was shot and killed in April of 2016 in North Dakota, 700 miles from his last known location (North Dakota Fish and Game press release, May 9 2016), illustrating just how illusory a wolverine's "occupation" of a region may be, and just how widely the species can travel. A wolverine may be detected in a mountain range, and may even remain there for some time, but without documentation of reproduction in that range, it's difficult to determine whether a wolverine's presence in a location is meaningful to the population.

To make matters more complex, there is evidence that ranges in Idaho and Wyoming that were occupied by reproductive animals over a span of multiple years have recently lost their wolverines. These include the Tetons in Wyoming and Idaho, and the Centennial Mountains, the Salmon Mountains, and the Smoky Mountains in Idaho. The Idaho Wolverine Winter Recreation Project (IWWRP), which set out to examine the relationship between wolverines and winter recreation, targeted ranges that were known from previous studies to contain wolverines. In the Centennial Mountains, where Inman (2007) reported 5 wolverine mortalities between 2001 and 2005, the project live-trapped for three years and did not capture or detect a wolverine. In the Salmon mountains, multiple reproductive adults were present at the outset of the project in 2010, but most had vanished by the conclusion of the project in spring of 2016; no new resident animals appeared to reoccupy the vacant territories. In the Tetons, where wolverine presence has been documented since 1996, and which were fully occupied with four reproductive adults as of 2007 (Inman 2007), three years of live trapping by the IWWRP project detected only a single male. This male was originally captured in 2002, making him at least 13 when he was recaptured

in 2014. He was captured again in spring of 2015, but has not been detected since, despite camera trapping by both the IWWRP and the Forest Service. In the Smoky mountains of Idaho, where resident wolverines were documented between 1992 and 1996 (Copeland 1996), four years of live- and camera-trapping efforts by the IWWRP failed to capture a wolverine; a single male, captured and instrumented in the Sawtooths, did cross the range. (Heinemeyer and Squires 2014; 2015). The IWWRP is not the first study to find that an area of historical occupancy holds fewer wolverines than anticipated. The Absaroka Range of western Wyoming was selected for a wolverine research effort in 2005 due to the strong historical presence of wolverines in the area. After 5 years of study including both extensive live-trapping and intensive aerial track surveys by helicopter, only 2 wolverines were documented in a very large contiguous landscape of wolverine habitat (Murphy et al 2011).

The disappearance of wolverines from areas formerly occupied by resident adults could be part of a normal cycle of occupancy, vacancy, and recolonization, as old animals die off and a certain amount of time passes before both a male and a female eventually arrive from nearby ranges to recolonize. Or the absence of wolverines from these ranges, concurrently, may indicate a range contraction. We cannot say for sure. But the fact that these ranges were occupied in earlier years, and are not now, illustrates the inadequacy of using a snapshot of wolverine distribution – even distribution of reproductive adults – in any specific year to understand the larger dynamics or trajectories of the meta-population. We cannot assume that wolverine detections in different ranges during separate studies conducted in separate years mean that all of those ranges are still occupied, or that they will be in the future. In short, it is impossible to justify the contention that the wolverine population is still expanding without some metric of population growth, and some understanding of meta-population dynamics.

In his April 2016 decision, Judge Christensen directed the USFWS to consider lack of genetic diversity as a potential threat to the wolverine population in the US Rockies. Wolverines persist at relatively low population densities, but disperse widely, suggesting that carrying a set of genes over a long distance to reach a vacant territory with less closely-related wolverines may be important to the survival of the species. The “rescue effect” of new genes on isolated populations has been demonstrated (e.g. Vila et al 2002; Whitley 2015), but the extinction risk associated with inbreeding has been harder to demonstrate in the wild. For mammals with relatively long lifespans and more widely-spaced generations, tracking these evolutionary processes can be a challenge. The process has been documented, however, among Glanville fritillaries, a species of

butterfly, in the Aland islands of Finland (Saccheri et al 1998). The authors document extinctions due to inbreeding in multiple small population nodes over the course of 2 years. Declines in reproductive fitness, correlated with decreases in heterozygosity (indicative of inbreeding) appear to be the cause. It may or may not be significant to note that the butterflies, which go through cycles of local extinction and recolonization of habitat patches, seemed to be suffering an overall decline at the end of the study, due to a series of "unfavorable summers," or, in other words, a disruptive climate pattern (Saccheri et al p. 491). Although the authors didn't set out to investigate this topic, there is a suggestion here that sub-optimal climate patterns that operate over the scale of multiple generations exacerbate the effects of inbreeding and reduce the chances of recolonization in patchy meta-populations. In any case, we believe that the wolverine's genetic situation warrants monitoring, and that genetic isolation is potentially a threat. Any hypothetical reduction in habitat due to climate change would reduce the total number of animals on the landscape, which would drive down the reproductive potential of the population while also increasing the travel distance between suitable habitat patches for dispersing wolverines, making the arrival of new genes within any mountain range less likely than it already is.

During winter 2016-2017 the states, supported by National Fish and Wildlife Federation money, will undertake a one winter survey of the wolverine population in Wyoming, Idaho, Montana, and Washington State (WAFWA 2015). Any effort to expand our knowledge of wolverines is a positive step, but for the reasons we discuss above, a single-season survey is inadequate to truly understand what is going on within the wolverine meta-population of the U.S. Rockies. Although the multi-state survey has repeatedly been referred to as a "monitoring program," it is not; it is a snapshot. Its further focus on connectivity and reintroductions within the Montana-Idaho-Wyoming region should be regarded with caution. Wolverines disperse widely, and apparently somewhat indiscriminately; they are not migratory animals, following particular and definable routes, and although they may have some preferences for certain habitat types as they travel between mountain ranges (Schwartz et al 2009), they seem capable of deviating from these routes into unexpected habitat, as in the case of M56. Corridor ecology has long been a trendy topic, and protecting migration and dispersal corridors for species like pronghorn, elk, and bears has been a focus of the conservation community for decades. Wolverines are likely to benefit from any work done to preserve wildland linkages among mountain ranges, regardless of whether that work focuses on wolverines, or on other species. We encourage any future proposed wolverine-related work on connectivity and road crossing structures (WAFWA 2015 pp. 10, 12

and 13) to first assess whether the *specific* benefits to wolverines are worth the investment of scarce funds in this area, or whether those funds would be better spent working on understanding core areas, developing a monitoring program, or investigating other topics of interest. In most cases, we strongly suspect that a focus on linkage corridors as a conservation action is essentially a default non-action, since there is already so much attention to this topic for other species, and corridor protection and construction of road-crossing structures is advocated for by numerous conservation researchers and organizations. If a wolverine-specific focus to these questions adds substantially to the motivation to take conservation action for corridors or wildlife crossings, and if wolverine-specific benefits can be proved, we support it; otherwise, we remain dubious of its utility in advancing wolverine conservation while so many other questions about the species remain unanswered.

Finally, we strongly oppose the idea of manually moving wolverines from one mountain range to another within the Wyoming-Idaho-Montana region (WAFWA 2015 p.13), unless and until we understand what that does to the reproductive potential and the occupancy and recolonization rates of the ranges from which the animals are being removed. We would support this idea only if wildlife managers can identify and target juveniles rather than resident adults as the animals to be moved – in that case, it would be a question of simply hastening the dispersal process rather than punching holes in occupied ranges elsewhere. Even when working with juveniles, however, there is always a chance that a captured juvenile will not remain in the range to which it is introduced - a male, M57, caught in a bobcat trap in Menan, Idaho in 2009, was taken to the vet and then released into habitat considered vacant in the Centennials; he promptly abandoned that range for the Absarokas (Murphy et al 2011 p. 27). The risks of reintroductions must be carefully weighed against the potential benefits. Removing reproductive adults should be avoided, and wolverine conservation in the US Rockies should remain focused on the continued existence of a naturally connected and self-sustaining meta-population, rather than a population dependent on continual human intervention.

Summary of points:

- A simple detection of presence does not equal residency, and it does not suggest that we have any idea of reproductive success or positive demographic trend.
- Detection and wolverine relocations from years past does not necessarily mean wolverines currently occupy the same areas, nor does this suggest that those areas currently hold a demographically stable population.

- In the absence of meaningful demographic measures and data on reproduction, assumptions of population expansion solely due to the presence of males in recently unoccupied areas far from known nodes of reproduction does not necessarily suggest meaningful population expansion.
- While the distribution of similar genetic haplotypes across the lower 48 suggest the extant wolverine population has its origins in Canada, this does not mean rates of expansion in distribution are constant, or are being maintained, or will continue.
- When considering fundamental characteristics of wolverine populations, such as wolverines living at extremely low densities, having a low reproductive rate, and as best we know a low recruitment rate, there is no sound argument to assume positive reproductive growth at scale. There is simply no demographic data representative of wolverine populations at scale suggesting that wolverine populations are increasing in number or current distribution.
- Best available information suggests that local wolverine populations are exceedingly vulnerable to decline. For example, the removal of any one reproductive female from any distinct mountain range has a profound effect on the population growth rate of that distinct population group.
- Further, if reproductive females in a population node die, assumptions of population "rescue" (in a meta-population a source population would provide individuals for sink areas) are currently based on no evidence of this rescue. We do not have meta-population sources identified, nor can we guarantee true dispersal of individuals from one area to another area needing rescue. We simply do not have an adequate understanding of the dynamics of a wolverine meta-population to claim that these dynamics are functioning to the degree that many assume.

3. Any information on the biological or ecological requirements of the species, and ongoing conservation measures or efforts for the species and its habitat.

The crux of the listing discussion is the relationship between wolverines and snow. This relationship has long been intuitively understood to exist, as the species is exclusively circumboreal in its distribution, and highly evolved to specialize in cold, snowy conditions Not until 2010, however, was the link between wolverines and snow scientifically described. Copeland et al (2010) demonstrated a relationship between persistent spring snowpack (on the

ground until about May 15th), low maximum August temperatures, and global wolverine distribution, and hypothesized that female wolverines require spring snowpack to den successfully. The authors demonstrated that nearly every wolverine den known at the time fell within this model, and that the exceptions were still located in snow, even if not within the model. Significantly, the paper also notes that north of 54° latitude, the correlation between spring snow and cool summer temperatures diverges, and that wolverine distribution in these areas tends to be subject to other factors besides just spring snow. They also note that north of 54° latitude, wolverine distribution tends to extend slightly south of the snow model, particularly in places with low topographic relief (Copeland et al. 2010 p. 239).

Two recent papers add to our understanding of wolverine distribution by highlighting small populations that are persisting outside of the snow model, but north of 54° latitude. Webb et al (2016) discuss a population in the boreal forest of Alberta where lactating females have been documented on camera in areas outside the snow model. The paper also assesses decades of trapping records that show that female wolverines have been consistently trapped in areas with low or no spring snow. Within this same study area, female wolverines have been found denning in structures such as beaver lodges, root balls, and brush piles, in the absence of deep snow (Scrafford and Boyce 2014; 2015).

A second paper, Arronson and Persson 2016, mentions a little-studied wolverine population in southern Sweden that also appears to be persisting and reproducing in forested lowlands beyond the edge of the snow model, although there is no information in this case about whether the wolverines are still using snow to den, or whether they are employing other structures.

While these populations are interesting, their relevance to wolverine conservation in the US Rockies should be considered with a critical eye. The data all come from regions significantly north of 54° latitude, and with significantly different ecological and habitat characteristics, than those of the U.S. Rockies. Both populations exist close to populations that are breeding in areas of persistent spring snow, and while reproduction has been documented in both regions, the relative reproductive success compared to wolverines denning in the snow hasn't been determined. In some discussions surrounding wolverines and snow, people appear to have conflated the idea of a wolverine-snow obligate relationship with a biological relationship between the presence of snow, and a wolverine giving birth. We know that wolverines can become pregnant and have kits in the absence of snow, but the real question is the persistence of the population over time. A hypothetical snow-obligate relationship exists at the population

level, not the level of individual animals, and individual aberrations don't categorically disprove the idea of an obligate relationship between wolverines and snow. Instances of wolverines having babies in areas within dispersal distance to the south, or in the interstices, of regions with persistent spring snow is not surprising, but currently we are not sure whether these areas are producing enough kits to sustain themselves over time, or whether they are simply sinks for excess animals who cannot establish territories within more optimal habitat. These sorts of source-sink dynamics are characteristic of populations in variable habitats (e.g. Dias 1996), and ignoring the body of ecological literature that demonstrates such a basic concept would be unwise.

In the Swedish case, it's also important to note that the recent colonization of the region in southern Sweden follows both the implementation of a payment-for-dens scheme in areas of high conflict with reindeer herders further north, where wolverines were previously being killed at greater rates, and also the implementation of a moose hunting season that, in combination with the reintroduction of wolves to the area, provides greater levels of carrion in the region. This hypothetically may have provided both larger numbers of dispersers seeking to establish territories on an increasingly crowded landscape, and also supplemental calories for those animals.

We remain intrigued, however, by the variations in wolverine behavior in different habitat types at different latitudes, and we don't categorically discount the viability of these populations. It is possible that the boggy environment of the boreal forest at the Alberta study locations offers some of the same benefits as snow does in mountain environments, which may make wolverines in these environments less dependent on snow. The Scrafford and Boyce (2015) progress report from this region mentions dens found in old beaver lodges, which would provide both thermal insulation and protection, similarly to snow dens. The authors also speculate that the bogs may limit the presence of large ungulates, which in turn limits the presence of other predators, another proposed function of snow in other parts of wolverine range. In the boggy boreal environment, beaver tend to be a major component of the wolverine diet, and acidic bog environments may be used as cache sites that preserve food, as snow does in areas where it persists for longer (Scrafford and Boyce 2015). Snow is not the only wolverine habitat component likely to be affected by climate change. If the reproductive success and long-term viability of these populations can be demonstrated, we should be asking what allows these wolverines to persist in an environment that is still decidedly cold and northern (even in the absence of late spring snow),

and determining whether those factors exist in the US Rockies, and whether they are likely to change with a changing climate. While the authors of Webb et al (2016) cite the presence of these boreal forest wolverines as an example of "local adaptation" (Webb et al p. 1468) scientists and managers need to better understand what that "adaptation" entails. These wolverines may be responding to factors that are either not present in the U.S. Rockies, or else they may be relying on factors that are still likely to vanish with a warming climate; regardless, there is no evidence of actual adaptation in the evolutionary sense.

Again, although populations breeding outside the snow model are well worth consideration and further investigation, and although the Wolverine Foundation has funded the Alberta work and continues to do so, we don't believe that the findings from this project should be applied to wolverine management decisions in the U.S. Rockies, because of the uncertainties over the long-term viability of these populations, and the vast difference in habitat and latitude. In fact, Webb et al (2016) state that mountainous environments and boreal forest environments should be considered separately when making management decisions, stating, "We feel...that it may be important to view the Rocky Mountains and Boreal Forest data separately when drawing conclusions…" (Webb et al 2016 p 1467), because the association between wolverines and snow is much tighter even in mountainous areas at the same latitude. The association is even stronger as one moves south.

We especially caution against the impulse to use a few exceptions to state that a rule that holds everywhere else is "false." Scientists and policy makers alike sometimes have an unfortunate tendency to see things in terms of binaries – either something is true 100% of the time, or else it's entirely false. Wolverines at the southern edge of the extent of deep spring snow in the Canadian boreal forest may indeed be using different survival strategies than those in the U.S. Rockies, but this should lead us to questions about why, and, in the event of snow loss from the U.S. Rockies in the future, whether our landscapes and ecosystems provide the same alternative options for the species. It should not lead us to categorically reject a model that otherwise correlates so strongly with global wolverine distribution. And it should not lead to statements such as "This is proof that wolverines are adapting," because adaptation is a long-term evolutionary process of genetic selection for specific traits, and we currently have no evidence that this has happened.

We still believe the snow-and-temperature model (Copeland et al 2010) is the best model for describing wolverine distribution globally, and should be used as a starting point for refining our

understanding of the species. Inman (2013) offers an alternative habitat model, but uses datasets only from study animals in the Greater Yellowstone region, and then extrapolates across the entire western US. Predictive models based on regression analyses rely on variation in proportional availability compared to proportional use. Such a model assumes that the availability, or the proportion of availability of each variable, remains the same across the entire analysis area - that the proportion of the landscape covered in snow, or within some category ruggedness, or occurring at some elevation, is the same in California as it is in Montana. The Akaike Information Criterion (AIC) is a measure of the goodness of fit of an estimated statistical model. The reason AIC is most commonly employed as the model selection tool for broadscale predictive models is its tendency to prefer simple models. Generalizing will always be more acceptable the fewer the variables one is attempting extrapolate. With 12 variables, the Inman model is unnecessarily complex, and therefore loses predicative power. It reminds us that snow is a proxy for other habitat characteristics that are likely also important to wolverines in the US Rockies and potentially in the Sierra Nevada Mountains, but we believe that Copeland et al (2010), which uses only snow and low summer temperatures as variables, and notes an expected presence of some wolverines beyond the southern edge of spring snow distribution, particularly in high northern latitudes, better delimits wolverine habitat.

Finally, Arronson and Persson (2016) explicitly deal with the ways in which management priorities in a given national context influence the ways in which researchers frame questions and conduct studies. This is not to say that scientists are doing bad science; within context, the science is frequently quite good. But it's worth considering that the primary threat with which Canadian researchers in the boreal forest are coping is widespread infrastructure development by extractive industries. Most of the wolverine research from Canada is designed to explore this challenge. Consequently, the literature from Canadian research tends to make arguments primarily about the impacts of development. The Wolverine Foundation has supported many of these studies, including work in Alberta on these populations, but we note that Webb et al (2016) conclude with an assertion that development rather than climate change is the biggest problem for wolverines. Again, the idea of binary true-false situations in science should be avoided; both of these things are threats. In the lower 48 states, wolverines tend to occupy areas that are difficult to develop and that are only intermittently used for extractive purposes, so climate change may be the issue of greater concern; in boreal forest regions of Canada, roads, pipelines, or other infrastructure development may be more pressing. The gradient of threats may shift with both latitude and national borders, but papers suggesting threat due to climate change do not

necessarily work against papers suggesting threat due to infrastructure development in a zero sum game of demonstrating that only one thing is a problem for wolverines; they work together to reinforce the idea that this species is vulnerable from multiple processes that show no signs of slowing down.

Summary of points:

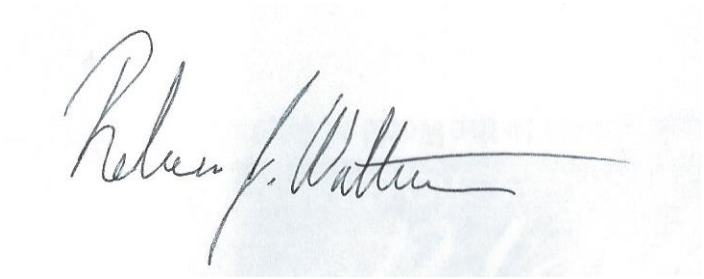
- Recent research results showing exceptions to the wolverine snow denning hypothesis should be given due consideration, as they raise a number of interesting and pertinent questions.
- They should not, however, be used to make arguments that a wolverine-snow relationship does not exist or is unimportant. Both populations documented breeding outside the snow model are north of 54° latitude and occupy different habitat types than those available to wolverines in the US Rockies. The reproductive success and long-term viability of these populations has not been assessed, nor have the ways in which they might be otherwise dependent on cold climate conditions and habitat features (e.g. the presence of bogs characteristic of boreal forest and tundra areas, the widespread presence of beavers) that may or may not also exist in the U.S. Rockies.
- The existence of source-sink dynamics among species that occupy different types of habitat is widely accepted. We cannot be sure that the populations in Sweden and Alberta are viable without continued infusions of new wolverines from more robust source populations in habitat with spring snow.
- Wolverines face numerous challenges, including both development and climate change, and we should consider these challenges as interacting with and potentially amplifying negative effects, rather than arguing about which one is "the" threat. All of them need to be addressed.

The Wolverine Foundation believes that the existing literature shows substantial threat to wolverines from climate change effects, and that those threats are great enough to warrant threatened status under the Endangered Species Act. We are, however, open to alternatives to listing. Climate change presents a unique challenge to wildlife conservation, and any forward path for wildlife conservation in the era of climate change must employ strategies that will best cope with the threat. The ESA is a strong tool for dealing with risks to species, but it may or may

not be the best option in this case. Any alternative effort, however, including a process led by the states, must meet the highest standards for a scientifically robust and inclusive process for wolverine conservation. At a minimum, this includes:

- A commitment to reducing wolverine mortalities from all sources. Spending millions to build road crossing structures to prevent hypothetical mortalities while maintaining a trapping season, or even an option to reopen the trapping season, is illogical and counterproductive.
- Developing a long-term monitoring program that provides more than just a static snapshot of the population.
- Adequately funding research into questions such as local extinction/recolonization dynamics, identification of key core source areas, and further clarification of the links between wolverines, snow, low temperatures, and other habitat characteristics.
- Innovative approaches that address the challenges of new threats like climate change, rather than approaches that rely only on things that are already happening (corridor conservation) and highly interventionist techniques (moving wolverines from one mountain range to the next).

We commend everyone who is working towards better understanding of the species, and we hope that the discussion around listing leads to conservation outcomes, whether through threatened status or an alternative, that ensure the continued existence of this species in the contiguous United States.



Rebecca Watters
Executive Director

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