May 17, 2010

COMMENTS: WOLVERINE STATUS REVIEW AND REQUEST FOR NEW INFORMATION

Submitted via the Federal eRulemaking Portal
http://www.regulations.gov
Docket "FWS–R6–ES–2008–0029"

Also submitted via U.S. mail to:
Public Comments Processing
Attn: FWS–R6–ES–2008–0029
Division of Policy and Directives Management
U.S. Fish and Wildlife Service
4401 N. Fairfax Drive, Suite 222
Arlington, VA 22203

Defenders of Wildlife, Center for Biological Diversity, Center for Native Ecosystems, Conservation Northwest, Friends of the Bitterroot, Friends of the Clearwater, Greater Yellowstone Coalition, Idaho Conservation League, Jackson Hole Conservation Alliance, Klamath-Siskiyou Wildlands Center, Save Our Cabinets, and Wyoming Outdoor Council submit the following comments in response to the U.S. Fish and Wildlife Service's (FWS) notice announcing the initiation of its status review of the North American Wolverine (*Gulo gulo luscus*). 75 Fed. Reg. 19,591 (April 15, 2010). These comments are organized by the categories listed in the "Request for Information" section of this notice.

1. **General information (taxonomy, biology, ecology, genetics and status, in the lower 48 and across North America)**

We call attention to the following research findings important to wolverine conservation and completed since FWS's previous wolverine status review.

Schwartz et al. 2009
Key findings: Wolverine effective population size estimated at just 35 individuals ("credible limits, 28-52") in the U.S. Rocky Mountains. Also, empirically derived wolverine movement corridors identified important to maintaining a viable wolverine metapopulation in the U.S. Rockies, but currently under no special management designation.

Copeland et al. 2010
Key findings: Wolverine distribution worldwide is highly correlated with areas that maintain snowpack that persists well into spring (May 15). Also, wolverines are shown to avoid areas that exceed a certain mean temperature during the summer months, indicating an upper threshold for wolverine habitat. The reduction and fragmentation of these areas within the bioclimatic "envelope" suitable for wolverines is anticipated to increase with the onset of global warming, especially in the lower-48 states.

Balkenhol 2009 (enclosed)

Key findings: An extension of the landscape genetics analysis employed by Schwartz et al. (2009), which provides additional evidence that wolverine range in the lower 48 is highly correlated with persistent spring snowpack, and shows wolverines avoid areas of human developments and activities, especially when dispersing between areas of suitable habitat.

Brodie and Post 2010
Key findings: Wolverine populations declined in areas of northern Canada and Alaska with decreasing snowpack, inferred from trapping records. This is some initial empirical evidence in support of the risks posed to wolverines by human-induced climate change, especially at the southern extent of their range.

Moriarty et al. 2009 (along with Griffith 2009; Fimrite 2010, enclosed)
Key Findings: Documentation of a wolverine in California initially in 2008, and again in 2009 and 2010, indicating the Sierra Nevada provides suitable habitat to support wolverines. Genetics analysis found that the wolverine is most closely related to the population in Idaho's Sawtooth Mountains, indicating it may have dispersed from the Rocky Mountains on its own.

Wildlife Conservation Society, 2009 (enclosed)
Documentation of a wolverine dispersal into Colorado, indicating a wolverine traveled from its own from the Greater Yellowstone Ecosystem to the southern Rocky Mountains, and subsequent evidence of its ongoing survival in Colorado indicates the area provides suitable habitat to support wolverines (WCS Researcher Bob Inman, personal communication, January 2010).

Rohrer et al. 2008
Ongoing documentation of a small wolverine population resident to the North Cascades in Washington State.

2. The lower-48 wolverine population is both discrete and significant, and thus it meets the criteria to be designated a Distinct Population Segment ("DPS").

The previous FWS status review found that wolverines in the lower-48 states did not constitute a "listable entity" under the ESA in part because they were not "discrete" from healthy wolverine populations in Canada and thus could not be designated as a Distinct Population Segment. To put to rest the erroneous interpretations of the Endangered Species Act and the FWS Distinct Population Segment policy that the "not warranted" finding was inappropriately based upon, we provide an accurate interpretation in these comments.

A. The lower-48 wolverine population is discrete.

FWS DPS Policy (emphasis added): 61 Fed. Reg. 4725.

> A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:
> 1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
> 2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

Both conditions apply to the lower-48 wolverine population, for reasons that we described in detail as follows.

i. The lower-48 wolverine population is "markedly separated" from other populations

There is ample evidence of genetic discontinuity between this population and wolverines in Canada and Alaska, as acknowledged in the previous status review (emphasis added). 73 Fed. Reg. 12937.

> Genetic studies have highlighted the essential role that genetic exchange plays in maintaining genetic diversity in small wolverine populations. Genetic drift has occurred in the remaining populations in the contiguous United States where wolverines contain four of nine haplotypes found in Canadian populations (Kyle and Strobeck 2001, p. 343; Cegelski et al. 2003, pp. 2914-2915; Cegelski et al. 2006, p. 208; Schwartz et al. 2007, p. 2176). The reduced number of haplotypes indicates not only that genetic drift is occurring, but also that there is some level of genetic separation; if these populations were freely interbreeding, they would share more haplotypes (Cegelski et al. 2006, p. 205). The reduction of haplotypes is likely a result of the fragmented nature of wolverine habitat in the United States and is consistent with an emerging pattern of reduced genetic variation at the southern edge of the range documented in a suite of boreal forest carnivores (Schwartz et al. 2007, p. 2177). As stated previously, the low effective population size and accompanying reduction in genetic diversity is a concern because populations with low genetic diversity are more vulnerable to extinction.

Despite this acknowledgement, FWS erroneously interpreted its own DPS policy to require complete genetic isolation for a DPS designation: 73 Fed. Reg. 12936.

> The U.S. population is connected to wolverine populations in Canada and is likely dependent on them to some degree for maintaining genetic diversity. Therefore, the U.S. population of the North American wolverine does not meet the markedly separated criterion of the DPS Policy.

A review of the FWS DPS policy clearly indicates this interpretation is in error. 61 Fed. Reg. 4724.

> The Services do not consider it appropriate to require absolute reproductive isolation as a prerequisite to recognizing a distinct population segment…
>
> [T]he standard adopted does not require absolute separation of a DPS from other members of its species, because this can rarely be demonstrated in nature for any population of organisms.

For more detailed rebuttals of the FWS's previous finding on this issue, see the arguments articulated in the legal briefs submitted by Earthjustice on behalf of Defenders of Wildlife and other plaintiffs challenging that finding (Attachments 1 and 2 to these comments).

ii. The lower-48 wolverine population is delimited by an international boundary, and there are significant differences on either side of this boundary regarding control of exploitation, habitat management, conservation status and regulatory mechanisms affecting wolverines.

There is ample evidence that the international boundary between the United States and Canada results in different control of exploitation, management of habitat, conservation status, and regulatory mechanisms overall for wolverines on either side of this boundary, which are significant enough to indicate that current regulatory mechanisms are not adequate to ensure the survival of wolverines in the lower-48 states.

FWS acknowledged some of these differences in its previous status review, yet it dismissed other significant differences without adequate justification, and erroneously dismissed differences it found with the erroneous refrain that since the differences were not a direct "cause" of the wolverine's threatened status in the lower 48, they were not sufficient to fulfill the "discrete" criteria of a listable DPS under the ESA.

The intent of the "international boundary" criterion for a DPS designation is simply to provide the grounds for using a political boundary for a DPS when it is justified for reasons not grounded in biology. 61 Fed. Reg. 4723.

> … it appears to be reasonable for national legislation, which has its principal effects on a national scale, to recognize units delimited by international boundaries when these coincide with differences in the management, status, or exploitation of a species.

Put another way, when considering the question if adequate regulations are in place to effectively address the various threats facing wolverines in the lower 48 (section 4(a)(1)(D) of the ESA), FWS should consider if there are any significant differences in control of exploitation, habitat management, conservation status, or regulatory mechanisms for wolverines in the lower 48 versus in Canada. If so, FWS can designate a DPS for the U.S. population of that species and consider listing it under the ESA. If not, the U.S. population is not sufficiently discrete to be considered for DPS designation.

a) International differences in wolverine conservation status

In its previous status review, FWS clearly documents differences in conservation status between wolverine populations in the lower 48 and Canada. The following excerpts from the previous status review were included in the Notice of Intent to Sue ("NOI") filed on July 8, 2008 by Earthjustice on behalf of Defenders of Wildlife and the other co-plaintiffs challenging that review (Attachment 1, p. 9):

- "Throughout its current range in Canada and Alaska, wolverines exist in well-distributed, interconnected, large populations. Conversely, wolverines in the contiguous United States appear to exist in small, fragmented, and semi-isolated populations that put them at greater risk of being lost due to catastrophic or stochastic events than those populations to the north in Canada and Alaska." 73 Fed. Reg. at 12,936.
- "The total population sizes for wolverines in Canada and Alaska, and the contiguous United States, differ by more than an order of magnitude," with estimates of only 500 wolverines in the lower-48 states and more than 23,000 wolverines in Canada and Alaska. *Id.* "Small populations, such as the contiguous U.S. population, face higher extinction risk than large ones such as the Canada and Alaska population." *Id.*

- The effective population size of the lower-48 population is only 39 individuals—which is too low for even "short-term maintenance of genetic diversity"—whereas available information "indicates that the populations in Alaska and Canada are less vulnerable to extinction pressures associated with a low effective population size." *Id.* at 12,937; *see also id.* ("The small effective population size in the contiguous United States contrasts with the situation in Canada and Alaska where wolverines are relatively abundant and exist in habitats with a high level of connectivity.").
- "Wolverine habitat in the contiguous United States consists of small, isolated 'islands' of high-elevation, alpine habitats containing sufficient depth of snow during the denning period, separated from each other by low valleys of unsuitable habitats." *Id.* "The low population densities and reduced genetic diversity of wolverines in the contiguous United States means that, to avoid further inbreeding or local extirpation due to demographic stochasticity, regular exchange of individual wolverines between islands of habitat must occur." *Id.* "Wolverine populations in the Canadian Rockies also exist on habitat islands, but the islands are much larger and host larger populations so that exchange of individuals is likely to be less critical for short-term maintenance of genetic diversity and demographic stability." *Id.* at 12,937-38 (citation omitted).

Yet as mentioned earlier in these comments and in the NOI, in its initial status review FWS claimed these differences in conservation status are not sufficient to consider the U.S. population discrete, with the erroneous interpretation that they are "not significant in light of section 4(a)(1)(D) of the ESA. As we state above, section 4(a)(1)(D) of the ESA simply asks if regulatory mechanisms are in place to effectively address the threats to a species or population under consideration for listing. The wolverine's conservation status is significantly different in the lower 48 states compared to Canada, and current regulations on either side of the international border have failed to prevent this difference. Nor is there any evidence that current regulations affecting wolverines and their habitat in the U.S. and Canada are sufficient to restore the lower-48 population such that the differences in the wolverine's conservation status on each side of the international border will become less significant at any time in the foreseeable future. Thus, the lower-48 wolverine population meets the "discrete" criterion of the FWS DPS policy.

b) International differences in the management of wolverine habitat

In its previous status review, FWS also dismisses important differences in habitat management for wolverines in the lower 48 versus Canada without adequate justification (73 Fed Reg at 12936, emphasis added):

> In both the contiguous United States and Canada, <u>little habitat management occurs</u> in areas frequented by wolverines. <u>Therefore, we find that there are no significant differences</u> in management of habitat for wolverines that relate to the status of the species between the contiguous United States and Canada.

FWS confuses the "absence of human presence and development" that characterizes much of the wolverine's current range with the ESA requirement that sufficient regulations are in place to ensure sufficient habitat quality and security for wolverines. Simply because wolverine habitat is generally remote from human activities and developments does not mean that this habitat is not vulnerable to harmful impacts, or that the regulations in place on either side of the international border that may or may not effectively prevent these impacts are not significantly different.

Information in the FWS administrative record indicates that a significant portion of the wolverine's current range in the U.S. Rocky Mountains is protected from disturbance by motorized vehicles as a designated Wilderness area or national park (e.g., Brocke et al. 2007, p. 34), plus a significant portion of the wolverine's range in Canada is protected under similar designations. Yet this also means that the rest of the wolverine's range—the vast majority—is currently unprotected from motorized use and other potentially harmful activities on either side of the international border. These areas are subject to a full range of impacts, including but not limited to: road building, motorized recreation, logging, mining, oil and gas exploration and development, livestock grazing and associated predator control activities, resort developments (i.e., ski areas, vacation homes, golf courses, etc.), and backcountry recreation. Also important in the lower 48 especially are connecting "intermountain valley" habitats between patches of high-elevation wolverine habitat, which are impacted by human highways, and the development of private lands and communities within and adjacent to these highway corridors.

The regulations that govern this vast majority of wolverine habitat in the U.S. and Canada change abruptly at the international border. On the U.S. side, much of the habitat is managed by the U.S. Forest Service, which is obliged to manage habitat for native species under the National Forest Management Act (though how this responsibility is implemented varies considerably across national forests—see Section 4(D) of these comments below). In Canada, there is no such legal mandate to maintain native species not listed under the federal Species At Risk Act. Furthermore, the status of wolverines is much more secure in Canada, so they receive much less attention when managers face decisions affecting their habitat. Canada is under no obligation to help maintain wolverines in the lower 48 by providing source populations or maintaining connectivity to the U.S. populations, thus the United States has sole responsibility to maintain wolverines in the lower 48. Such is the purpose and intent of the federal Endangered Species Act, as well as the "international boundary" criterion of the FWS DPS policy.

c) International differences in how the exploitation of wolverines is controlled.

In its previous status review, FWS describes some of the many differences between wolverine trapping regulations in Canada compared to the U.S. ("commercial furbearer" "Regulated Harvest" in BC with no quotas; Fur Management Zones in Alberta, some with quotas; and stricter quotas in Montana, with trapping prohibited in other lower-48 states). 73 Fed. Reg. 12939.

Yet FWS dismisses these differences claiming that they appear to be commensurate with the differences in wolverine conservation status between the two countries and thus are not significant (*Ibid*).

> We conclude that the differences in control of exploitation between the United States and Canadian wolverine populations are not significant in light of section 4(a)(1)(D) of the Act because in both countries exploitation appears to be adequately regulated according to what the overall population can sustain.

An analysis of what level of trapping the lower-48 wolverine population can sustain belongs in a consideration of section 4(a)(1)(B) of the Act (see Section 4(B) of these comments below), and is not relevant to the question if the lower-48 population can be considered discrete from wolverines

in Canada. To meet the condition for discrete, FWS should simply analyze if there are significant differences in the control of exploitation on either side of the international border, and if these differences are significant in terms of the question, are adequate regulatory mechanisms in place to address the threats to the population? FWS has acknowledged a variety of differences between regulations to control trapping wolverines in British Columbia, Alberta, and the U.S., in terms of who is allowed to trap, how long they are able to trap, how many wolverines they can trap, etc. Furthermore, there is no evidence that the more liberal trapping regulations in Canada are designed to maintain wolverines in the lower 48, and they clearly have not prevented the decline of wolverines in the lower 48 in the past. Thus, the differences in trapping regulations between the two countries provide further justification for designating wolverines in the lower 48 a distinct population segment.

d) International differences in regulatory mechanisms affecting wolverines overall.

If there were no international boundary at the 49th Parallel, and Canada was the 51st United State, then the only reason to create a DPS for wolverines in the lower-48 states would be their "marked separation" from wolverines in Canada described above. In that hypothetical scenario, consistent regulations might occur across the wolverine's range to maintain and restore wolverines and their habitat now at risk in the lower 48. Yet given that the international boundary is indeed in place, American wildlife laws, policies and officials have no control over what happens in Canada and vice versa. The best American managers can do, and what the ESA requires, is for FWS to maintain species, populations and ecosystems in the U.S. where they are threatened or endangered, and work collaboratively with our neighbors to provide for these species range-wide. Where differences occur in regulations affecting these species and their habitat at an international border, which is almost always the case, the U.S. is obliged to consider its portion of that species discrete, designate it as a distinct population segment, and do whatever it can to protect and restore that DPS.

When examining the management of wolverine habitat, the control of its exploitation, and other regulations affecting the species, it is clear that each State, Province, national forest, provincial forest, or other land or wildlife management entity regulates these issues separately, without regard for persistence of the species across its current range. The current lack of federal protections either under the Species At Risk Act in Canada or the Endangered Species Act in the U.S. results in piecemeal management of the species and its habitat by States and Provinces, with little regard for regional management directed at the continued existence of the species. This fact, coupled with the clearly more imperiled conservation status of wolverines in the lower-48 states is ample justification for the delineation of a DPS to address these conservation concerns and ensure the persistence of wolverines in the lower 48.

B. The lower-48 wolverine population is significant

Besides being discrete, the lower-48 wolverine population must also be "significant" to be designated a DPS according to FWS policy (emphasis added): 61 Fed. Reg. 4725.

> *Significance:* If a population segment is considered discrete under one or more of the above conditions, its biological and ecological significance will then be considered in light of Congressional guidance (see Senate Report 151, 96th Congress, 1st Session) that the authority to list DPS's be used " * * * sparingly" while encouraging the conservation of

> genetic diversity. In carrying out this examination, the Services will consider available scientific evidence of the discrete population segment's importance to the taxon to which it belongs. This consideration may include, but is not limited to, the following:
> 1. Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,
> 2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon,
> 3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or
> 4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

While the previous FWS status review did not address the issue of significance—because of its erroneous conclusion that the lower-48 wolverine population is not discrete—there is ample evidence in the scientific literature that up to three of these four criteria for significance are met.

i. Wolverine habitat in the lower 48 is ecologically unusual and unique.

The lower-48 states contain all of the wolverine's range in North America south of the 49th parallel. This encompasses the entire southern periphery of the wolverine's range, and thus is ecologically unusual and unique. Resident, breeding wolverine populations are known to persist as far south as the 44th parallel (350 miles south of the U.S./Canada border) in the Sawtooth Mountains in Idaho, and in northwestern Wyoming. Furthermore, individual wolverines were documented as far south as Colorado and California in the past year. There are many differences in ecological conditions of these areas in the southern extremity of the wolverine's range compared to in Canada and Alaska, including but not limited to: climate, weather patterns, topography, geology, soils, hydrology, vegetation, animal communities, and ecosystems overall. For example, some of these relationships are analyzed and described in a recent study by Keith Aubry and others (2007, pp. 2151-2).

> Overlaying historical wolverine records from the western United States on selected Kuchler potential natural vegetation types (Fig. 3) and Holdridge climatic life zones (Fig. 4), revealed potential relations with relatively large expanses of alpine vegetation or climatic conditions in many areas…
> [T]he elevation of wolverine records increased significantly with decreasing latitude and differed substantially from a regression of random locations sampled in the same area.

These differences are sufficient to satisfy the "significant" criterion of the FWS DPS policy.

ii. Loss of the lower-48 wolverine population would result in a significant gap in the wolverine's range.

Wolverines have already been extirpated from much of their historic range in the lower-48 states, including the entire Northeast and Upper Midwest, the southern Rockies (Colorado and Utah), and the Sierra Nevada (e.g., Aubry et al. 2007, Schwartz et al. 2007). There is no question that the loss of this range, plus any additional extirpations of wolverines from their current range in the U.S. northern Rocky Mountains and Pacific Northwest would fit the definition of a "significant gap" in their range. Given its low density wherever it occurs, it is difficult to calculate the area of past and presently "occupied" wolverine habitat in the lower 48, but suffice to say that if they were to be

extirpated from the lower 48, their range would be reduced at least 800 miles northward from their historic range, and 350 miles from their current range in the western U.S. A range gap of this magnitude is more than sufficient to satisfy the "significant" criterion of the FWS DPS policy.

iii. The genetic characteristics of the lower-48 wolverine population are markedly different than other wolverine populations

As we discussed in the "discrete" section above, while wolverines are not genetically isolated from other populations, they do exhibit genetic differentiation due to limited gene flow with populations in Canada and Alaska, which the FWS aptly described in its previous finding excepted above. 73 Fed. Reg. 12937. This is the third out of four possible criteria, any one of which is sufficient to meet the "significant" component of the FWS DPS policy.

C. The wolverine's range in the lower 48 constitutes a significant portion of its range overall.

The FWS notice announcing its status review does not specifically request information indicating if the range of wolverines in the lower-48 wolverine population constitutes a significant portion of the species' range overall, which is an alternate justification for its listing under the ESA in cases where the criteria for a distinct population segment are not met. Since FWS found in its previous review that not only does the lower-48 wolverine population fail to meet the prerequisites to be designated a DPS, but it also does not constitute a significant portion of the wolverine's range, we rebut this erroneous conclusion here.

The best scientific and commercial data available firmly establishes that the range of the wolverine is severely diminished. While wolverines once ranged as far south as California and New Mexico, within the contiguous United States the wolverine's range is now limited to Idaho, Montana, Washington and Wyoming. This range reduction warrants listing of the wolverine based on extinction throughout a significant portion of its range, as a species can be extinct 'throughout … a significant portion of its range' if there are major geographical areas in which it is no longer viable but once was.

Additional details that explain why the FWS' interpretation of "significant portion of its range" is incorrect—such as the perverse outcome that the smaller the area where the species still survives, the less likely it merits ESA protections—are described in the legal briefs appended to these comments (Attachments 1 & 2). Yet we take the opportunity with these comments to rebut the FWS' erroneous conclusions in its previous status review that wolverines in the lower 48 contribute neither to the resilience, redundancy nor representation of the species overall, and thus are not significant.

i. Wolverines in the lower 48 are important to the species' resilience.

In its previous status review, FWS defines "resilience" as the ability of the species to recover from disturbance, which can be indicated by a large area, and/or high quality habitat. 73 Fed. Reg. 12940. Climate change is the most likely foreseeable disturbance to affect wolverines (See Section 4(A)(v) of these comments below), and all potential refugia are likely to be important to recover from the projected impacts to the species, especially those at high latitudes and high elevations. The lower 48 contains occupied high elevation habitats for wolverines in the Greater Yellowstone Ecosystem, the

Northern Continental Divide Ecosystem, the Sawtooth Mountains, the North Cascades in Washington, and various areas of suitable and connecting habitats in between. The proven ability of these places to support self-sustaining wolverine subpopulations, even given the low densities and large individual range sizes within those populations, is ample evidence that they represent sufficient quantities and quality of habitat individually and collectively to contribute to the resilience of the species as a whole. Also found in the lower 48 are potentially important potential wolverine habitats recently recolonized by dispersing wolverines in the southern Rocky Mountains (Colorado) and Sierra Nevada Mountains (California), which may provide additional resilience due to their potential ability to retain areas of persistent snowpack in face of human-induced global warming.

If we refer to grizzly bears as an example, the lower-48 population may be as much of a source population for grizzly bear populations in southern Alberta and British Columbia as the other way around. This is a good example of how the lower-48 grizzly bear population contributes to the resilience of grizzly bears in North America, and the same may be true for wolverines, as indicated in this excerpt from a recent study from Alberta (Bradbury and Fisher, 2007, p. 1):

> Wolverines inhabit the mountains, foothills and boreal plain of Alberta, areas of increasingly rapid development *via* forest harvesting, mining, and oil and gas activities. Preliminary information from the Alberta Wolverine Experimental Monitoring Project (Fisher 2003, 2004, 2005; Fisher and Bradbury unpublished data) suggests that wolverines occur in very low densities in Alberta - lower than in other jurisdictions to the south, west, and north. The Monitoring Project also revealed that wolverine habitat is being heavily impacted by human development. For example, areas with detected wolverine activity in 2005 were subsequently bisected with new gas pipeline developments in 2006, rendering that habitat unusable to wolverines (Fisher and Bradbury, unpublished data). Historical harvest data from Alberta (Poole and Mowat 2001) suggests that wolverine populations are declining, and data from British Columbia (J. Krebs, pers. comm.) indicate that wolverines are highly susceptible to human development.
>
> Habitat loss is likely the largest parameter affecting wolverine survivorship in Alberta. In an era of unprecedented economic growth, and concomitant habitat loss to fuel this growth, few areas in Alberta remain sufficiently remote and undisturbed to support and protect wolverines…

ii. Wolverines in the lower 48 provide redundancy important to the species

Similar to how they contribute to the resiliency of the species, wolverines in the lower 48 also provide important redundancy for the species. In its previous finding, FWS dismissed the small lower-48 population (which it estimated at approximately 2% of the North American population overall) as insufficient to contribute to redundancy. This conclusion—that wolverines in the lower 48 do not significantly reduce the risk of the species' ability to withstand catastrophic events that affect portions of its range—is in error. Population size is just one criterion. Of equal or greater importance when considering redundancy can be the location and connectivity of the population. In this case, even though it is a small portion of the population overall, the lower 48 represents the entire southern portion of the species' range. Its fragmentation from wolverine populations in Canada and Alaska can be an asset to redundancy, since it can catalyze the development of unique traits that may help withstand catastrophic events, and it can provide isolation from disease or invasive species that may threaten contiguous populations, for example. Again the grizzly bear

serves a useful example of how the lower-48 population significantly contributes to redundancy in the species overall.

iii. Wolverines in the lower 48 provide representation important to the species

There is no doubt that the entire southern portion of the wolverine's range—8 degrees of latitude historically, and 5 degrees today—contributes to representation within the species overall. FWS defines genetic uniqueness as an indicator of representation (73 Fed. Reg. 12941), and as mentioned above found ample evidence of genetic differentiation in the lower 48 wolverine population. Incidentally, a genetic strain of wolverines unique to the Sierra Nevada Range in California has already been lost (Schwartz et al. 2007), which itself is sufficient to fulfill this criterion for significance. A broader interpretation of representation includes unique behavioral traits, which are also evident in the lower-48 population, as needed to adapt to higher elevations in the southerly latitudes as described above (see Section 2(B)(i) of these comments above).

For FWS to dismiss these contributions of wolverines in the lower 48 to the species overall and label their range "not significant" is to reduce the viability of the species overall in violation of its duty under the Endangered Species Act. As a final point on this subject, contrasting the case of the wolverine with the grizzly bear or the gray wolf further illustrates Congress's intended interpretation of "significant portion of range." The lower-48 distribution of grizzly bears and the Rocky Mountain Gray Wolf is similar to the distribution of wolverines, as is each of these species' distribution in Canada. Few people would argue that the area occupied by grizzly bears and wolves in the western U.S. is not a "significant portion of their range" and that the federal protection of these species and recovery programs well underway represent an overreaching of the ESA.

3. Conservation status in the lower 48 and across North America (distribution, abundance and trends)

See Sections 1 and 4 of these comments.

4. Five listing factors (habitat loss, exploitation, disease/predation, regulations, other factors)

Wolverine habitat is typically remote from human activities and developments. Yet many of these areas are under increasing use and development, plus the intermountain valleys that wolverines need to regularly travel between them. Examples of threats facing the majority of the wolverine's habitat in the lower 48 include: road building, motorized recreation, logging, mining, oil and gas exploration and development, livestock grazing and associated predator control activities, resort developments (i.e., ski areas, vacation homes, golf courses, etc.), and backcountry recreation. Threats to the "intermountain valley" habitats important to connect patches of high-elevation wolverine habitat, include human highways, and the development of private lands and communities within and adjacent to these highway corridors. Given the low effective population size of wolverines in the lower 48 (see Section 4(E) of our comments below), any reduction in wolverine habitat may be significant, especially considering the projected harm to wolverines due to human induced climate change (see Section 4(A) of our comments below). No conservation strategy is currently in place that maps wolverine habitat and ensures that declines do not occur (see Section 4(D) of our comments below).

A. Habitat loss

Here we present sufficient evidence of threats to wolverine habitat to warrant its listing under the ESA. Impacts to wolverine habitat can be organized into the following five categories: dispersed activities, permanent developments, transportation corridors, other land management actions (i.e., road-building, logging, livestock grazing), and effects from human-induced climate change.

i. Dispersed activities

Information in the FWS' administrative record indicates that dispersed recreation, especially snowmobiling and helicopter-assisted backcountry skiing, may not be compatible with maintaining adequate habitat security in wolverine reproductive denning habitat. Human activity in wolverine denning areas may stress and increase energy expenditure of female wolverines, and result in incidental mortality of offspring due to den abandonment, which may result in population-level impacts (Banci 1994), especially in the lower 48 states where the reproduction rate is low (Inman et al. 2007). See Attachment 3 to these comments for a more detailed discussion of this issue.

One example of the threat posed by dispersed winter recreation on wolverines is the recent revised management plan for the Beaverhead-Deerlodge National Forest in southwestern Montana. This national forest contains 3.3 million acres, and is considered vital habitat for wolverines in the northern Rockies because it provides key connecting habitats between wolverine subpopulations across the region (e.g., Bob Inman, remarks at the Western Forest Carnivores Committee conference, October 2009; Schwartz et al. 2009). A recent analysis by the Wildlife Conservation Society indicates that the current forest plan allows winter motorized use in approximately 1.4 million acres of wolverine habitat (Attachment 4). Not only will this decision reduce the security and usability of this habitat for wolverines, it also may reduce their ability to safely travel across the key movement corridors connecting wolverine subpopulations across the Rockies identified in the recent study by Mike Schwartz and others (2009).

This is just one example of the many impacts harming wolverine habitat by dispersed activities, due to ever-increasing recreational access into remote alpine terrain.

ii. Permanent developments

Wolverine habitat is characterized by alpine environments typically remote from human activities and developments, yet these areas are increasingly being developed for vacation resorts and resort communities that reduce and fragment wolverine range. Examples in southwestern Montana include new developments and expansions associated with four different ski resorts in the Madison and Bridger Mountain Ranges in recent years: Big Sky, Yellowstone Club, Moonlight Basin and Bridger Bowl. While their direct impacts on wolverines and their habitats are difficult to determine, there is no question that the developments themselves—houses, ski lifts, golf courses—and associated human activities displaces wolverines from these areas, result in the loss and fragmentation of wolverine habitat and populations.

iii. Transportation corridors

The FWS' previous wolverine status review acknowledges the threat posed to wolverines in the lower 48 from development of dispersal corridors between areas of suitable wolverine habitat (emphasis added): 73 Fed. Reg. 12937.

> The low population densities and reduced genetic diversity of wolverines in the contiguous United States means that, to avoid further inbreeding or local extirpation due to demographic stochasticity, regular exchange of individual wolverines between islands of habitat must occur. Intermountain valleys are increasingly the sites of human residential and commercial developments and transportation corridors, and represent semi-permeable barriers to wolverines. Although crossings of valleys, primarily by males (e.g., Packila et al. 2007, Fig. 2, 3), have been documented, these crossings are not common, and movements within valleys occur less frequently than movements in suitable wolverine habitats (Packila et al. 2007, p. 110).

The development of these transportation corridors, and of "intermountain valleys" between patches of wolverine habitat more generally, pose a significant risk to maintaining the wolverine connectivity sufficient to sustain the overall lower-48 wolverine metapopulation. Since the previous status review, new tools from the field of landscape genetics have been used to identify key movement corridors in the U.S. Rocky Mountains (Schwartz et al. 2009). The following excerpt from Balkenhol (2009) describes the threat posed to these areas by human developments (pp. 122-123).

> [F]or distances that are beyond reported wolverine dispersal distances (i.e., beyond ~420km), housing density and terrain ruggedness became increasingly important.. To maintain connectivity over such large distances, wolverines have to disperse outside of their typical, mountainous habitat, and cross areas that are characterized by higher housing densities and gentler topography. Thus, for long distance dispersal, wolverines choose to traverse areas with relatively little anthropogenic influences so that housing density and terrain ruggedness had an increased impact at larger scales.

Failure to address this threat to wolverine habitat could result in the complete fragmentation and isolation of wolverine subpopulations in the lower 48, which may result in their extirpation, especially considering their low effective population size (Schwartz et al, 2009, see Section 4(E) of our comments below).

iv. Other land management actions

A fourth category of threats to wolverine habitat besides dispersed activities, permanent developments, and the development of transportation corridors includes: roadbuilding and reconstruction, logging operations, domestic livestock grazing and associated predator control activities, and various other management actions affecting wolverines and their habitat in the lower 48. Alpine areas favored by wolverines are not immune to these activities, particularly on the national forests, and they have the potential to degrade, reduce and fragment wolverine habitat wherever they occur, either short or long term. No regional conservation strategy is in place to map, quantify and mitigate these habitat threats as needed to ensure survival of the lower 48 wolverine population (see Section 4(D) of our comments below).

v. Climate change impacts

As if current conditions and threats to wolverine habitat were not challenging enough, wolverines in the lower 48 face the added challenge of a significant decline and fragmentation of their habitat due to human-induced global warming. Evidence has recently come to light that wolverines worldwide depend on deep snow that is persistent into late spring for successful reproduction and distribution overall (Aubry et al. 2007, Ruggiero et al. 2007, Schwartz et al. 2007, Copeland et al. 2010). These studies warn of the consequences for wolverines from declining snowpack already underway in the southern portions of their range (emphases added):

> Aubry et al. 2007, p. 2154
> If the persistence of wolverine populations is linked to the availability and quality of relatively deep snow for reproductive den sites, insufficient snow cover during the denning period could play an important role in limiting their distribution.

> Ruggiero et al. 2007, p. 2146
> Snow cover that persists through the spring denning period appears vital to reproduction. Elevations and habitats associated with this attribute may be critical for successful natal (birthing) dens throughout the wolverine's range… because alpine conditions become increasingly fragmented at southern latitudes, opportunities for population recovery and natural recolonization will be limited… Given current predictions about warming climates, this situation will likely be exacerbated.

> Schwartz et al. 2007, p. 2177
> It appears that wolverines, at least in the Pacific Coast mountains, are associated with relatively large expanses of alpine habitat conditions and snow cover that persists through the spring denning season. Although these findings have range-wide implications, they may be most relevant in peripheral portions of the wolverine's range where increasing temperatures associated with global climate change could shift treeline to higher elevations, in effect shrinking the alpine zone… and decreasing the probability of spring snow cover. If such changes occur, current wolverine habitat at the periphery of the range may lose the ability to support viable populations of wolverines.

A study published earlier this year correlated putative declines in wolverine populations in Canada with decreasing snowpack in those areas (Brodie and Post 2010, pp. 281-2, emphasis added).

> Annual snowpack depths declined across all six western Provinces… Across provinces, wolverine population growth rate was positively related to temporal trends in winter snowpack (Fig. 3a). Thus, in provinces where winter snowpack levels are declining the fastest, wolverine populations tend to be declining most rapidly. Spring snowpack also appears to influence wolverine population dynamics… where snowpack has strong positive effects on population dynamics, wolverine populations tend to be declining. The only province with a positive wolverine population growth rate is the Northwest Territories where snowpack levels, though declining, are still much higher and less variable than in other provinces…

The authors suggest various mechanisms for wolverine declines in areas of reduced snowpack (*Ibid*, pp. 284-5).

> Why would declining snowpack negatively affect wolverines? If reduced snowpack limits dispersal (Schwartz et al. 2009), individuals could potentially be precluded from successfully establishing new home ranges. Declining snowpack could also reduce reproductive success

> (Magoun and Copeland 1998) or alter the availability or procurement efficiency of food in winter and early spring (Persson 2005; Lofroth et al. 2007). Lower snowpack levels may reduce the density of ungulate carcasses through increased ungulate survival (Wilmers and Post 2006), and lower per-capita hunting success of wolves (Mech et al. 2001). Landa et al. (1997) suggest that wolverine reproductive success may depend on small-mammal abundance, which may, in turn, be affected by snowpack via positive relationships between snowpack depth and small-mammal overwinter survival (Korslund and Steen 2006). By potentially limiting wolverine dispersal (Schwartz et al. 2009), reduced snowpack could threaten population viability as well as genetic structure.

Furthermore, the results from two "landscape genetics" studies concur about the importance of snow to wolverine habitat, and the risk posed by climate change (emphasis added).

> Schwartz et al. 2009, p. 3230
> Overall, this research suggests that areas characterized by persistent spring snow cover, which in previous studies have been shown to strongly correlate with wolverine denning locations and year-round movement, also is correlated with gene flow. This spring snow-cover niche has the biologically important elements of snow during the winter and spring, and acts as a surrogate for wolverine's within-home range movements and dispersals year-round. In addition, we identified potential movement corridors that may be critical for the persistence of wolverines. Unfortunately, spring snow cover, and the bioclimatic niche that it indicates, is likely to continue to be strongly impacted by global climate change (Mote et al. 2005), threatening wolverine throughout their geographic distribution.

> Balkenhol, 2009, pp. 119-120
> In congruence with the previous study by Schwartz et al… our results suggest that snow is particularly important for wolverine gene flow… our analyses indicate that snow is one of the major factors influencing successful wolverine dispersal. Climate change is expected to decrease levels of snowpack across the Rocky Mountains (CIRMOUNT 2006; Mote et al. 2005), and could therefore reduce connectivity among wolverines in the contiguous United States. Furthermore, decreasing levels of snowpack could also result in a decline in the number and size of habitat complexes suitable for wolverine denning. Thus, climate change will likely further reduce the effective population size of wolverines in the contiguous United States, and could severely reduce the viability of the species in this region…

In his conclusion, Balkenhol emphasizes the importance of addressing threats to wolverine habitat as an essential component of an effective strategy against the harmful effects of climate change on wolverines in the lower 48 (*Ibid*, p. 120-121, emphasis added).

> The effects of climate change will further be exacerbated by increased human presence in the Rocky Mountains. Our results suggest that terrain ruggedness and housing density strongly influence population genetic structure in wolverines… high topographic ruggedness in our study areas likely indicates areas with little human influences…
> Overall, successful wolverine dispersal seemed to occur primarily in areas with little direct (housing density) and indirect (ruggedness) anthropogenic influences. These results again suggest that connectivity among wolverines may be further reduced by the ongoing increase in human presence across the Rockies and the related development of open spaces. Thus, together with climate change, anthropogenic encroachment into wildlands will have substantial implications for connectivity and persistence of wolverines in the southern part of their range.

These findings make us gravely concerned about the future of the wolverines in the lower 48. We urge FWS to help avoid this fate by providing them federal protections under the ESA, and developing a recovery plan to best ensure against the projected harms caused by climate change. This likely will include a combination of reducing other stressors to wolverines and their habitat to the extent feasible, carefully monitoring their distribution and population over the coming decades to chart any declines, mitigating the impacts of climate change by helping to leverage the reduction of greenhouse gas emissions, and putting adaptive strategies in place to help wolverines cope with the inevitable changes to their habitat in the lower 48. The Endangered Species Act is the appropriate tool to design, implement and fund this important conservation program for the sake of this magnificent survivor of our western mountains.

B. Exploitation

To its credit, Montana has made significant changes to its trapping regulations to reduce the risk to wolverine populations from this practice. Yet this still does not justify the continuation of any wolverine trapping in the lower 48. We are aware of no legal trapping season for a species so reduced in number, except perhaps fisher trapping in Montana, which we also oppose. Particularly with the recent study indicating an effective population size of just 35, and not just in Montana but across the U.S. Rocky Mountains (Schwartz et al. 2009), there is simply no basis to trap a population so close to the margin of extirpation. Projecting ahead to the next few decades, the added stress to wolverines in the lower 48 expected from human-induced global warming adds still further urgency—if any were needed—to halt the unnecessary risk to wolverines posed by Montana's trapping season. One of the published studies completed since the FWS' previous wolverine status review concludes with this exact point in the following excerpt (Brodie and Post 2010, p. 285, emphasis added).

> In addition to simply suggesting impacts of climate change on a threatened mammalian species, these analyses may help managers alleviate said impacts. We show here that wolverine populations may be affected by climate change via demographic impacts of declining snowpack. Yet, wolverine populations are also affected by human harvest (Golden et al. 2007; Lofroth and Ott 2007). Squires et al. (2007) showed that harvest of wolverines in Montana was the single most important driver of adult mortality and that adult mortality is the vital rate that drives population dynamics. Whereas there is little that managers on the ground can do to improve snow conditions, they can easily adjust trapping seasons or quotas. Harvest-induced mortality of wolverines is thought to be additive to natural sources of mortality (Krebs et al. 2004), implying that adjusting harvest is an effective management tool for regulating wolverine populations. <u>We suggest that, for wolverine populations negatively affected by declining snowpack, harvest levels could be reduced as a way to offset the impacts of changing abiotic conditions and preclude irreversible declines in abundance</u>.

C. Disease or Predation

We are aware that individual wolverines are at risk in the extreme environments where they live year-round by a great variety of threats, which include predation by wolves, bears, and perhaps other carnivores. While any wolverine mortality may be significant to the population, given its small and fragmented status, we have no evidence that predation or disease presents a significant risk to their survival in the lower 48.

D. Inadequate regulatory mechanisms

The Forest Service and other agency partners have made some important progress toward creating a wolverine conservation strategy for the western U.S., mostly in the area of creating and compiling important research that has improved our understanding of the species' current conservation status and needs. Just in time to inform the FWS' previous status review, a collection of wolverine papers was published in a special supplement to the Journal of Wildlife Management.[1] As mentioned above, subsequent research with groundbreaking findings indicating the low effective population size of wolverines in the U.S. Rocky Mountains, and the delineation of empirically-derived movement corridors for wolverines across the northern Rockies and beyond was published in Ecology last fall (Schwartz et al. 2009). A study that documents the striking correlation between areas that retain spring snowpack and wolverine distribution worldwide was published this past winter (Copeland et al. 2010), and this and a second study inferred grave implications for wolverines due to the impacts of climate change (Brodie and Post 2010). From this research, we have a good idea how to map wolverine habitat across the western U.S. and thus where to focus conservation actions.

Yet these important new findings have been applied to management of wolverines and their habitat in a piecemeal fashion at best. A "Wolverine Conservation Assessment and Strategy" for wolverines across their range in the western U.S. has been eagerly anticipated to apply this recent spate of wolverine research, but seems to be on hold indefinitely. Individual biologists and managers within certain national forests are using the new findings to map wolverine denning habitat and movement corridors, but still lacking is a comprehensive strategy to ensure the persistence of wolverines across their current range. Documentation of recent wolverine dispersals to Colorado and California have inspired great hope of the species' resilience and potential restoration in these areas, but it receives no special protections or management considerations beyond basic state prohibitions against take..

A similar situation facing the Canada lynx in the lower 48 a decade ago resulted in its listing as a Threatened species due to a lack of adequate regulatory mechanisms to ensure its survival. In fact, greater protective measures were planned for the lynx than exist for the wolverine, because an interagency Lynx Conservation Assessment and Strategy had just been completed that did provide a comprehensive strategy to conserve the species (Ruediger et al. 2000). Even with this Strategy in place, FWS appropriately concluded that the regulations in place were not sufficient to address the many risks facing lynx and thus provided the added ESA "safety net" to help ensure against those risks. 65 Fed. Reg. 16,052. The following excerpt from the remanded FWS lynx status review reaffirmed this decision (emphasis added). 68 Fed Reg 40,096-7.

> The final rule discussed the fact that a substantial amount of lynx habitat in the contiguous United States is found on Federal lands, primarily National Forest and BLM lands. The final rule thoroughly described the purposes and analyses of the LCAS and the biological assessment of National Forest and BLM Land Management Plans (U.S. Forest Service and Bureau of Land Management 1999, Ruediger *et al.* 2000). At that time, we found that Federal land management plans did not adequately address risks to lynx and, as identified in the LCAS, that plans allowed actions that cumulatively could result in significant detrimental effects to lynx in the contiguous United States. As a result, we concluded in the final rule that the lack of Federal Land Management Plan guidance for conservation of lynx, and the

[1] See *J. Wildl. Mgmt. 71(7):2145-2229*

> potential for Plans to allow or direct actions that adversely affect lynx, were a significant threat to the contiguous United States lynx population…
>
> As a result of Federal, State, and Tribal regulations and plans that conserve lynx, the threats to lynx from the inadequacy of existing regulatory mechanisms have been reduced. However, until Federal land management plans are amended to address lynx, we conclude that the threat to lynx because of the inadequacy of existing regulatory mechanisms continues to be moderate...

Wolverines face similar risks as lynx and have fewer regulatory mechanisms in place to protect them, and thus an ESA listing is even more justified and necessary than it was for lynx. The lack of regulation to protect wolverines from winter recreational activities, developments in transportation corridors, and other current threats to the vast majority of currently unprotected wolverine habitat described above, coupled with the fact that no federal or state regulatory mechanisms exist to address the threat of modification of wolverine habitat due to climate change provide ample justification for an ESA listing of the wolverine.

E. Other factors

A critical "other factor" that justifies an ESA listing for wolverines in the lower 48 is their dangerously low effective population size. Extensive field work, interagency cooperation, and powerful new genetics techniques have been applied to better understand the conservation status of wolverines in the U.S. Rocky Mountains (Schwartz et al. 2009) and the conclusion is cause for both alarm and conservation action. The term "effective population size" refers to that portion of the total population that effectively contributes to the gene pool (Schwartz et al. 1998). Effective population sizes of wolverines or any other species below 50 individuals are at significant risk from demographic stochasticity in the short term (i.e., inability to find a suitable mate) and/or genetic and environmental stochasticity in the longer term (i.e., inbreeding and genetic drift, reduction of habitat due to global warming). The genetic differentiation already apparent among wolverines in the lower 48 indicate these risks are already manifest in the population, hence the need to immediately address any additional reduction or isolation of wolverine populations in the lower 48, particularly given the effects of global warming already underway. In sum, the wolverine's low effective population size provides the urgency to list and set conservation actions in motion as soon as possible, even as uncertainties persist concerning the exact status and trends of their population, and given persistent threats that include winter recreation, trapping and global warming.

5. Conservation actions

See Section 4(D) of our comments above.

6. Climate change impacts

See Section 4(A) of our comments above.

7. Canada vs. U.S. management of wolverines and their habitat

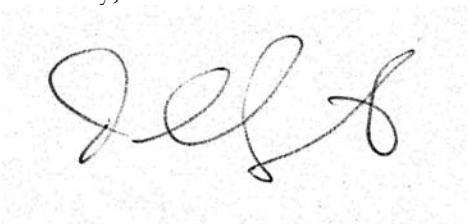
See Section 2(A)(ii)(b) of these comments above.

Additional comment regarding the priority of listing wolverines
The wolverine in the lower 48 states faces threats that are both high magnitude and imminent, and merits immediate protection under the Endangered Species Act so that conservation actions to ensure its survival and recovery have the highest probability of success. We urge FWS to move as expeditiously as possible to list the wolverine and we stand by to assist the Service in this effort however we can.

Additional comment regarding the designation of critical habitat for wolverines
We also are ready to support and assist with the designation of critical habitat for wolverines as required by the ESA upon listing. We believe this designation should start with all areas of currently occupied wolverine habitat, and include all areas necessary to help sustain for the survival and recovery of wolverines in the lower 48 in the face of human-induced global warming and other threats. The southern Rocky Mountains and the Sierra Nevada Mountains should be considered for critical habitat designation as currently occupied and potentially important habitat to sustain the species, such as their potential to provide refugia against the impacts of climate change.

Conclusion
Thank you for your consideration of these comments in the preparation of your status review of wolverines in the lower-48 states. Please contact us for any additional information pertaining to our comments.

Sincerely,



David Gaillard, Rocky Mountain Region Representative
Defenders of Wildlife
303 W. Mendenhall Ave., Suite 3
Bozeman, MT 59715
(406) 586-3970
dgaillard@defenders.org

AND FOR…

Shaye Wolf, Ph.D.
Center for Biological Diversity
351 California Street, Suite 600
San Francisco, CA 94104
(415) 632-5301
swolf@biologicaldiversity.org

Paige Bonaker, Staff Biologist/GIS Specialist
Center for Native Ecosystems
1536 Wynkoop Street, Suite 303

Denver, CO 80202
(303) 546-0214 x 7
paige@nativeecosystems.org

Dave Werntz, Science and Conservation Director
Conservation Northwest
P.O. Box 2813
Bellingham, WA 98227
(360) 671-9950 x.14
dwerntz@conservationnw.org

Jim Miller
Friends of the Bitterroot
P.O. Box 442
Hamilton, MT 59829
(406) 381-0644
millerfob@earthlink.net

Gary Macfarlane
Friends of the Clearwater
P.O. Box 9241
Moscow, ID 83843
(208) 882-9755
gary@wildrockies.org

Craig Kenworthy, Program Director
Greater Yellowstone Coalition
POB 1874
Bozeman, MT 59771
(406) 586-1593
ckenworthy@greateryellowstone.org

John Robison, Public Lands Director
Idaho Conservation League
PO Box 844
Boise, ID 83701
208-345-6933 ext. 13
jrobison@idahoconservation.org

Louise Lasley, Public Lands Director
Jackson Hole Conservation Alliance
P.O. Box 2728
Jackson, WY 83001
(307) 733-9417
Louise@jhalliance.org

Joseph Vaile, Campaign Director
Klamath-Siskiyou Wildlands Center

POB 102
Ashland, OR 97520
(541) 488-5789
joseph@kswild.org

Jim Costello
Save Our Cabinets
P.O. Box 1406
Trout Creek, Montana 59874
406-544-1494
jimrca@rockcreekalliance.org

Sophie Osborn, Wildlife Program Manager
Wyoming Outdoor Council
262 Lincoln Street
Lander, Wyoming 82520
(307) 742-6138
sophie@wyomingoutdoorcouncil.org

Literature Cited

Aubry, K. B., Kevin S. Mckelvey, and Jeffrey P. Copeland (2007). "Distribution and broadscale habitat relations of the wolverine in the contiguous United States." Journal of Wildlife Management **71**(7): 2147–2158.

Balkenhol, Niko (2009). Evaluating and improving analytical approaches in landscape genetics through simulations and wildlife case studies. Ph.D. Dissertation, College of Graduate Studies, University of Idaho, Moscow, May 2009.

Banci, Vivian (1994). Wolverine. Pp. 99-127 In L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski, tech eds. The scientific basis for conserving forest carnivores: American marten, fisher, lynx, and wolverine in the western United States. U.S. Dept. of Agriculture, Forest Service, Gen. Tech. Rep. RM-254.

Bradbury, Steve and Jason Fisher (2007). Wolverine abundance and habitat use in the Rocky Mountain Parks of central Alberta, Canada: Year-end Report, 2006-2007. Alberta Research Council, Vegreville, Alberta. [Available online at: http://www.wolverinefoundation.org/research/research.htm]

Brock, Brent L., Robert M. Inman, Kristine H. Inman, Anthony J. McCue, Mark L. Packila, and Brian Giddings (2007). Broad-scale wolverine habitat in the conterminous Rocky Mountain states. *Pp. 21-53 in* Greater Yellowstone Wolverine Program Cumulative Report, May 2007. Wildlife Conservation Society, North America Program, Ennis, MT.

Brodie, J. F., and Eric Post (2010). "Nonlinear responses of wolverine populations to declining winter snowpack." Population Ecology **52**(2): 279-287.

Copeland, J. P., K.S. McKelvey, K.B. Aubry, A. Landa, J. Persson, R.M. Inman, J. Krebs, E. Lofroth, H. Golden, J.R. Squires, A. Magoun, M.K. Schwartz, J. Wilmot, C.L. Copeland, R.E. Yates, I. Kojola, and R. May (2010). "The bioclimatic envelope of the wolverine (*Gulo gulo*): do climatic constraints limit its geographic distribution?" Canadian Journal of Zoology **88**: 233-246.

Fimrite, Peter. (2010). Wandering wolverine can't find mate in California. San Francisco Chronicle story posted March 13, 2010.

Griffith, Martin. (2009). A year later, wolverine spotted again in Sierra. Associated Press story published in the Reno-Gazette Journal on March 22, 2009.

Inman, Robert M., Kristine H. Inman, Mark L. Packila and Anthouny J. McCue (2007). Wolverine reproductive rates and maternal habitat in Greater Yellowstone. *Pp. 65-84 in* Greater Yellowstone

Wolverine Program Cumulative Report, May 2007. Wildlife Conservation Society, North America Program, Ennis, Montana.

Moriarty, K. M., William J. Zielinski, Armand G. Gonzales, Todd E. Dawson, Kristie M. Boatner, Craig A. Wilson, Fredrick V. Schlexer, Kristine L. Pilgrim, Jeffrey P. Copeland, and Michael K. Schwartz (2009). "Wolverine Confirmation in California after Nearly a Century: Native or Long-Distance Immigrant?" Northwest Science **83**(2): 154-162.

Rohrer, J., Keith Aubry and Cathy Raley (2008). Distribution and ecology of wolverines in the North Cascades, Year (winter 2007/08) of a 5-Year Study. FY 2008 Status Report for the Interagency Special Status/Sensitive Species Program (October 22, 2008). Methow Valley Ranger District, Okanagan-Wenatchee National Forests, U.S. Department of Agriculture, Winthrop, Washington. [Available online at: http://www.wolverinefoundation.org/research/research.htm]

Ruediger, B., J. Claar, et al. (2000). Canada lynx conservation assessment and strategy. USDA Forest Service, USDI Fish and Wildlife Service, USDI Bureau of Land Management, and USDI National Park Service. Missoula, MT, 2nd edition, August 2000.

Ruggiero, L. F., Kevin S. Mckelvey, Keith B. Aubry, Jeffrey P. Copeland, Daniel H. Pletscher, and Maurice G. Hornocker. (2007). "Wolverine Conservation and Management." Journal of Wildlife Management **71**(7): 2145–2146.

Schwartz, M. K., Jeffrey P. Copeland, Neil J. Anderson, John R. Squires, Robert M. Inman, Kevin S. McKelvey, Kristy L. Pilgrim, Lisette P. Waits, and Samuel A. Cushman. (2009). "Wolverine gene flow across a narrow climatic niche." Ecology **90**(11): 3222–3232.

Schwartz, Michael K., Keith B. Aubry, Kevin S. McKelvey, Kristine L. Pilgrim, Jeffrey P. Copeland, John R. Squires, Robert M. Inman, Samantha M. Wisely, Leonard F. Ruggiero (2007). Inferring Geographic Isolation of Wolverines in California. Journal of Wildlife Management **71**(7): 2170–2179.

Schwartz, Michael K., David A. Tallmon and Gordon Luikart (1998). Review of DNA-based census and effective population size estimators. Animal Conservation **1998**(1): 293–299.

Wildlife Conservation Society. 2009. After 90-Year Absence, Wolverine Returns to Colorado. Press release distributed June 17, 2009 by the Wildlife Conservation Society, New York, NY.