

Wolverine Conservation and Management

LEONARD F. RUGGIERO,[†] *United States Forest Service, Rocky Mountain Research Station, Missoula, MT 59801, USA*

KEVIN S. MCKELVEY, *United States Forest Service, Rocky Mountain Research Station, Missoula, MT 59801, USA*

KEITH B. AUBRY, *United States Forest Service, Pacific Northwest Research Station, Olympia, WA 98512, USA*

JEFFREY P. COPELAND, *United States Forest Service, Rocky Mountain Research Station, Missoula, MT 59801, USA*

DANIEL H. PLETSCHER, *Wildlife Biology Program, Department of Ecosystem and Conservation Sciences, University of Montana, Missoula, MT 59801, USA*

MAURICE G. HORNOCKER, *P.O. Box 929, Bellevue, ID 83313, USA*

ABSTRACT This Special Section includes 8 peer-reviewed papers on the wolverine (*Gulo gulo*) in southern North America. These papers provide new information on current and historical distribution, habitat relations at multiple spatial scales, and interactions with humans. In aggregate, these papers substantially increase our knowledge of wolverine ecology and population dynamics in North America, in many cases replacing previous speculations and informed judgments with empirical information. North American wolverines occur primarily in tundra, taiga, and subalpine environments. These environments become increasingly fragmented at southern latitudes, where wolverine populations occur at low densities and are potentially vulnerable to human-caused mortality. The combination of highly fragmented habitat, demographic sensitivity to adult mortality, and low population densities make local wolverine populations difficult to monitor and easy to overharvest. Where populations are fragmented, persistence is critically dependent on dispersal between habitat islands. While dispersal dynamics are poorly understood, high levels of genetic structure observed in both current and historical populations indicate that dispersal between mountain ranges is limited. Wolverine biology remains poorly understood, and many fundamental issues need additional research. (JOURNAL OF WILDLIFE MANAGEMENT 71(7):000-000; 2007)

DOI: 10.2193/2007-217

KEY WORDS conservation, federal listing, *Gulo gulo*, management, North America, wolverine.

The wolverine (*Gulo gulo*) is one of the least-studied carnivores in North America. This is particularly true for populations at the southern extent of its range. Prior to publication of this Special Section, Hornocker and Hash (1981) was the only peer-reviewed journal article that reported wolverine habitat relations, home-range sizes, or behavior in the contiguous United States. The United States Fish and Wildlife Service (USFVVS) was recently petitioned to list the wolverine as threatened or endangered under the federal Endangered Species Act. Their 12-month finding, pursuant to this petition and a related United States District Court ruling, is scheduled for release on 28 February 2008. Without the publication of additional peer-reviewed information, the USFVVS and others would be forced to evaluate this potential listing with little reliable information about current and historical range, habitat relationships at multiple spatial scales, current threats to persistence, or the potential for natural recolonization in southern portions of its former range. This Special Section was assembled largely to ensure that such information would be available to the USFVVS and to other interested individuals during the listing process. Several major field studies have recently been completed, enabling us to include significant new information on North American wolverines in this Special Section.

The Special Section consists of 8 independently peer-reviewed papers. Aubry et al. (2007) provide a comprehensive analysis of historical and current wolverine distribution in the contiguous United States, and Lofroth and Krebs (2007) present an assessment of its current distribution and abundance in British Columbia, Canada. Schwartz et al.

(2007) use genetic data to evaluate historical connectivity between wolverine populations, with an emphasis on the California wolverine, which appears to have been extirpated by about 1930. Copeland et al. (2007) and Krebs et al. (2007) present comprehensive analyses of habitat use by wolverines in Idaho and British Columbia, respectively. Lofroth and Ott (2007) and Squires et al. (2007) provide new insights about population-level responses of wolverines to harvest, and Magoun et al. (2007) evaluate the efficacy of rapid, low-cost aerial survey methods for wolverines in Ontario, Canada.

CURRENT ECOLOGICAL UNDERSTANDINGS

The papers included in this Special Section do not represent a comprehensive body of knowledge. Nevertheless, they contain significant new information and important insights into the wolverine's ecological niche in southern North America, and the potential effects of human activities on their populations. Some of the more significant findings reported here include:

1. Since the 1800s, dramatic contractions have occurred within the historical range of the wolverine in the contiguous United States. Although the species once occurred in California, Utah, Colorado, and the Great Lakes states, the wolverine's current range is limited to north-central Washington, northern and central Idaho, western Montana, and northwestern Wyoming (see Aubry et al. 2007, Schwartz et al. 2007).

2. Many wolverine populations appear to be relatively small and isolated. Accordingly, empirical information on the landscape features that facilitate or impede immigration

[†] E-mail: lruggiero@fs.fed.us

and emigration is critical for the conservation of this species. Even in "high-quality" habitat, wolverines exist at low densities, making sampling difficult and increasing the magnitude of errors associated with estimates of abundance. Genetic methods can help mitigate this problem while also providing important insights about population isolation, population substructuring, and the likelihood of successful reintroductions (see Aubry et al. 2007, Lofroth and Krebs 2007, Schwartz et al. 2007).

3. 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. This understanding is supported by genetic findings that demonstrate the long-term isolation of wolverine populations in the southern Sierra Nevada of California, which contains a large, isolated island of alpine and subalpine habitat. Wolverine populations that occurred there historically were isolated from neighboring populations for at least 2,000 years. Moreover, because alpine conditions become increasingly fragmented at southern latitudes, opportunities for population recovery and natural recolonization will be limited in these areas. Given current predictions about warming climates, this situation will likely be exacerbated (see Aubry et al. 2007, Copeland et al. 2007, Schwartz et al. 2007).

4. Low wolverine densities, the fragmented nature of suitable habitat at the southern extent of their North American range, and high demographic sensitivity to adult mortality raise concerns that the harvesting of wolverines in southern boreal forests could have a detrimental effect on their metapopulation dynamics. Our current understanding is that no other type of human activity has the same potential to cause populations to become dangerously small or locally extirpated. Thus, decisions concerning wolverine harvest appear to be critical to the persistence of extant populations and to the recolonization of depleted populations, especially in isolated mountain ranges (see Lofroth and Ott 2007, Squires et al. 2007).

5. Resource extraction (including timber harvesting), backcountry skiing and snowmobiling, roads, and other forms of human disturbance merit careful consideration by those concerned about wolverine conservation. Researchers in British Columbia found a consistent negative association between wolverine occurrence and areas where helicopter and backcountry skiing occur. However, the causal factors associated with these patterns are not well understood (see Copeland et al. 2007, Krebs et al. 2007).

6. Knowledge of wolverine ecology and population dynamics based on peer-reviewed research remains limited. This is particularly true in North America, where the state of knowledge has changed only slightly, albeit significantly, in recent years. Remediation will require a sustained commitment to field research on extant populations. For example, our understanding of the ecological and environmental characteristics of wolverine natal dens in North

America is based on descriptions of 15 dens established by only 5 females—3 in Alaska and 2 in Idaho (Magoun and Copeland 1998). Although available data indicate that the habitat conditions required for wolverine dens play an important role in limiting their distribution and abundance, our understandings continue to be extrapolated from a limited data set. Additional field studies are urgently needed to fill these and other critical information gaps, including the potential effects of global warming.

ACKNOWLEDGMENTS

We particularly wish to thank Dr. R. Powell who served as Associate Editor for this Special Section on Wolverine Ecology and Conservation. Dr. Powell was extraordinarily diligent in reviewing manuscripts, overseeing the anonymous peer-review process, and evaluating manuscript revisions. We also thank J. Claar, United States Forest Service Northern Region, for his support and funding in the production of this Special Section. J. Claar continues to provide funding and support for wolverine administrative studies in Montana. We also thank Editor-in-Chief M. Morrison for agreeing to publish this Special Section and for his guidance during the process. In addition, Dr. Morrison considered each paper individually for publication in the journal, rather than as a group, so that "in press" manuscripts could be made available to the USFVVS and other interested parties as soon as they were accepted for publication.

LITERATURE CITED

- Aubry, K. B., K. S. McKelvey, and J. P. Copeland. 2007. Distribution and broad-scale habitat relations of the wolverine in the contiguous United States. *Journal of Wildlife Management* 71:000-000.
- Copeland, J. P., J. M. Peek, C. R. Groves, W. E. Ivlevskiy, K. S. McKelvey, G. W. McDaniel, C. D. Long, and C. E. Harris. 2007. Seasonal habitat associations of the wolverine in central Idaho. *Journal of Wildlife Management* 71:000-000.
- Hornocker, M. G., and H. S. Hash. 1981. Ecology of the wolverine in northwestern Montana. *Canadian Journal of Zoology* 59:1286-1301.
- Krebs, J., E. C. Lofroth, and I. Parfitt. 2007. Multi-scale habitat use by wolverines in British Columbia, Canada. *Journal of Wildlife Management* 71:000-000.
- Lofroth, E. C., and J. Krebs. 2007. The abundance and distribution of wolverines in British Columbia. *Journal of Wildlife Management* 71: 000-000.
- Lofroth, E. C., and P. K. Ott. 2007. Assessment of the sustainability of wolverine harvest in British Columbia. *Journal of Wildlife Management* 71:000-000.
- Magoun, A. J., and J. P. Copeland. 1998. Characteristics of wolverine reproductive den sites. *Journal of Wildlife Management* 62:1313-1320.
- Magoun, A. J., J. C. Ray, D. S. Johnson, P. Valkenburg, F. N. Dawson, and J. Bowman. 2007. Modeling wolverine occurrence using aerial surveys of tracks in snow. *Journal of Wildlife Management* 71:000-000.
- Schwartz, M. K., K. B. Aubry, K. S. McKelvey, K. L. Pilgrim, J. P. Copeland, J. R. Squires, R. M. Inman, S. M. Wisely, and L. F. Ruggiero. 2007. Inferring geographic isolation of wolverines in California using ancient DNA. *Journal of Wildlife Management* 71:000-000.
- Squires, J. R., J. P. Copeland, T. J. Ulizio, M. K. Schwartz, and L. F. Ruggiero. 2007. Sources and patterns of wolverine mortality in western Montana. *Journal of Wildlife Management* 71:000-000.