BIOLOGICAL CONSERVATION 130 (2006) 16–24

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Inferring species distributions in the absence of occurrence records: An example considering wolverine (*Gulo gulo*) and Canada lynx (*Lynx canadensis*) in New Mexico

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ARTICLE INFO

Article history:
Received 29 January 2005
Received in revised form
18 November 2005
Accepted 29 November 2005
Available online 25 January 2006

Keywords:
Conservation
Distribution
Geographic range
Gulo gulo
Lynx canadensis
Museum voucher specimen

ABSTRACT

Information about geographic distributions is required for species conservation and management. Ultimately, this information is derived from records of occurrence. However, the reliability and availability of occurrence records are variable. A conceptual framework for evaluating the reliability of occurrence records is provided. Only records associated with physical evidence, especially a museum voucher specimen, are considered verified. However, errors in species identification or location are possible even for verified records. In addition, biases exist in occurrence records because they generally are collected haphazardly. Other sources of bias include sampling error associated with small areas or range limits and aspects of the species' biology that make it unlikely to be documented. A practical method is provided for interpreting a species' distribution in a particular area given a paucity of reliable occurrence records. Factors that must be considered for including such areas of interest within the range of a species include: (1) plausible reason for the paucity of records; (2) continuous suitable habitat between the area of interest and localities of reliable occurrence; and (3) absence of biogeographic breaks in the distribution of other organisms with similar evolutionary histories. The possible distribution of wolverine (*Gulo gulo*) and Canada lynx (*Lynx canadensis*) in New Mexico provides a case study of this approach. It is concluded that the mountains of north-central New Mexico should be considered within the natural range of wolverine and Canada lynx.

1. Introduction

Conservation and management of a species requires information about its geographic distribution. Local, state, and federal entities develop laws, regulations, policies, and conservation programs for species that occur, or formerly occurred, within their geographic area of jurisdiction. Thus, occurrence data must be available from local to regional scales. In addition, data on both historical and current distribution often are required. The need for historical occurrence data is especially important for the conservation of species that have experienced substantial losses in range. One important reason is restoration programs require information on where a species formerly occurred in order that appropriate reintroductions are made (IUCN, 1995). Introductions beyond the natural range of a species are potentially harmful to both the introduced species and to other members of the biotic community where released (e.g., Woodford and Rossiter, 1994).

The need for evidence about occurrence is complicated by the nature of political jurisdictions. Each jurisdiction can

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0006-3207/$ - see front matter
doi:10.1016/j.biocon.2005.11.029

require proof of a species' occurrence (or former occurrence) before enacting protective measures or participating in conservation and restoration programs. For example, the US Fish and Wildlife Service originally listed the jaguar as endangered within its historic range from Mexico southward (USFWS, 1972). The United States was not included within that listing due to an oversight of occurrence records in Arizona, New Mexico and other southern states (Brown and López González, 2001). Need for proof of occurrence can compromise a species' conservation and management, especially at the local level where occurrence data are more likely to be absent. Consequently, it may be necessary to provide justification for a species' distribution within an area in the absence of verified occurrence records.

Virtually all methods for inferring species' distributions are ultimately based on occurrence records (Ferrier, 2002). This is true even for geographic information system and other habitat models that predict species distributions based on environmental data because information on the biotic and abiotic associations of a species ultimately is derived from occurrence data (Scott et al., 2002). While there have been many recent advances in modeling for the purpose of predicting species occurrences (see Scott et al., 2002), these techniques require specialists and are expensive in data acquisition and model development (Goodchild, 2002). Consequently, there is a need for a simple and practical method for inferring species distributions when resources are not available for more costly and sophisticated modeling exercises. The purpose of this paper is to review the nature of occurrence data, to provide a simple and practical approach for inferring species distributions in the absence of reliable occurrence data, and to provide an example of the application of the method.

The example concerns the possible historic occurrence of wolverine (*Gulo gulo*) and Canada lynx (*Lynx canadensis*) in New Mexico. Both species are of conservation concern in North America, especially in the southern portions of their geographic ranges. Both species historically occurred in the Colorado portion of the Southern Rocky Mountains (Armstrong, 1972). However, both were rare in Colorado by 1900 and the most recent surveys have found scant evidence of their current occurrence (Armstrong, 1972; Nead et al., 1985; Murray, 1987; McKelvey et al., 1999). Both species are listed as endangered in Colorado and efforts to restore lynx into southwestern Colorado currently are underway (CDW, 2003, 2005; Steury and Murray, 2004). Further, the contiguous US populations of lynx recently were listed as threatened under the Endangered Species Act (ESA; USFWS, 2000) and at least two petitions have been filed for listing the wolverine under the ESA (USFWS, 2003). While there are no verified records of occurrence for these species in the New Mexico portion of the Southern Rocky Mountains, it has been suggested that both species historically occurred in New Mexico but were extirpated before occurrence was verified (Frey and Yates, 1996; Frey, 2004).

2. Nature of occurrence records

2.1. *Types and reliability of occurrence records*

The most unambiguous type of data that can verify a species' occurrence is a museum voucher specimen (Table 1; Yates, 1985; Reynolds et al., 1996). Voucher specimens provide physical evidence that corroborate a taxon's occurrence at a particular place at a particular time. Its accession into a museum allows other researchers an opportunity to corroborate the record (Huber, 1998). Consequently, material must be sufficiently complete and properly prepared so diagnostic features can be assessed. In certain instances, other physical evidence, such as photographs, DNA, or hair samples, can be used to unequivocally verify a species' occurrence (e.g., Wemmer et al., 1996; Taberlet et al., 1997). Because misidentification of cataloged museum material can be common, identifications should be verified and Meier and Dikow (2004) recommended using specimen records from published taxonomic revisions rather than directly from museum databases (Allen et al., 2001).

Occurrence records not associated with physical evidence are more equivocal. However, researchers often accept such records, especially for taxa such as birds and large mammals that can be accurately identified based on external or behavioral features (e.g., Frey and Campbell, 1997; Aubry and Lewis, 2003; Frey, 2003). However, criteria for evaluating the reliability of records often are not explicitly stated (but see Aubry and Houston, 1992). There has been no concerted attempt to standardize criteria. Table 1 presents a general strategy for evaluating the reliability of species occurrence records.

All occurrence records are based on observation of a living or dead organism or the remains or sign of an organism. A crucial aspect of evaluating the reliability of an occurrence record involves the accuracy of the observation upon which the record was based. Unequivocal species identification is dependent on three criteria: (1) the species exhibits diagnostic characters; (2) the observer is knowledgeable of the diagnostic characters of alternative potential species; and (3) conditions allow for a clear observation of the diagnostic features. An observation can be rendered inaccurate by any of these criteria. A second aspect of this strategy concerns the researcher's ability to assess details of the original observation. For example, the accuracy of first-hand information can be better appraised than that of second-hand information because the researcher may be able to obtain more details about the incident and evaluate the knowledge of the observer (Sutherland, 2000). In general, second-hand reports should not be accepted without compelling reason. Finally, it is essential that details of occurrence records be maintained with field notes in museum collections or published in a peer-reviewed outlet so that other researchers can evaluate the information. Distribution maps published without reference to occurrence record details provide no opportunity for critical evaluation.

2.2. *Problems associated with the interpretation of occurrence records*

Regardless of the reliability assigned to a record, there is always potential for data errors and misinterpretations. Errors of species identification and location are of particular concern, even for records supported by museum voucher specimens (Allen et al., 2001). Many groups of organisms are difficult to identify, even by experts. Such erroneous occurrence records are not uncommon in published, peer-reviewed articles and monographs. For example, Dalquest (1975) reported *Microtus montanus* in northeastern New Mexico and

Table 1 – Probability classes for evaluating the reliability of species' occurrence records

Class	Characteristics
A: Verified	An expert's evaluation of preserved physical evidence that exhibits diagnostic characteristics
B: Highly probable	An expert's accurate observation, but no physical evidence is preserved
C: Probable	A first-hand report of an observation that is likely to be accurate. Convincing details are provided
D: Possible	A potentially inaccurate observation made by an expert due to poor conditions or few diagnosable characters
E: Questionable	First-hand report of a potentially inaccurate observation because of the observers' lack of knowledge, few diagnostic characters, suboptimal observation conditions, or the lack of supporting details, this class is not as convincing as Class C
F: Highly questionable	Records that have a high potential of inaccuracy. Includes second-hand reports, unpublished reports, first hand reports with inadequate or questionable identification or locality data, and instances with no readily observable diagnostic characters
G: Erroneous	Physical evidence verifies that the species is other than originally reported

See text for requirements of an accurate observation.

southeastern Colorado. Subsequent reexamination of the voucher material proved the specimens referable to *Microtus mexicanus* (=*Microtus mogollonensis*; Hubbard et al., 1983; Finley et al., 1986). This case is instructive because virtually all subsequent articles and monographs have overlooked the correction, including major North American mammalogy reference works (e.g., Tamarin, 1985; Wilson and Reeder, 1993; Wilson and Ruff, 1999; Kays and Wilson, 2002). Similarly, locality data associated with occurrence records can be misinterpreted or incorrect due to data handling errors. For example, Baird (1859) and subsequent authors (e.g., Bailey, 1931; Findley et al., 1975) referred a report of a jaguar from "Santa Fe" to a city in northern New Mexico; the account actually is referable to a city in Argentina (Brown and López González, 2001).

Occurrence records typically are summarized by plotting on a map. Such range maps have inherent bias. While dot maps depict fine scale records of species occurrence, available records represent a minute fraction of the places where the species occurs or occurred (Brown and Lomolino, 1998). In contrast, outline maps rely on the author's knowledge and perception about a species distribution. These maps extrapolate from dot maps or other information to infer a distribution, illustrated by shading the supposed species range on the map. The outline is assumed to represent the range limits of the species. The accuracy of a map not only is dependent on the quality of the data but also on the author's knowledge about the distribution and natural history of the species, the physiographic features and associated habitats, and the biogeography and associations with other organisms. In turn, published range maps can strongly influence our perception about the biogeography, ecology and evolution of the organism (e.g., Axtell, 1983; Tucker, 1995). Further, outline maps are of coarse scale and include many areas that are not suitable for the species within the hypothesized range. Finally, range maps usually do not include a temporal component (Hafner and Shuster, 1996). Species range margins can change dramatically in response to natural or human mediated alterations in a relatively short time (e.g., Frey, 1992). Thus, because range maps usually are constructed by compiling all available occurrence data, this can result in artificially enlarged distributions relative to any given time.

2.3. Reasons for data gaps in occurrence records

Only rarely are systematic inventories used to determine a species' distribution across its entire geographic range. Generally, these efforts have focused on species of economic or conservation concern, that have an extremely small range, or that can be surveyed using remote techniques (e.g., Bradford et al., 2004). Further, such sampling can only establish a species' current distribution, which may be greatly altered from a historical condition. Thus, geographic (and temporal) gaps in occurrence records are the norm for most species and can result from three basic causes, including chance, geographic considerations, and the species' biology (including its propensity for exploitation).

Museums acquire specimens through studies of a particular species, geographic region, or incidental collections. This results in data gaps in the geographic coverage of voucher records (Kress et al., 1998; Ponder et al., 2001). Consequently, voucher records exhibit bias such that they do not fully portray a species' distribution or indicate abundance. For example, during inventories of a particular region many individuals of abundant species may be released or discarded whereas most uncommon species may be preserved (Stangl and Jones, 1987). It is also more likely that an individual will be preserved if discovered in an unusual circumstance than in a more typical circumstance (e.g., Dunnum et al., 2002).

Geography can influence the probability that a species is recorded from a particular area within its range. First, sampling error makes it unlikely that distributional data are available for smaller geographical areas or political units (Ferrier, 2002). Such false-absences are particularly important because most regional conservation planning is conducted at finer spatial scales (Ferrier, 2002). Second, it is expected that a species is more likely to be documented from the center of its range than from the edge of its range because of the discontinuous nature of a species' distribution and temporal dynamism at the range limit (Gorodkov, 1986; Gaston, 2003). Thus, political units near the range limits of a species may be less likely to have documentation of the species' occurrence.

Aspects of a species' biology can result in a paucity of occurrence records. For example, records of many taxa may be underrepresented because collection requires specialized techniques, the remoteness of habitat in which a species occurs, the species' rarity, the difficulty or distaste in preparing specimens of certain species (e.g., porcupine, skunks), a lack of perceived interest in the species (e.g., domestic and commensal animals), and large body size because of the time and cost involved with their preparation and limited museum storage space. Ironically, voucher specimens of some commonly harvested species (e.g., deer) may be relatively uncommon because it typically requires special permits to collect protected species. Finally, species subject to human exploitation may be less likely to be documented. This may be especially true for species that were subject to exploitation and population reduction or extirpation prior to significant biological inventories of the region.

3. Method for inferring distribution with a paucity of reliable records

Many factors can result in a paucity of reliable distribution data within a particular geographic area of a species' range. Here I outline a simple, practical method for evaluating the inclusion of areas within the accepted range of a species (Table 2). First, occurrence records of the species should be compiled from the area of interest and surrounding region. The reliability of each record should be assessed using criteria outlined in Table 1. If this step fails to produce reliable occurrence records, the second step is to evaluate potential reasons for the paucity of occurrence records, including reasons associated with chance, geography, and the species' biology. The more potential reasons that are identified for a lack of occurrence records, the higher the probability that the absence represents a false negative. Where possible, such rational could be augmented with techniques that model background species occurrence (Ponder et al., 2001).

The third step is to assess habitat connectivity between the area of interest with localities of reliable occurrence records. The most conservative approach is to include only areas within the inferred range of the species that are in continuous habitat with localities of reliable occurrence records. The accuracy of such judgment will depend on knowledge about the species' habitat requirements as well as knowledge about the distribution of habitats in the region. Scale often will be an important issue in such decisions because coarse scale habitat maps may show different geographic patterns than finer scale habitat maps. Thus, decisions must be made at a scale appropriate to the organism.

The final step is to evaluate the biogeographic patterns exhibited by other sympatric species that occupy the same habitat. Species' range limits are not always determined by abrupt changes in habitat. Other factors can cause range limits including, exceeding tolerance limits for an environmental variable, inter-specific interactions, and synergistic effects of combined factors that relate to the species' reproduction and survival (Gaston, 2003). The evolutionary approach to biogeography assumes that, although each species adapts to its environment in an individualistic way, species are adapted to the environmental conditions that existed when they originated (Hengeveld, 1990). Thus, many species that originated in the same environmental conditions may share similar distribution patterns (i.e., faunal elements; Armstrong, 1972; Frey, 1992). Discovery of range limits of other species that evolved under similar environmental conditions as the focal species suggests that the focal species also may be impacted by the same conditions (Frey, 1992). If such a biogeographic break occurs between the area of interest and localities of accepted occurrence it decreases the probability that the area represents part of the species' range.

Determination of a species' range is a biogeographic problem that involves spatial (and possibly temporal) extrapolation from limited pieces of point information. It may be helpful to view a species' range as a dynamic response surface (Hengeveld, 1990; Gaston, 2003). In this view, a species' range represents a dynamic and composite reflection of the species' biology with highest abundances where conditions are most optimal (often, but not always, in the center of the species range) and decreasing or absent where conditions are worse (often at range limits). Extinction and colonization, especially as developed in metapopulation theory, is a natural part of this dynamism and may be especially relevant at range limits (Hanski, 1998; Gaston, 2003). Thus, at range limits conservation should focus on reducing factors that either increase extinction or decrease colonization. Further, it must be recognized that determination of a species' occurrence in an area does not provide evidence about the provenance or persistence of that occurrence. In some ways, it is not important whether an area represents a population source or sink in order to initiate conservation or management strategies for the area. Although source populations are obviously important to a species' viability, sinks (including currently unoccupied habitat) can be important for the long-term persistence of a species because such areas can provide a larger pool of individuals, provide dispersers that can reoccupy other areas that

Table 2 – Steps for inferring a species' geographic distribution based on available records of occurrence

Step	Description
1	Compile occurrence records for the species. For each record, assign a reliability using steps outlined in Table 1 .
2	Assess potential reasons for a paucity of available occurrence records in the area of interest.
3	Assess habitat availability and connectivity of the area of interest with areas with reliable occurrence records.
4	Assess biogeographic patterns of other organisms with similar evolutionary histories as the species of interest.

become vacated, and potentially provide a future source area given that environmental conditions change through time and space (Hanski, 1998).

4. Application of method to wolverine and lynx in New Mexico

4.1. Step 1: Review occurrence records

As an example of the methodology for interpreting a species' distribution in an area given a paucity of reliable occurrence records, I consider the plausibility of the occurrence of wolverine and Canada lynx in New Mexico. The first step of this method is to compile and assesses occurrence records for the area of interest and surrounding region. Numerous occurrence records of both species are available from the Southern Rocky Mountains in adjacent Colorado. These mountains include two ranges, the San Juan and Sangre de Cristo, which extend southward into northern New Mexico. Armstrong (1972) and Nead et al. (1985) summarized a total of 97 occurrence records of wolverine in Colorado, including multiple records from these ranges. At least one record from each range was associated with physical evidence including a skull from northern edge of the San Juans (southwestern Gunnison County; classified as verified) and photographs and description of an animal from the crest of the Sangre de Cristos approximately 19.5 km north of the New Mexico border (southwest Huerfano County; classified as probable; Nead et al., 1985). Several records of wolverine in the southern San Juans (La Plata and Archuleta counties) are within 45 km of the New Mexico border. Similarly, McKelvey et al. (1999) reported 196 occurrence records of Canada lynx in Colorado including 17 they considered "verified", although details of most records were not provided. These included multiple records from the San Juans, including a specimen from near Cumbres Pass (Conejos County) approximately 3 km north of the New Mexico border. Multiple occurrence records for lynx are also available for the Sangre de Cristos including physical evidence taken in either the Sangre de Cristo or adjacent Greenhorn (=Wet) Mountains (Warren, 1906). Thus, highly reliable and verified records of occurrence for both the wolverine and lynx are available for the Colorado portion of the San Juan and Sangre de Cristo ranges.

There are no verified occurrence records of wolverine from New Mexico, although there are several of lower reliability (see Table 1). Coues (1877) considered wolverine to occur in New Mexico based on statements of hunters that he likely contacted in northern New Mexico in 1864 (Bailey, 1931). Bailey (1931) subsequently concluded that wolverine historically occurred in New Mexico based on Coues report and his perception that the Sangre de Cristos contained suitable habitat for the species. Seton (1931) described a conversation with an Acoma Indian who told him that wolverine were part of the Acoma cultural tradition and had formerly occurred in all of the mountains in northern New Mexico. Because these reports were second-hand, each must be classified as highly questionable. More recently, McDonald (1985) provided a detailed description of a first-hand observation of a wolverine in tundra habitat on Latir Peak in the Sangre de Cristos. This report is classified as possible because it was a first hand observation with a moderate amount of detail.

There are no known historical occurrence records of lynx in New Mexico. However, over 200 lynx have been released in southwest Colorado since 1999 as part of a restoration project in that state (CDW, 2005). Telemetry data has located numerous individuals in at least 8 northern New Mexico counties and several lynx have been found dead in the state (T. Shenk, personal communication).

4.2. Step 2: Reasons for paucity of occurrence records

The second step is to assess potential reasons for the paucity of reliable historical occurrence records of wolverine and lynx in New Mexico. Both species are broadly sympatric throughout northern North America with southern range limits in the Southern Rocky Mountains (Hall, 1981). Thus, New Mexico represents a relatively small area at the periphery of these species' ranges. Further, wolverine and lynx are associated with remote high elevation habitats (Banci, 1994; Koehler and Aubry, 1994; Pasitschniak-Arts and Lariviere, 1995; McKelvey et al., 1999), are relatively difficult to capture, collect, or otherwise document (Zielinski and Kucera, 1995), and are naturally rare. They exhibit solitary behavior, large home ranges, extensive movements, and low densities (Hornocker and Hash, 1981; McCord and Cardoza, 1982; Koehler, 1990; Pasitschniak-Arts and Lariviere, 1995; Aubry et al., 1999). Lynx density may be relatively low at the southern edge of its range because densities of its primary prey, snowshoe hare (*Lepus americanus*), are lower in this region (Hodges, 1999; Malaney, 2003; Steury and Murray, 2004).

It is likely that both species experienced heavy exploitation prior to significant biological exploration of the region. Both species are highly valued for their fur and subject to exploitation (Koehler and Aubry, 1994; Banci, 1994). Effects of harvest mortality on populations of these species generally are thought to be additive rather than compensatory; trapping can account for a substantial portion of mortality (e.g., Hornocker and Hash, 1981; Bailey et al., 1986; Quinn and Thompson, 1987; Banci, 1994; Koehler and Aubry, 1994; Mowat et al., 1999). Human-caused mortality is considered a threat to these species and has been at least partially implicated in their decline or extirpation in various regions (e.g., Wilson, 1982; Nowak, 1991; Banci, 1994; Aubry et al., 1999; Stinson, 2001). Northern New Mexico was a focal point of European activity for more than 450 years and the region became a nucleus for the fur trade in the first decades of the 19th century and continuing thru the mid-1840s until resources were depleted (Weber, 1971; Jenkins and Schroeder, 1974; Hafen, 1997). The problem of exploitation in the Southwest was compounded because it occurred prior to significant biological inventory of the region. The first comprehensive study of the mammals of New Mexico occurred from 1889 to 1924 (Bailey, 1931).

4.3. Step 3: Habitat connectivity

The third step for inferring distributions is to assess connectivity of appropriate habitat between the area of interest with areas where there are reliable occurrence records. The wolverine is associated with boreal and subalpine forests, talus, and tundra habitat and seems to prefer areas with snow on the ground in winter (Wilson, 1982; Banci, 1994). At the southern edge of its range in the western US, it is limited to mountainous regions where it is associated with remote high-elevation habitats, especially in summer (Banci, 1994; Landa et al., 1998). The historic range may have extended more regularly below subalpine forest into the lower elevation mixed conifer zone (Wilson, 1982). In contrast, the lynx has more restricted habitat associations because it avoids tundra and other open habitats (McCord and Cardoza, 1982). In general, lynx occur in boreal and subalpine forests with a high abundance of snowshoe hare (Koehler and Aubry, 1994). In the western contiguous US, 83% of lynx records were in Rocky Mountain conifer forest types (McKelvey et al., 1999). Based on Küchler (1964) and Brown and Lowe (1980) vegetation maps, subalpine forest (and tundra in the Sangre de Cristo Range) extends continuously from localities of reliable occurrence records of wolverine and lynx in the San Juan and Sangre de Cristo ranges in Colorado throughout the higher elevations of these ranges in New Mexico.

4.4. *Step 4: Biogeographic patterns*

The final step is to assess biogeographic patterns of other organisms that have similar evolutionary histories. There are 20 mammal species in the Southern Rocky Mountains associated with conifer forest and tundra zones and have boreal-cordilleran or cordilleran distribution patterns (Armstrong, 1972). The distribution of two species (*Sorex hoyi* and *Tamias umbrinus*) are not informative to the occurrence of wolverine and lynx in New Mexico because they are restricted to areas north of the Gunnison Basin in west-central Colorado; wolverine and lynx occur on both sides of this biogeographic break. Except for *M. montanus*, which may be excluded from the Sangre de Cristos by competition with *Microtus pennsylvanicus* (Getz, 1985), all of the remaining species occur in both the San Juan and Sangre de Cristo ranges. This indicates that the lower elevation forest type at Poncha Pass between the Sangre de Cristos and the remainder of the Southern Rocky Mountain does not act as a barrier to this group of species. With the exception of wolverine and lynx, all species verified as occurring in the Colorado portion of the San Juans and Sangre de Cristos also have been verified from the New Mexico portion of those ranges. Thus, no biogeographic breaks are evident between New Mexico and Colorado portions of these ranges.

The Jemez Mountains are in close proximity to both the San Juan and Sangre de Cristo ranges in northern New Mexico and are linked to the San Juans by a corridor of lower elevation forest type. However, several species verified from both the San Juan and Sangre de Cristo ranges do not have verified occurrence records in the Jemez Mountains (i.e., *Lepus americanus*, *Marmota flaviventris*, *Phenacomys intermedius*, *Zapus princeps*, *Martes americana*), indicating an important biogeographic break separating the Jemez Mountains from the Southern Rocky Mountain ranges. Consequently, a conservative approach of this method is to exclude the Jemez Mountains from consideration as part of the distribution of wolverine and lynx.

4.5. *Conservation of wolverine and lynx*

The proposed methodology supports inclusion of the New Mexico portions of the San Juan and Sangre de Cristo ranges within the natural geographic range of wolverine and Canada lynx. However, because it has not been widely recognized that New Mexico is within the natural geographic range of these species, neither species currently receives protection under state law. Based on information and logic similar to that presented in this paper, wolverine and lynx were added to the informal list of New Mexico species of concern in 1999 (J. Klingel, email 1 April 1999; NMDGF, 2002, 2003). Both species were listed as "apparently extirpated," which is a classification for "native species apparently no longer occurring in New Mexico but existing elsewhere" (NMDGF, 2003, p. 3). The designation of apparently extirpated was used even though no surveys for either species have occurred in New Mexico. Although the New Mexico Wildlife Conservation Act does not specifically prohibit it, species considered extirpated have not been included on the list of endangered or threatened wildlife.

In the final ruling to list the contiguous US distinct population segment of Canada lynx as threatened, New Mexico was not included in the list of states within the historic range of the species and it is unclear whether lynx receive ESA protection in New Mexico (USFWS, 2000). Currently, the species' listing status in New Mexico is being litigated in the courts. Legal protections for lynx in New Mexico is especially important because lynx originating from releases in Colorado frequently cross the state border into New Mexico where there are no clear regulations affording the species protection. The primary threat identified for contiguous US populations of lynx was the lack of guidance for its conservation in federal land management plans (USFWS, 2000).

The recent petition to list wolverine in the contiguous US under the Endangered Species Act was declined on basis the information was not substantial (USFWS, 2003). However, the wolverine has declined in the Southern Rocky Mountains and the most recent comprehensive survey for the species in Colorado concluded that it was probably extant, but of unknown status in the state (Nead et al., 1985). There also have been several, recent probable reports of wolverines in the New Mexico portion of the Sangre de Cristo Range. Thus, the current occurrence of wolverine in New Mexico should not be dismissed, even if that occurrence is sporadic due to the species' extreme movements. Further, in 1998 Colorado approved the restoration of wolverine in that state. The San Juan Range was selected as the initial primary release area because it was determined to offer the best combination of habitat and other features (CDW, 1998). Although this restoration project has been postponed (CDW, 1998), future release of wolverine into the San Juan Range of Colorado almost certainly would result in individuals dispersing to New Mexico. Thus, New Mexico should be included in conservation measures directed at the protection and restoration of both species.

Acknowledgements

I am grateful to Jerry Choate, Terry Enk, Tim Frey, Chuck Hays, Andrew Hope, Jason Malaney, Kristen Otten, Jim Stuart, Joe Truett, and Christy Wampler for helpful comments on an earlier version of this paper. Special thanks to Jim Stuart for providing valuable information.

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