

Chapter 8 : GREATER SAGE-GROUSE AS AN UMBRELLA SPECIES IN THE GREAT BASIN

Introduction

Dramatic declines in the quality and amount of sagebrush habitats during the last several decades have brought new attention to this remote and expansive ecosystem (e.g., BLM 1999, 2000; Young and Sparks 2002; Monsen et al. In Press). In the Great Basin Ecoregion (Great Basin), catastrophic fires and the associated invasion of cheatgrass have destroyed or altered millions of hectares of sagebrush and other shrubland habitats (see [Chapters 2, 4](#)). Concomitant with concern about the sagebrush ecosystem has been keen interest in the fate of sage-grouse, a species intimately tied to sagebrush (Braun et al. 1976, Paige and Ritter 1999, Schroeder et al. 1999, Beck et al. 2003). (Hereafter, sage-grouse refers to greater sage-grouse, and not the more geographically restricted populations of Gunnison sage-grouse.) Habitats and populations of sage-grouse have declined substantially across major portions of the species' range in response to a variety of detrimental land uses (Connelly and Braun 1997, Schroeder et al. 1999). The range of sage-grouse has contracted 50% across North America and 40% in the Great Basin ([Fig. 8.1](#)). Of the range currently occupied by the species, 19% occurs in the Great Basin and 23% in Nevada.

These declines have prompted increasing concern about the viability of sage-grouse populations, and the species has been proposed for listing as threatened or endangered under the Endangered Species Act throughout its range (Kritz 2003). Consequently, sage-grouse populations, and the maintenance and restoration of their habitats, have been the focus of numerous committees, workshops, reports, and conservation strategies during the past decade (e.g., Barrett et al. 2000; BLM 2000, 2002; Wambolt et al. 2002; Monsen et al. In Press).

One outcome of the dual emphasis on sage-grouse and the sagebrush ecosystem has been the emergence of sage-grouse as a putative "umbrella species" for other sagebrush-dependent species (e.g., Rich and Altman 2001, Rich et al. 2003). The umbrella species approach is 1 of several "shortcuts" designed to increase efficiency in multi-species management (Marcot et al. 1994, Andelman and Fagan 2000, Andelman et al. 2001, Wisdom et al. 2003:Appendix 5). Fleishman et al. (2001:1489) defined an umbrella species as one "whose conservation confers a protective umbrella to numerous co-occurring species." Given the lack of adequate resources to fully and immediately address the plethora of problems facing sagebrush habitats and the hundreds of species of concern associated with them (Suring et al. In Prep.), such an approach is appealing.

The efficacy of sage-grouse as an umbrella species, however, has not been substantiated. Evaluation of this approach is both appropriate and timely because of the increasing attention on habitat management (e.g., USDA Forest Service, USDI Bureau of Land Management), population management (e.g., state wildlife agencies), and associated regulations (e.g., USDI Fish and Wildlife Service) for sage-grouse, coupled with continuing and widespread threats to sagebrush habitats in the Great Basin and elsewhere. Moreover, sage-grouse are well-studied compared to most species associated with sagebrush (e.g., >750 publications are available concerning sage-grouse [Rowland and Wisdom 2002]). Finally, detailed habitat guidelines were published for the species in 1977 (Braun et al. 1977) and revised in 2000 (Connelly et al. 2000).

Three criteria have been used to select umbrella species: (1) wide co-occurrence of the species with other species of interest; (2) a moderate level of ubiquity; and (3) high sensitivity to human disturbance (Fleishman et al. 2000). Based on these criteria, sage-grouse appear promising as an umbrella species. The species is closely associated with sagebrush habitats across its wide range, and thus co-occurs with a host of other shrubland species (criterion 1). Moreover, current populations of sage-grouse are neither rare nor ubiquitous (criterion 2) (see range and population status described by Schroeder et al. 1999). Third, sage-grouse are sensitive to anthropogenic disturbances (criterion 3) (e.g., Aldridge 1998, Connelly et al. 2000, Lyon and Anderson 2003, Rowland 2003).

Accordingly, in this chapter we evaluate the degree to which greater sage-grouse may function as an umbrella species for the other 39 vertebrates of conservation concern included in our assessment. Our specific objectives were to (1) assess the spatial overlap of each species' range, habitat associations, and habitat amount and risks in the Great Basin with sage-grouse, for each of the 39 species of concern; and (2) interpret the results for conservation planning in the Great Basin.

Methods

Overlap Between Species' Ranges—Our first criterion to evaluate the effectiveness of sage-grouse as an umbrella species in the Great Basin was the overlap in range for each of the species in our assessment with the current range of sage-grouse. Range maps were assembled from a variety of sources and scanned and digitized (Table 5.2, Chapter 5; Appendix 4). For greater sage-grouse, we used a map produced by Schroeder (2000) depicting both current and historical range of the species (Fig. 8.1).

To calculate the overlap of each species' range with sage-grouse, we overlaid the digital range maps for each of the 39 species of concern (Appendix 4) with the current range of sage-grouse in the Great Basin. We then calculated the percentage of each species' range that occurred within the current range of sage-grouse. Note that these calculations included all area within the range of each species, regardless of the species' habitat distribution within the range (see Wisdom et al. [2003] for the definition of a species' range, as used here).

Overlap of Species' Habitat Associations—We used the habitats identified for each species of concern in our assessment (Chapter 6) to estimate the overlap of each species' habitat associations with the habitat associations of sage-grouse. Habitats were assigned to each species based on the land cover types available in the “sagestitch” map, which is the vegetation layer used for our analyses (see Chapter 6).

To estimate overlap of each species' habitat associations with those of sage-grouse, we identified the cover types that each species used as habitat that were also used as habitat by sage-grouse. For each species, we then divided the number of cover types that were shared with sage-grouse by the total number of cover types used by the species to yield the percent overlap in habitat association between each species and sage-grouse. This was the second criterion used to evaluate sage-grouse as an umbrella species.

Overlap in Amount of Habitat and Habitat at Risk—Our third and fourth criteria were to determine each species' overlap in habitat amount and habitat at risk with the range of sage-grouse. To determine the overlap of habitat amount, also referred to as habitat area, between each species and sage-grouse, we overlaid maps of each species' habitats with the range of sage-

grouse, and calculated the percentage of the species' habitat area within the current range of sage-grouse in the Great Basin. We did this by dividing the amount of each species' habitat within sage-grouse range by the total amount of the species' habitat in the Great Basin and expressing this as a percentage.

To examine patterns of habitat at risk for each species within the range of sage-grouse, we used the following steps, based on previously compiled data on habitat at risk to displacement by cheatgrass in the Great Basin (summarized as part of results in [Chapter 6](#)). All habitats for species of concern had previously been classified into 1 of 4 cheatgrass risk categories: none, low, moderate, or high (see [Chapters 4, 6](#)). First, we calculated the amount of each species' habitat in each of the 4 categories of cheatgrass risk within the Great Basin ([Table 6.3](#)). Second, we overlaid these habitats with the current range of sage-grouse to determine the amount of habitat, by risk category, for each species that fell within the range of sage-grouse. And third, we used these amounts to calculate the percentage of each species' habitat, by risk category, that occurred within the range of sage-grouse.

Based on this analysis, if the percentage of a species' habitat in each risk category within sage-grouse range mirrored its percent overlap of all habitats with the range of sage-grouse, then managing habitats within the range of sage-grouse would benefit a predictable portion of that species' habitat at risk. Alternatively, a large disparity between spatial patterns of habitat risk for a given species across its range versus within the portion of its range that overlaps that of sage-grouse would indicate that management solely within the range of sage-grouse may ignore substantial areas of habitat in need of management attention.

Our analysis of each species' overlap of habitat at risk with the range of sage-grouse used our estimates of cheatgrass risk, but not our estimates of risk that pinyon-juniper would displace sagebrush habitats (see [Chapter 6](#)). We did not make the latter comparisons because this risk model was applied to a relatively small part of the eastern Great Basin that only partially encompassed the current range of sage-grouse.

Results

Overlap Between Species' Ranges—In the Great Basin, overlap between the ranges of species of concern and the range of greater sage-grouse varied from 20% for groundsnake and Merriam's kangaroo rat to 100% for Wyoming ground squirrel ([Table 8.1](#)). The current range of sage-grouse in the Great Basin covers 13.4 million ha, or 46% of the ecoregion ([Fig. 8.1](#)). For most species in our assessment, the percent overlap in range with that of sage-grouse was similar to this percentage ($\bar{x} = 47\%$; [Table 8.1](#)). For those species whose ranges encompassed all or most of the Great Basin, such as Brewer's sparrow, desert horned lizard, and Great Basin spadefoot, the percent overlap in range was by definition equivalent, or nearly so, to the percentage of the Great Basin occupied by sage-grouse ([Table 8.1](#)).

Species with the least range overlap included groundsnake, Merriam's kangaroo rat, desert spiny lizard, and Great Basin collared lizard. These 4 species occur primarily along the western border of the Great Basin, with the exception of the collared lizard, which also occurs in western Utah outside the range of sage-grouse ([Appendix 4, Fig. 2](#)). Species with the highest degree of overlap were Wyoming ground squirrel (100%), white-tailed jackrabbit (62%), and dark kangaroo mouse (60%). The ranges of the latter 2 species are similar to that of sage-grouse, but extend somewhat farther south or northwest in the Great Basin ([Appendix 4, Figs. 3, 4](#)). The

very limited range of the Wyoming ground squirrel in the Great Basin is entirely contained within the range of sage-grouse (Appendix 4, Fig. 1).

Among the 5 groups of species in our analyses (see Chapter 7), overlap in range with sage-grouse was highest for the sagebrush group (\bar{x} = 57%) and lowest for the salt desert scrub group (\bar{x} = 35%; Table 8.1, Fig. 8.2). Range overlap for the remaining 3 groups was similar to the current range of sage-grouse as a percentage of the ecoregion (i.e., 46%). In comparing across taxonomic groups, mammals had the highest percent overlap in range with sage-grouse in the Great Basin, and herptiles had the least (Fig. 8.3)

Overlap of Species' Habitat Associations—Ten cover types were identified as habitat for sage-grouse, 8 of which were sagebrush types (Table 6.1). Thus, the maximum number of cover types that a species could share with sage-grouse was 10, although the percent overlap could vary, depending on the total number of cover types used as habitat by a species. Wyoming ground squirrel had the highest percent overlap (70%) with sage-grouse in cover types identified as habitat (Table 8.1). The 7 cover types used by this species that were also used by sage-grouse included 6 of the 8 sagebrush types and bunchgrass (Table 6.1).

By contrast, chisel-toothed kangaroo rat had the lowest overlap (8%), with only 1 (black sagebrush) of its 13 cover types shared with sage-grouse (Table 8.1). Other species with comparatively low overlap included 4 lizard species: Great Basin collared lizard (13%), long-nosed leopard lizard (19%), desert horned lizard (19%), and desert spiny lizard (19%). These 4 species, as well as the chisel-toothed kangaroo rat, were all in the salt desert scrub group (Fig. 8.2). Mean overlap in cover types across all 39 species was 32%, and was highest for the sagebrush group (\bar{x} = 47%) and lowest for the salt desert scrub group (\bar{x} = 19%; Table 8.1, Fig. 8.2). Mammals shared the largest percentage of cover types as habitat with sage-grouse, and herptiles the least (Fig. 8.3).

Six species (northern harrier, short-eared owl, western burrowing owl, white-tailed jackrabbit, Great Basin spadefoot, and Swainson's hawk) used all 10 cover types used by sage-grouse. These 6 species, however, also used a wide variety of other cover types (total number ranged from 27 for white-tailed jackrabbit to 35 for Swainson's hawk) beyond those shared with sage-grouse. Thus, the percent overlap in cover types of these 6 species with sage-grouse was close to the average overlap calculated among all species in our assessment (29 to 37%). By contrast, 6 species had ≤ 3 cover types in common with sage-grouse: Great Basin collared lizard, long-nosed leopard lizard, desert horned lizard, desert spiny lizard, chisel-toothed kangaroo rat, and Brewer's blackbird (Table 8.1).

Overlap of Amount of Habitat and Habitat at Risk—For most species, the percentage of the species' amount of habitat (habitat area) that occurred within the range of sage-grouse (\bar{x} = 48%) paralleled the species' percent overlap of its range with sage-grouse range (\bar{x} = 47%; Table 8.1). Only one-third of the species (n = 13) had >50% of their habitat area within the range of sage-grouse, including all members of the sagebrush and sagebrush-woodland groups (Table 8.1). Wyoming ground squirrel had the highest percentage (100%) of habitat area within the current range of sage-grouse, whereas groundsnake and desert spiny lizard had the lowest percentage (14%) of habitat area within the range of sage-grouse.

Species with higher percentages of their habitat area within the range of sage-grouse generally were those species that had higher overlap in ranges and habitat associations with sage-grouse. For example, the pygmy rabbit had a range overlap of 54%, a habitat association overlap of 64%, and a habitat area overlap of 68% with sage-grouse. This pattern was consistent for all members of the sagebrush group. By contrast, the overlap of habitat area for members of the salt

desert scrub group was consistently less than their percent overlap in range, a result of their dissimilarity in habitat associations from those of sage-grouse (Table 8.1). As was found for the previous 2 criteria (i.e., percent overlap in range and in habitat associations), the sagebrush group had the greatest percentage of habitat area within the range of sage-grouse (\bar{x} = 68%). By contrast, the salt desert scrub group had a comparatively small percentage of habitat area in the range of sage-grouse (\bar{x} = 27%; Fig. 8.2). Among taxonomic groups, passerine birds had the greatest percentage of habitat area within the range of sage-grouse, and herptiles had the least (Fig. 8.3).

The percentage of each species' habitat at risk of displacement by cheatgrass within the range of sage-grouse varied widely by risk category among the species and species groups. Generally, a disproportionately greater percentage of each species' habitats at low and moderate risk were inside the range of sage-grouse (Table 8.2). By definition, a disproportionately greater percentage of high and no risk habitats therefore were outside the range. For example, although 58% of the habitat for Brewer's blackbird in the Great Basin was within the range of sage-grouse, only 22% of its high-risk habitat was within this range (Table 8.2). For pronghorn, the overlap in habitat area with sage-grouse was 43%, but less than a third (27%) of its high-risk habitat was within the range of sage-grouse. By contrast, 71% of the low-risk habitat for pronghorn was in the range of sage-grouse. No species had a greater percentage of habitat area at high risk within the range of sage-grouse compared to its percent overlap in total habitat area with sage-grouse.

As a group, shrubland species had the greatest discrepancy between the percent overlap in habitat at high risk within the range of sage-grouse and the percent overlap of all habitat with sage-grouse. These 13 species also had a substantial amount of habitat at high risk in the Great Basin (\bar{x} = 7.3 million ha). Overall, species in the sagebrush and sagebrush-woodland groups had the greatest percentage of their high-risk habitat within the range of sage-grouse, and species in the salt desert scrub group had the lowest percentage (Table 8.2, Fig. 8.2). Both passerine birds and mammals had about 43% of their high-risk habitat contained within the range of sage-grouse, whereas herptiles had only 25% (Fig. 8.3).

For habitats at moderate risk from cheatgrass, this pattern was weaker. A lower percentage of moderate-risk habitat in the range of sage-grouse, compared to the percentage of all habitat in the range of sage-grouse, was found for 12 species. These species included all members of the sagebrush and sagebrush-woodland groups, as well as Brewer's blackbird. As was true for the high-risk category, this discrepancy was most pronounced for Brewer's blackbird (Table 8.2).

For low-risk habitats, the pattern was reversed from that observed for high risk. That is, for all 39 species, a disproportionately greater amount of habitat at low risk was found within the range of sage-grouse compared to that expected by the total overlap in habitat area with the range of sage-grouse. For 16 species, this difference was >20%. Last, 30 species (79%) had a disproportionately lower percentage of habitat at no risk from cheatgrass inside the range of sage-grouse, compared to their total habitat overlap with sage-grouse. This discrepancy was greatest for pronghorn, Brewer's sparrow, and vesper sparrow (Table 8.2).

Discussion

Our evaluation of the effectiveness of sage-grouse as an umbrella species revealed large disparities among species and groups of species in their degree of coverage under the umbrella concept. Not surprisingly, species in the sagebrush group had the greatest overlap with sage-grouse, based on the 4 criteria we used. However, despite having the best overlap among the 5 groups, overlap of the sagebrush group of species with sage-grouse remained somewhat weak. The criterion best met was the area of habitat overlap (68%), but mean overlap in habitat associations for this group was only 47%. Some individual species within the sagebrush group were closely aligned with sage-grouse, such as Wyoming ground squirrel. In the Great Basin Ecoregion this species' range, and thus 100% of its habitat, is contained entirely within the current range of sage-grouse. Moreover, 7 of the 10 cover types identified as habitat for the Wyoming ground squirrel also are shared with sage-grouse. Other species in this group, such as Brewer's sparrow, did not compare as well in their overlap of range, habitat associations, and habitat amount and risk with sage-grouse. Interestingly, the sagebrush-woodland group was nearly equal to the sagebrush group in the degree of coverage provided by sage-grouse, based on our evaluation criteria.

For members of the salt desert scrub group, whose habitats are dominated by arid shrubland species (e.g., spiny hopsage, black greasewood), management based on habitats within the range of sage-grouse would likely fail in a variety of ways. For example, the range of Merriam's kangaroo rat scarcely overlaps that of sage-grouse (20%), and only 16% of its habitat is contained within sage-grouse range. Moreover, this species had the greatest percentage of habitat at high risk from displacement by cheatgrass among all species in the Great Basin, and only 16% of that high-risk habitat was within the range of sage-grouse. Ultimately, decisions about the effectiveness of sage-grouse as an umbrella species must be based on value judgments about what level of conservation is deemed sufficient for associated species.

Patterns of overlap among the 5 groups of species, based on the criteria in our evaluation, were generally similar. For all groups, the percent overlap in habitat association was the lowest among the 4 criteria, and the percent overlap in amount of habitat was always greater than the overlap in habitat association. This result may indicate that the cover types that were shared in common as habitat for the species of concern and sage-grouse were typically those that comprised a comparatively large proportion of these species' habitats. Moreover, for all groups, the percent overlap in habitat at high risk was less than that for all habitat. This comparison indicates that the pattern of disproportionately less high-risk habitat occurring within the range of sage-grouse was true across all groups of species.

Comparisons among taxonomic groups revealed that passerines and mammals were best represented by sage-grouse. However, burrowing mammals such as pygmy rabbit and sagebrush vole depend on friable soils in sagebrush habitats to establish and maintain burrows (e.g., Gabler et al. 2000, Carroll and Genoways 1980). Such requirements obviously would not be a focus of management practices intended to improve sage-grouse habitats. Herptiles had uniformly low overlap in all criteria used in our evaluation. This lack of conformity across taxa (i.e., from a gallinaceous bird to other vertebrate classes) was not unexpected, and were other habitat variables considered in addition to vegetation cover types, reptiles and amphibians likely would be even less suited as species under the sage-grouse umbrella. Reptiles often are also associated with non-vegetative habitat features such as rocky outcrops; our broad-scale assessment did not consider such features.

Using sage-grouse as an umbrella species for vertebrates in the sagebrush ecosystem also may be problematic due to issues of scale, which we did not address in our evaluation. Not only are sage-grouse widespread across 11 states and 2 provinces in western North America, but also individuals and populations have larger home ranges than do many other species associated with sagebrush. For example, home ranges for individual sage-grouse may vary from 100s to 1,000s of hectares (Rowland 2003). By contrast, territories for sage sparrows are on the order of hectares (Martin and Carlson 1998). With such large differences in scale between sage-grouse and less mobile species, particularly herptiles, declining trends in sage-grouse may not be apparent locally until other species associated with sagebrush habitats have experienced far more severe population declines that may be difficult to reverse.

In addition, little is known about differences in responses of sage-grouse versus other sagebrush-associated species to size and fragmentation of sagebrush patches. For example, sage-grouse may use a variety of patch sizes arranged as a mosaic across the landscape, given their high mobility and large home ranges. Sage sparrows, by contrast, appear to require large, unfragmented patches of sagebrush (Knick and Rotenberry 1999). These disparities suggest that better knowledge of the spatial requirements of sage-grouse is needed in relation to those for other sagebrush inhabitants, rather than assuming the requirements are similar.

Many bird species associated with sagebrush habitats are also associated with specific structural features of vegetation, such as shrub canopy cover, density, and height (e.g., Martin and Carlson 1998, Martin and Parrish 2000, Johnson et al. 2002), which also are important for sage-grouse (Schroeder et al. 1999, Connelly et al. 2000). Less is known, however, about the overlap between environmental requirements for sage-grouse and those for herptiles and mammals associated with sagebrush habitats. Indeed, published research about habitat requirements for birds and mammals is far more common than for amphibians and reptiles (Wisdom et al. 2002); in particular, game species or threatened or endangered taxa are better studied than non-game or more common species (Heglund 2002, Wisdom et al. 2002).

Across all 39 species of concern considered in our evaluation of sage-grouse as an umbrella species, about half of their habitat was found outside the current range of sage-grouse. Thus, management actions directed at sage-grouse within its current range in the Great Basin will neglect about half the habitat in the Great Basin for most other species associated with sagebrush habitats. If this failing is accepted, an additional consideration is the question of habitat at risk. Our evaluation revealed that habitats at high risk to displacement by cheatgrass were disproportionately located outside the range of sage-grouse. This finding has important implications for managing habitats at risk for species of concern in our assessment. These high-risk habitats, primarily shrub species in the salt desert scrub complex, would not be addressed in management for sage-grouse in the Great Basin.

How well a species or group of species functions as an umbrella for a suite of similar species depends in part on the objective of the umbrella approach. Traditional uses of umbrella species have included (1) prioritization of habitat remnants for conservation based on species richness (Fleishman et al. 2000); (2) reserve design to protect biodiversity (e.g., DeNormandie and Edwards In Press); and (3) protection of regional biodiversity (Andelman and Fagan 2000). If the objective of the umbrella species approach is to benefit multiple species when directing management actions toward habitats (e.g., both active and passive restoration of habitats), several criteria must be considered. First, the species' ranges must overlap to a sufficient degree such that management of the umbrella species' habitats will occur on a substantial proportion of the ranges of the species under the umbrella. Second, the habitats used by the umbrella species

must also coincide to a high degree with those used by the targeted species; in other words, species with similar distributions but dissimilar habitats will not benefit from management for the umbrella species. Third, management prescriptions appropriate for the umbrella species' habitats must parallel those required for habitats of other species under the "umbrella."

Our evaluation provided a simple examination of the value of sage-grouse as an umbrella species for 39 species of concern in our prototype assessment in the Great Basin. Based on our evaluation, sage-grouse appear to be inadequate as an umbrella species for the majority of the species we addressed, largely because their habitats do not overlap. For some species, however, management directed explicitly toward sage-grouse and their habitats will likely offer substantial conservation coverage. Moreover, the sagebrush portion of habitats for all of the 39 species of concern, which for some is substantial, will benefit by management aimed at improving sage-grouse habitats.

Assumptions and Limitations

- The range map polygons for each species that we used to evaluate greater sage-grouse as an umbrella species are generalized, 2-dimensional representations of the geographic range of each species. These range maps were not designed nor used to depict variation in population density across a given species' range (see [Chapter 7](#) and Wisdom et al. 2003 for a formal definition and a fuller discussion of species' ranges). Consequently, our calculations of overlap between each species' range, and overlap in habitats within those ranges, with those of sage-grouse, do not depict population overlap. An analysis of population overlap of each species with sage-grouse would require data on population occurrence beyond that used to estimate each species' range.
- Our calculations of contraction in the range of greater-sage grouse from historical to current periods did not involve delimiting areas within these ranges where the species may not have been, or currently is, present. Contraction in the species' range, therefore, is an estimate of the reduction in the outer geographic boundaries of the species' occurrence within the Great Basin, rather than a direct estimate of the reduction in population abundance or density. A revised map of current distribution of, and predicted former habitats for, greater and Gunnison sage-grouse has been prepared and submitted for publication (Schroeder et al. submitted). However, these revised maps are updates of the currently used range maps (Schroeder 2000) and thus do not depict relative population abundance or density.
- We conducted our analyses of sage-grouse as an umbrella species in the Great Basin by using a map of current distribution of greater sage-grouse, rather than their estimated historical distribution. Had we used the historical distribution, overlap of habitats and ranges of each species with sage-grouse generally would have been greater. However, existing management of sage-grouse is primarily focused on habitats and populations of the species within its current range. Our analysis was intended to highlight, in the most realistic way, the management attention that would be focused on the other 39 species of concern as a byproduct of management for greater sage-grouse habitats.

Key Findings

- Within the Great Basin, overlap between the ranges of species in our assessment and that of greater sage-grouse varied from 100% for Wyoming ground squirrel to only 20% for groundsnake and Merriam's kangaroo rat.
- For most species ($n = 29$, or 74%), the percent overlap of their ranges with that of sage-grouse was about 46%, which is the percentage of the Great Basin encompassed by the current range of sage-grouse. This result is consistent with independence in the distribution of these species from the distribution of sage-grouse in the Great Basin.
- Across the 39 species of concern, percent overlap in cover types used as habitat with those used by sage-grouse generally was low ($\bar{x} = 32\%$). Wyoming ground squirrel had the greatest overlap in habitat associations with sage-grouse (70%); by contrast, chisel-toothed kangaroo rat had only 1 of its 13 cover types (black sagebrush) shared with sage-grouse (8% overlap).
- Six species used as habitat all 10 cover types associated with sage-grouse; these species also were associated with a broad array of other cover types, however, so that overall, their percent overlap in cover types was near average (range = 29 to 37%).
- The percentage of habitat for each species that occurred within the current range of sage-grouse in the Great Basin ($\bar{x} = 48\%$) generally was similar to the mean overlap in species' ranges with sage-grouse. Percent overlap in habitat ranged from 100% (Wyoming ground squirrel) to only 14% (groundsnake and desert spiny lizard). Species with greater overlap in habitat associations with sage-grouse tended to have greater overlap in their area of habitat within the range of sage-grouse.
- For the 4 criteria evaluated, the sagebrush group of species was most closely associated with sage-grouse, whereas the salt desert scrub group was most divergent from sage-grouse (Fig. 8.2). Mean overlap for the sagebrush group was 57% (range of species), 47% (habitat cover types), 68% (amount of habitat), and 62% (high-risk habitat); by contrast mean overlap for the salt desert group was 35% (range), 19% (cover types), 27% (amount of habitat), and 21% (high-risk habitat).
- A disproportionately smaller percentage of habitat at high risk and no risk of displacement by cheatgrass was found within the range of sage-grouse, compared to the percent overlap in all habitat. The opposite was true for low- and moderate-risk habitats. Proportionately more of these habitats than expected were found within the range of sage-grouse versus outside, based on overlap in all habitat. Species in the shrubland and generalist groups had the greatest disparity in percentage of habitat at high risk within the range of sage-grouse versus total habitat in the range of sage-grouse. The amount of habitat involved was substantial; for many of these species, >5 million ha of habitat at high risk from cheatgrass was outside the range of sage-grouse.

Literature Cited

- Aldridge, C. L. 1998. Status of the Sage Grouse (*Centrocercus urophasianus urophasianus*) in Alberta. Alberta Environmental Protection, Wildlife Management Division, and Alberta Conservation Association, Wildlife Status Report 13. Edmonton, Alberta, Canada.
- Andelman, S. J., S. Beissinger, J. F. Cochrane, L. Gerber, P. Gomez-Priego, C. Groves, J. Haufler, R. Holthausen, D. Lee, L. Maguire, B. Noon, K. Ralls, and H. Regan. 2001. Scientific standards for conducting viability assessments under the National Forest Management Act: report and recommendations of the NCEAS working group. National Center for Ecological Analysis and Synthesis, Santa Barbara, California, USA.
- Andelman, S. J., and W. F. Fagan. 2000. Umbrellas and flagships: efficient conservation surrogates or expensive mistakes? *Proceedings of the National Academy of Sciences* 97:5954-5959.
- Barrett, H., E. Campbell, S. Ellis, J. Hanf, R. Masinton, J. Pollet, T. Rich, J. Rose, J. Sadowski, F. Taylor, P. Teensma, J. Dillon, D. Zalunardo, B. Bales, W. Van Dyke, and N. Pustis. 2000. Greater sage-grouse and sagebrush-steppe ecosystems management guidelines (Oregon and Washington). Bureau of Land Management, U. S. Fish and Wildlife Service, U.S. Forest Service, Oregon Department of Fish and Wildlife, and Oregon Department of State Lands.
- Beck, J. L., D. L. Mitchell, and B. D. Maxfield. 2003. Changes in the distribution and status of Sage-Grouse in Utah. *Western North American Naturalist* 63:203-214.
- Braun, C. E., M. F. Baker, R. L. Eng, J. W. Gashwiler, and M. H. Schroeder. 1976. Conservation committee report on effects of alteration of sagebrush communities on the associated avifauna. *Wilson Bulletin* 88:165-171.
- Braun, C. E., T. Britt, and R. O. Wallestad. 1977. Guidelines for maintenance of sage grouse habitats. *Wildlife Society Bulletin* 5:99-106.
- Bureau of Land Management (BLM). 1999. The Great Basin Restoration Initiative: out of ashes, an opportunity. Bureau of Land Management, National Office of Fire and Aviation, Boise, Idaho, USA.
- Bureau of Land Management (BLM). 2000. Management guidelines for sage grouse and sagebrush ecosystems in Nevada. Bureau of Land Management, Reno, Nevada, USA.
- Bureau of Land Management (BLM). 2002. Management considerations for sagebrush (*Artemisia*) in the western United States: a selective summary of current information about the ecology and biology of woody North American sagebrush taxa. USDI Bureau of Land Management, Washington, D.C., USA.
- Carroll, L. E., and H. H. Genoways. 1980. *Lagurus curtatus*. Mammalian Species 124. The American Society of Mammalogists.

- Comer, P., J. Kagan, M. Heiner, and C. Tobalske. 2002. Sagebrush vegetation in the western United States. Map 1:200,000 scale. USGS Forest and Rangeland Ecosystems Science Center, Boise, Idaho, and The Nature Conservancy, Boulder, Colorado, USA
- Connelly, J. W., and C. E. Braun. 1997. Long-term changes in sage grouse *Centrocercus urophasianus* populations in western North America. *Wildlife Biology* 3:229-234.
- Connelly, J. W., M. A. Schroeder, A. R. Sands, and C. E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. *Wildlife Society Bulletin* 28:967-985.
- DeNormandie, J., and T. C. Edwards, Jr. In Press. The umbrella species concept and regional conservation planning in southern California: a comparative study. *Conservation Biology*.
- Fleishman, E., R. B. Blair, and D. D. Murphy. 2001. Empirical validation of a method for umbrella species selection. *Ecological Applications* 11:1489-1501.
- Fleishman, E., D. D. Murphy, and P. F. Brussard. 2000. A new method for selection of umbrella species for conservation planning. *Ecological Applications* 10:569-579.
- Gabler, K. I., J. W. Laundré, and L. T. Heady. 2000. Predicting suitability of habitat in southeast Idaho for pygmy rabbits. *Journal of Wildlife Management* 64:759-764.
- Kritz, K. 2003. Summary of sage grouse petitions submitted to the U. S. Fish and Wildlife Service. USDI Fish and Wildlife Service, Reno, Nevada, USA. Available online at: <http://sagemap.wr.usgs.gov/documents.asp>.
- Heglund, P. 2002. Foundations of species-environment relations. Pages 35-41 in J. M. Scott, P. J. Heglund, M. L. Morrison, J. B. Haufler, M. G. Raphael, W. A. Wall, and F. B. Samson, editors. *Predicting species occurrences: issues of accuracy and scale*. Island Press, Washington, D.C., USA.
- Johnson, M. J., C. van Riper III, and K. M. Pearson. 2002. Black-throated sparrow (*Amphispiza bilineata*). In *The Birds of North America*, No. 637. A. Poole and F. Gill, editors. The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.
- Knick, S. T., and J. T. Rotenberry. 1999. Spatial distribution of breeding passerine bird habitats in a shrubsteppe region of southwestern Idaho. *Studies in Avian Biology* 19:104-111.
- Lyon, A. G., and S. H. Anderson. 2003. Potential gas development impacts on sage grouse nest initiation and movement. *Wildlife Society Bulletin* 31:486-491.
- Marcot, B. G., M. J. Wisdom, H. W. Li, and G. C. Castillo. 1994. Managing for featured, threatened, endangered, and sensitive species and unique habitats for ecosystem sustainability. USDA Forest Service General Technical Report PNW-GTR-329.

- Martin, J. W., and B. A. Carlson. 1998. Sage sparrow (*Amphispiza belli*). In *The Birds of North America*, No. 326. A. Poole and F. Gill, editors. The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.
- Martin, J. W., and J. R. Parrish. 2000. Lark sparrow (*Chondestes grammacus*). In *The Birds of North America*, No. 488. A. Poole and F. Gill, editors. The Birds of North America, Inc., Philadelphia, Pennsylvania, USA.
- Monsen, S. B., N. L. Shaw, and M. Pellant, editors. In Press. Proceedings of the sage-grouse habitat restoration symposium. USDA Forest Service Rocky Mountain Research Station Proceedings RMRS-P-XX.
- Paige, C., and S. A. Ritter. 1999. Birds in a sagebrush sea: managing sagebrush habitats for bird communities. Partners in Flight Western Working Group, Boise, Idaho, USA.
- Rich, T., and B. Altman. 2001. Under the sage grouse umbrella. *Bird Conservation* 14:10.
- Rich, T. D., M. J. Wisdom, and V. A. Saab. 2003. Conservation of sagebrush steppe birds in the interior Columbia Basin. In press, Proceedings of the Third International Partners in Flight Conference, 20-24 March 2002, Asilomar, California, USA.
- Rowland, M. M., and M. J. Wisdom. 2002. Bibliography of sage-grouse (*Centrocercus urophasianus* and *C. minimus*). Oregon Department of Fish and Wildlife; U.S. Department of the Interior, Bureau of Land Management, Oregon/Washington State Office; and U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Available online at: <http://sagemap.wr.usgs.gov/documents.asp>.
- Rowland, M. M. 2003. Effects of management practices on grassland birds: greater sage-grouse. Northern Prairie Wildlife Research Center, Jamestown, North Dakota, USA. Northern Prairie Wildlife Research Center Home Page. Available online at: <http://www.npwr.usgs.gov/resource/literatr/grasbird/>.
- Schroeder, M. A., C. L. Aldridge, A. D. Apa, J. R. Bohne, C. E. Braun, S. D. Bunnell, J. W. Connelly, P. A. Deibert, S. C. Gardner, M. A. Hilliard, G. D. Kobriger, C. W. McCarthy, J. J. McCarthy, D. L. Mitchell, E. V. Rickerson, and S. J. Stiver. Submitted. Distribution of Sage-Grouse in North America. *Condor*.
- Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage-grouse (*Centrocercus urophasianus*). A. Poole and F. Gill, editors. Number 425, *The birds of North America*, The Academy of Natural Sciences, Philadelphia, Pennsylvania and The American Ornithologists' Union, Washington, D.C., USA.
- Schroeder, M. A. 2000. Current and historic distribution of Greater and Gunnison Sage-grouse in North America. Map Edition 1.1. Washington Department of Fish and Wildlife. Olympia, Washington, USA.

- Schroeder, M. A., J. R. Young, and C. E. Braun. 1999. Sage-grouse (*Centrocercus urophasianus*). A. Poole and F. Gill, editors. The birds of North America, Number 425. The Academy of Natural Sciences, Philadelphia, Pennsylvania; The American Ornithologists' Union, Washington, D.C., USA.
- Suring, L. H., M. J. Wisdom, M. M. Rowland, and B. C. Wales. In Preparation. Determining species of potential conservation concern associated with sagebrush ecosystems in the western United States. Unpublished report on file, Pacific Northwest Research Station, La Grande, Oregon, USA.
- Wambolt, C. L., A. J. Harp, B. L. Welch, N. Shaw, J. W. Connelly, K. P. Reese, C. E. Braun, D. A. Klebenow, E. D. McArthur, J. G. Thompson, L. A. Torell, and J. A. Tanaka. 2002. Conservation of Greater Sage-Grouse on public lands in the Western U.S.: implications of recovery and management policies. Policy Analysis Center for Western Public Lands Policy Paper SG-02-02.
- Wisdom, M. J., M. M. Rowland, L. H. Suring, L. Schueck, C. Wolff Meinke, B. C. Wales, and S. T. Knick. 2003. Procedures for regional assessment of habitats for species of conservation concern in the sagebrush ecosystem. March 2003 Report, Version 1, Pacific Northwest Research Station, 1401 Gekeler Lane, La Grande, Oregon, USA
- Wisdom, M. J., N. M. Warren, and B. C. Wales. 2002. Vertebrates of conservation concern in the interior Northwest: priorities for research. Northwest Science 76:90-97.
- Young, J. A., and B. A. Sparks. 2002. Cattle in the cold desert. (Expanded edition.) University of Nevada Press, Reno, Nevada, USA.

Table 8.1. Overlap in species ranges and habitats between 39 species of conservation concern and greater sage-grouse in the Great Basin Ecoregion.

Group Species ^a	Overlap with greater sage-grouse (%)		
	Range of species ^b	Habitat cover types ^c	Amount of habitat ^d
Sagebrush			
Sage thrasher	46	29 (4/14)	59
Sage sparrow	47	38 (6/16)	58
Vesper sparrow	52	44 (8/18)	63
Brewer's sparrow	45	36 (8/22)	62
Wyoming ground squirrel	100	70 (7/10)	100
Pygmy rabbit	54	64 (9/14)	68
Mean(SD)	57(21.2)	47(16.6)	68(16.0)
Salt desert scrub			
Great Basin collared lizard	30	13 (2/15)	23
Long-nosed leopard lizard	46	19 (3/16)	37
Desert horned lizard	46	19 (3/16)	37
Desert spiny lizard	22	19 (3/16)	14
Long-nosed snake	47	26 (5/19)	38
Groundsnake	20	24 (4/17)	14
Merriam's kangaroo rat	20	24 (4/17)	16
Chisel-toothed kangaroo rat	46	8 (1/13)	34
Mean(SD)	35(12.8)	19(6.0)	27(11.0)
Shrubland			
Common sagebrush lizard	46	31 (8/26)	48
Northern harrier	46	33 (10/30)	45
Prairie falcon	45	33 (9/27)	45
Short-eared owl	46	33 (10/30)	45
Western burrowing owl	46	35 (10/29)	45
Loggerhead shrike	46	25 (6/24)	46
Black-throated sparrow	47	24 (4/17)	44
Kit fox	46	46 (5/11)	45
Pronghorn	48	50 (9/18)	43
Ord's kangaroo rat	46	33 (9/27)	47
Dark kangaroo mouse	60	40 (6/15)	54
Little pocket mouse	48	32 (6/19)	44
Northern grasshopper mouse	51	35 (9/26)	50
Mean(SD)	48(4.0)	35(7.2)	46(3.0)
Sagebrush-woodland			
Gray flycatcher	45	26 (5/19)	59

Table 8.1. Overlap in species ranges and habitats between 39 species of conservation concern and greater sage-grouse in the Great Basin Ecoregion.

Group Species ^a	Overlap with greater sage-grouse (%)		
	Range of species ^b	Habitat cover types ^c	Amount of habitat ^d
Green-tailed towhee	46	20 (4/20)	60
Merriam's shrew	47	53 (9/17)	62
Sagebrush vole	45	47 (9/19)	59
White-tailed jackrabbit	62	37 (10/27)	71
Mean(SD)	49(4.8)	37(9.9)	62(8.3)
Generalist			
Great Basin spadefoot	46	32 (10/31)	45
Nightsnake	48	29 (9/31)	48
Striped whipsnake	45	27 (9/33)	46
Ferruginous hawk	47	27 (9/33)	49
Swainson's hawk	46	29 (10/35)	48
Lark sparrow	48	22 (6/27)	48
Brewer's blackbird	45	25 (3/12)	58
Mean(SD)	47(1.2)	27(3.2)	49(4.3)
Grand mean	47	32.2	48

^a Each species in our assessment was assigned to 1 of 5 groups for evaluation of habitat conditions in watersheds; see [Chapter 7](#) for details.

^b Overlap in ranges was calculated by dividing the area of each species' range in the Great Basin Ecoregion that overlapped the current range of greater sage-grouse in the ecoregion by the total area of the species' range in the Great Basin (see [fig. 8.1](#) for a map of the current range of sage-grouse and [Figs. A4.1-4.5](#) for range maps of other species used in our assessment).

^c The percent overlap in cover types used as habitat was calculated by dividing the number of cover types shared in common with sage-grouse by the total number of cover types identified as habitat for a species. The values in parentheses are these numbers, i.e., the numerator is the number of types in common and the denominator is the total number of cover types used as habitat by each species.

^d Overlap in amount of habitat was calculated by dividing the amount of habitat in a species' range that occurred within the current range of greater sage-grouse by the total amount of habitat for the species in the Great Basin and multiplying by 100; see text for further details.

Table 8.2. Overlap in habitat amount and habitat at risk of displacement by cheatgrass between 39 species of conservation concern and greater sage-grouse in the Great Basin Ecoregion. (See text, [Chapter 4](#), for definitions of risk categories of displacement by cheatgrass.)

Group Species	Overlap in habitat amount with sage-grouse (%)	Overlap by risk category							
		None		Low		Moderate		High	
		Area ^a	% ^b	Area	%	Area	%	Area	%
Sagebrush									
Sage thrasher	59	1.39	50	2.61	72	2.53	54	1.59	52
Sage sparrow	58	1.58	44	2.45	74	2.46	54	1.58	52
Vesper sparrow	63	0.83	45	3.50	77	3.13	61	2.13	52
Brewer's sparrow	62	1.57	45	6.71	70	3.89	58	2.20	57
Wyoming ground squirrel	100	0.14	100	0.20	100	0.26	100	0.45	100
Pygmy rabbit	68	1.20	57	2.90	82	2.83	65	1.92	57
Salt desert scrub									
Great Basin collared lizard	23	2.10	23	0.69	31	1.66	29	5.24	20
Long-nosed leopard lizard	37	1.63	43	1.32	62	2.43	47	6.55	27
Desert horned lizard	37	1.63	43	1.32	62	2.43	48	6.56	28
Desert spiny lizard	14	1.02	7	0.62	25	1.25	23	3.00	11
Long-nosed snake	38	1.61	43	1.45	60	2.53	47	6.41	28
Groundsnake	14	0.52	4	0.40	21	0.92	21	2.14	12
Merriam's kangaroo rat	16	0.68	12	0.25	27	0.85	23	2.35	14
Chisel-toothed kangaroo rat	34	1.86	31	1.12	58	2.14	45	5.85	27
Shrubland									
Common sagebrush lizard	48	1.56	45	7.25	67	5.54	48	8.24	32
Northern harrier	45	2.70	42	4.38	67	5.20	50	8.64	32
Prairie falcon	45	2.52	43	4.38	67	5.20	50	8.64	32

Table 8.2. Overlap in habitat amount and habitat at risk of displacement by cheatgrass between 39 species of conservation concern and greater sage-grouse in the Great Basin Ecoregion. (See text, [Chapter 4](#), for definitions of risk categories of displacement by cheatgrass.)

Group Species	Overlap in habitat amount with sage-grouse (%)	Overlap by risk category								
		None		Low		Moderate		High		
		Area ^a	% ^b	Area	%	Area	%	Area	%	
Short-eared owl	45	2.70	42	4.38	67	5.20	50	8.64	32	
Western burrowing owl	45	2.53	43	4.38	67	5.20	50	8.64	32	
Loggerhead shrike	46	2.41	42	5.74	67	4.49	47	7.86	32	
Black-throated sparrow	44	1.59	44	2.78	63	4.60	51	7.88	32	
Kit fox	45	1.25	49	2.46	67	4.31	51	7.42	33	
Pronghorn	43	0.28	12	1.39	71	1.58	48	2.33	27	
Ord's kangaroo rat	47	1.56	45	5.71	66	5.56	49	8.63	33	
Dark kangaroo mouse	54	1.02	58	1.74	71	2.91	60	4.28	42	
Little pocket mouse	44	1.33	40	2.00	57	3.33	49	5.60	37	
Northern grasshopper mouse	50	1.38	51	3.95	71	4.75	55	7.51	37	
Sagebrush-woodland										
Gray flycatcher	59	0.57	45	5.95	68	3.14	50	1.75	48	
Green-tailed towhee	60	0.70	50	6.30	69	3.46	51	2.14	54	
Merriam's shrew	62	0.09	90	6.09	70	3.61	56	2.20	50	
Sagebrush vole	59	1.55	45	6.77	68	3.98	54	2.34	49	
White-tailed jackrabbit	71	1.60	58	4.53	80	2.41	70	1.56	62	
Generalist										
Great Basin spadefoot	45	2.94	39	7.40	67	5.77	48	8.77	32	
Nightsnake	48	2.48	37	7.39	67	5.71	49	8.43	33	
Striped whipsnake	46	2.93	34	7.42	66	5.77	48	8.78	32	
Ferruginous hawk	49	2.19	41	6.49	66	4.94	50	7.33	36	

Table 8.2. Overlap in habitat amount and habitat at risk of displacement by cheatgrass between 39 species of conservation concern and greater sage-grouse in the Great Basin Ecoregion. (See text, [Chapter 4](#), for definitions of risk categories of displacement by cheatgrass.)

Group Species	Overlap in habitat amount with sage-grouse (%)	Overlap by risk category							
		None		Low		Moderate		High	
		Area ^a	% ^b	Area	%	Area	%	Area	%
Swainson's hawk	48	2.73	45	6.77	69	5.43	49	8.51	32
Lark sparrow	48	2.27	45	5.56	70	4.43	48	7.94	33
Brewer's blackbird	58	1.32	36	4.04	70	0.66	39	0.14	22

^a Area expressed in millions of hectares, representing the total area of habitat (i.e., habitat for the species both within and outside the range of sage-grouse), by risk category, for each species within the Great Basin.

^b Percentages reflect the percent of habitat area, by risk category, that occurs within the current range of sage-grouse.

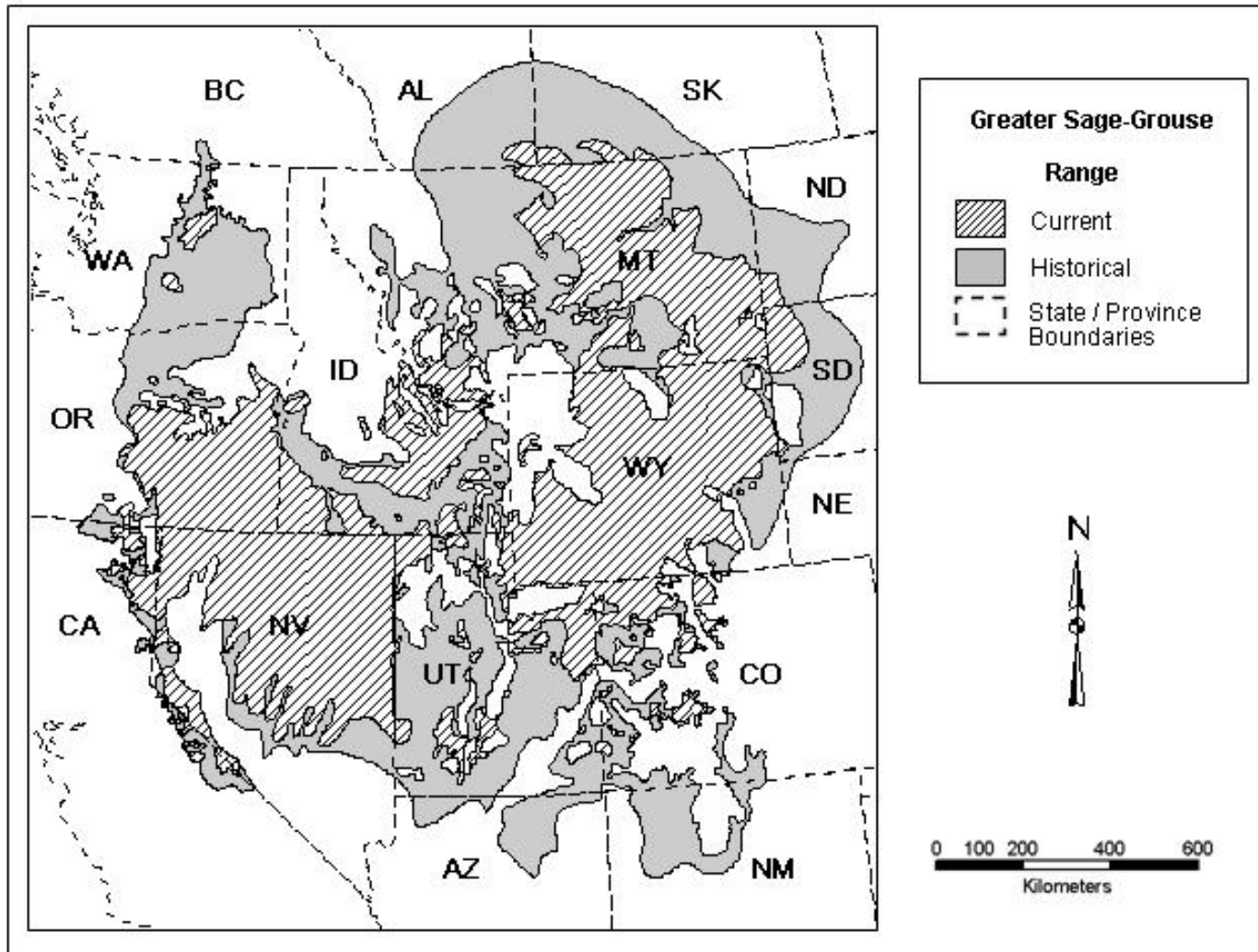


Fig. 8.1. Historical and current range of greater sage-grouse in North America (derived from Schroeder 2000).

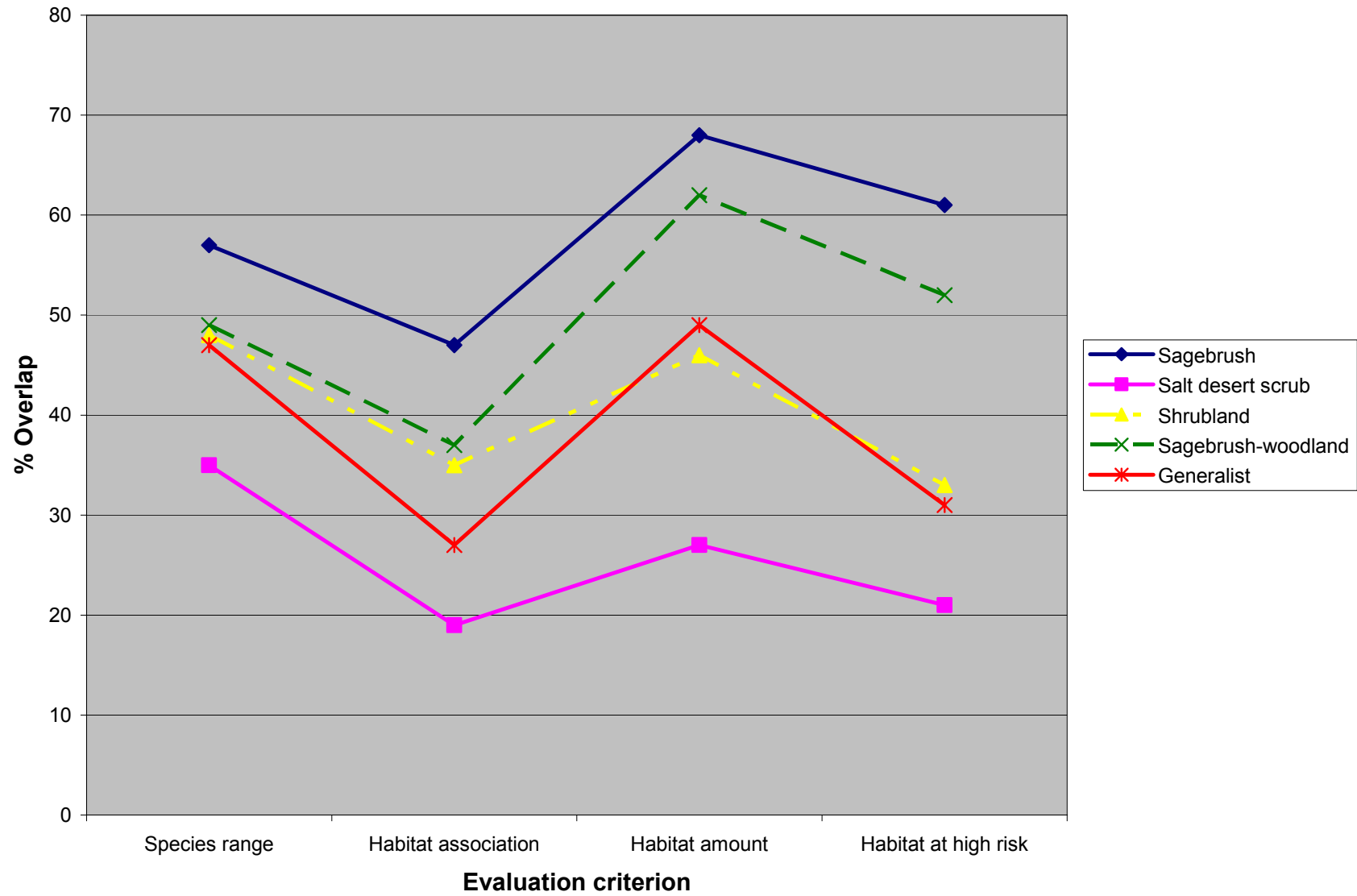


Fig. 8.2. Mean overlap of selected evaluation criteria between groups of species with the current range of sage-grouse. See text for methods and descriptions of criteria.

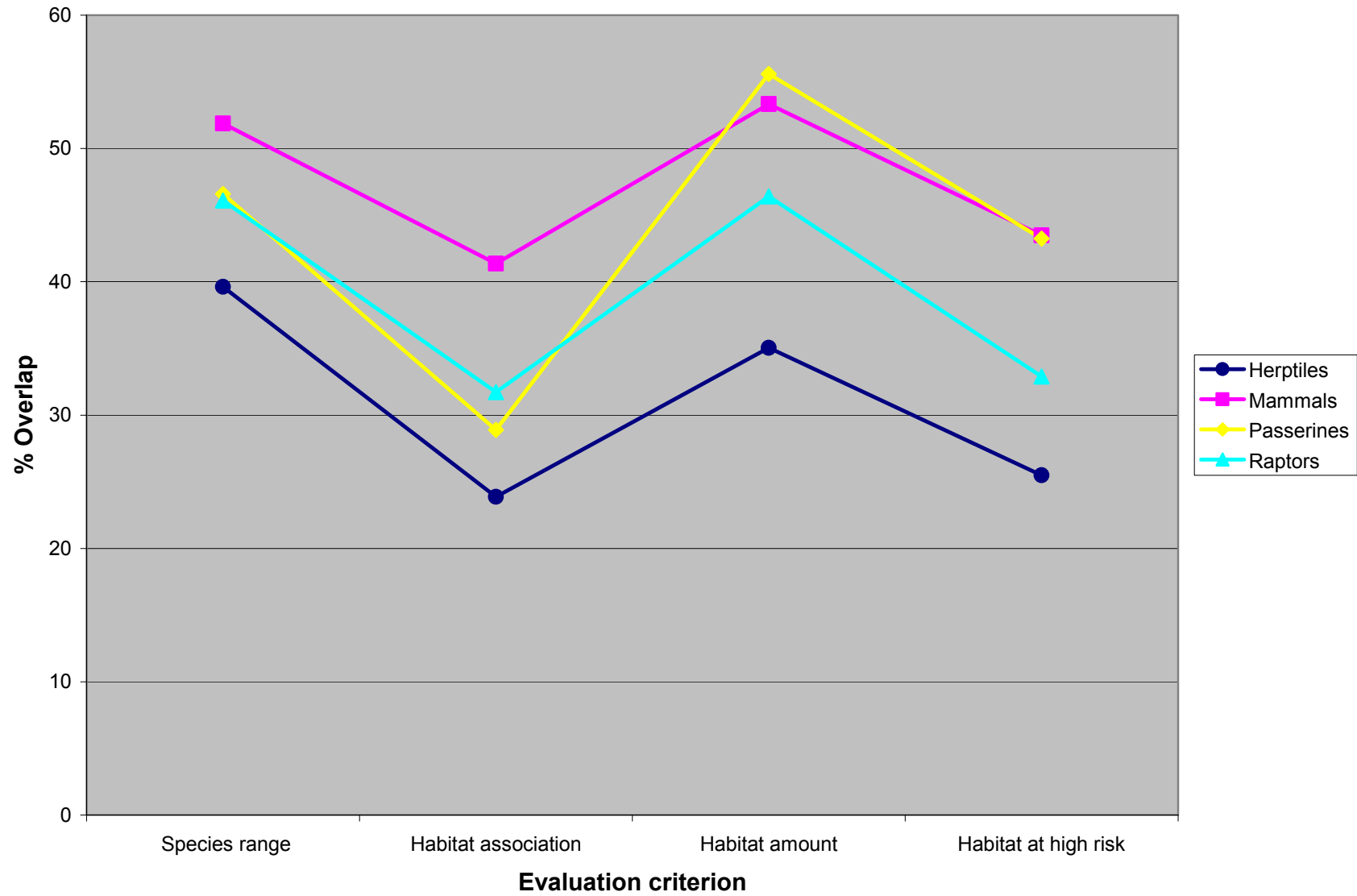


Fig. 8.3. Mean overlap of selected evaluation criteria between groups of vertebrate taxa with the current range of sage-grouse. See text for methods and descriptions of criteria.