

## Chapter 6 : HABITATS FOR SPECIES

### Introduction

Regional assessment of habitats for species of conservation concern must effectively address the information demands posed by inclusion of myriad species in such evaluations. Each species has not only unique habitat associations and responses to management, but also different scales at which these responses are expressed (Thompson et al. 1999; Wisdom et al. 2000, 2003). The first step in characterizing habitat conditions for each species is associating the species with the vegetation cover types and other environmental variables available for use in the assessment. This step can be accomplished through literature reviews, collection of field data, reviews by species experts, or, preferably, through a combination of these approaches (see Wisdom et al. 2003). The cover types or other variables available for regional assessment may not function well, however, as habitat “proxies” in representing the specific environmental requirements of some species (see [Chapter 9](#)).

Despite these challenges, habitat conditions and patterns for large sets of species of concern, mapped and summarized at regional scales, provide information needed to develop regional management strategies. Moreover, habitat conditions at regional scales cannot be managed effectively or efficiently if each BLM Field Office or National Forest is assessed and managed independently of one another (Thompson et al. 1999). Accordingly, regional knowledge of habitats for a comprehensive set of species provides essential context for credible and effective local planning and management (see Wisdom et al. 2003 for details).

In this chapter, we describe habitat associations for species of conservation concern for our regional assessment of the Great Basin Ecoregion (Great Basin) and State of Nevada. We then use these species-habitat associations to summarize the amount of habitat for each species, and to estimate the risk that each species’ habitat will be displaced by invasion from cheatgrass or pinyon-juniper woodlands. Our specific objectives for the chapter were to (1) identify those cover types, based on the “sagestitch” map (Comer et al. 2002), that function as habitat for the 40 species of conservation concern in our prototype assessment; (2) quantify the amount of habitat for each species at 2 spatial extents – the Great Basin and State of Nevada; and (3) estimate the risk that each species’ habitats will be displaced by cheatgrass invasion or pinyon-juniper encroachment.

### Methods

We compiled data on habitats for each of the 40 vertebrate species in our prototype assessment at 2 spatial extents, the Great Basin Ecoregion and State of Nevada. (See [Rowland et al. \[2003\]](#) for results summarized by BLM Field Offices in Nevada.) For our assessment, we first identified habitats associated with each species, based on the land cover types (cover types) available in the 90-m sagestitch map (Comer et al. 2002; see [Chapter 3](#)). Using these species-habitat associations, we then quantified the amount of habitat for each species and estimated the risk that these habitats would be displaced by cheatgrass or by pinyon-juniper woodlands (see [Chapter 4](#) for details about risk models). Habitats were quantified for each species within its range at both spatial extents, using the land cover types available. The absolute amount of habitat for a species may vary according to 3 factors: the geographic range of the species within the analysis area, the number of cover types identified as habitat for the species, and the extent of each cover type identified as habitat within the assessment area.

For risk of habitat displacement by cheatgrass, we report results for each species in both the Great Basin and Nevada. For risk of habitat displacement by pinyon-juniper, we report results for 3

ecological provinces in east-central Nevada and western Utah (Fig. 4.2). Tables displaying more detailed information about all cover types designated as habitat for each of the 40 species, summarized for both the Great Basin and Nevada, are in Appendix 4. In that appendix, we also provide maps of each species' habitats, categorized by risk classes (none, low, moderate, and high) of displacement by cheatgrass (Figs. A4.1-A4.5). These maps also depict each species' range within the Great Basin and Nevada.

*Defining Species-Habitat Associations*—To quantify the amount of habitat for species of conservation concern, we first identified the habitats associated with each species. To accomplish this, we first associated each species with the cover types we estimated to function as habitat, based on similar regional assessments conducted for the Interior Columbia Basin (Wisdom et al. 2000, Raphael et al. 2001), in combination with literature reviews. We then recruited species' experts to review these species-habitat associations. Each expert reviewed a different taxonomic set of species (e.g., passerine birds, herptiles), in accordance with their taxonomic expertise.

Experts were provided a package of materials for their review. The package included a general description of the purpose and background of our assessment, maps of the assessment area and dominant cover types, and estimates of the amount of each cover type occurring in the Great Basin. We also provided each expert with the initial list of cover types we considered to be habitat for each species, as well as cover types not considered to be habitat. These initial habitat designations for each species included 48 cover types identified in the sagesitch map (Comer et al. 2002) that we used for our assessment. To accompany this initial list of species-habitat associations, experts were given explicit definitions of habitats as used in our assessment and detailed descriptions of the 48 cover types (Table 3.2).

Habitats were defined for our analyses as those cover types that contribute to increasing or stationary rates of population growth for a species in a specified area and time. This definition is based on concepts and terms developed by Wisdom et al. (2000, 2003) for regional assessment of “source habitats” for species of conservation concern. Such habitats contribute to “source environments” (Pulliam 1988, Pulliam and Danielson 1991), which represent the composite of all environmental conditions that contribute to increasing or stationary rates of population growth. Habitats thus defined are “distinctly different from habitats that are simply associated with species occurrence, which may or may not contribute to viable, long-term population persistence” (Wisdom et al. 2000:4).

Species experts reviewed habitat associations for the 40 species of conservation concern that we included in our assessment (see Chapter 5) and for 6 other species that were later dropped (Tables 5.1, 6.1). The 6 species initially included in our regional assessment, but subsequently dropped before our habitat analysis was completed, were deemed by the experts to be unsuitable for regional assessment. The 6 species were unsuitable because they were strongly associated with micro-habitats, such as rock outcrops and cliffs, which could not be accurately mapped at the broad scale (cliff chipmunk, pinyon mouse, rock wren, and rock squirrel), or they were not closely associated with sagebrush habitats (pinyon mouse, long-billed curlew, and MacGillivray's warbler). Dropping these species was part of the final step (Step 7, Fig 5.1) of identifying species of concern whose habitats could be assessed at regional scales of our analysis (Chapter 5).

*Quantifying the Amount of Habitat*—We used the habitat designations for each species, following review and refinement of these designations by the species experts, to calculate the amount of habitat currently present in the Great Basin and in Nevada for each of the 40 species of concern. We quantified habitat within each species' range in the Great Basin and Nevada (see Chapter 5 for a description of these range maps and Appendix 4, Figs A4.1-A4.5 to view these range maps). Each 90-m pixel (0.81 ha) of a cover type identified as habitat for a species, using the 90-m sagesitch map

(Wisdom et al. 2003), was counted. The total area (sum) of all pixels of habitat present in each spatial extent was then calculated for each species.

*Quantifying Habitat at Risk*—We used results from the models developed to estimate the risk that native vegetation would be displaced by cheatgrass or pinyon-juniper woodlands (as described in [Chapter 4](#)) to estimate the amount of habitat at risk from these threats for each of the 40 species. Each pixel of habitat within the Great Basin and Nevada was assigned to 1 of 4 categories for risk of displacement by cheatgrass (none, low, moderate, or high). Using the methods described above for quantifying total amount of habitat for each species, we calculated the amount of habitat within each of the 4 cheatgrass risk categories for each species at the 2 spatial extents. To estimate amount of habitat at risk of displacement by pinyon-juniper, we determined the risk of each pixel of sagebrush habitat within a species' range that overlapped the 3 ecological provinces in which the pinyon-juniper model was run. The amount of habitat within each of the 3 categories of risk (low, moderate, or high) was then summed. Because only sagebrush habitats were included in the pinyon-juniper model, summaries of habitat at risk of displacement by pinyon-juniper include only the sagebrush portion of each species' habitat.

## Results

*Species-Habitat Associations*—The 40 species of conservation concern were associated with a wide variety of habitats; 16 species used at least half of the 42 cover types that occur in the Great Basin as habitat ([Tables 6.1, 6.2](#)). Among the 7 species that relied on  $\geq 30$  cover types, 4 were raptors (ferruginous hawk, Swainson's hawk, Northern harrier, and short-eared owl) and 3 were herptiles (Great Basin spadefoot, nightsnake, and striped whipsnake; [Table 6.2](#)). Habitats for these 7 species included all 8 sagebrush cover types, as well as a broad array of other shrublands, agricultural lands, and pinyon-juniper woodlands. Overall, birds and herptiles used more cover types ( $\bar{x} = 22.5$  and  $22.0$ , respectively) than did mammals ( $\bar{x} = 17.8$ ). The 3 species associated with the fewest cover types as habitat—Wyoming ground squirrel, greater sage-grouse, and kit fox—used a disparate mixture of cover types beyond sagebrush, including agriculture (Wyoming ground squirrel), black greasewood (kit fox), and bunchgrass (sage-grouse, Wyoming ground squirrel; [Table 6.1](#)).

The 8 sagebrush cover types were commonly identified as habitats for various species, ranging from low sagebrush-Wyoming big sagebrush and silver sagebrush (used by 32 species) to mountain big sagebrush (28 species; [Table 6.1](#)). In addition to sagebrush cover types, those identified as habitat most often for the species in our assessment were other shrubland types, such as winterfat (34 species), rabbitbrush (33 species), and black greasewood and spiny hopsage (32 species; [Table 6.1](#)). Twenty-seven of the 40 species were associated with the single most abundant cover type in the Great Basin and in Nevada, salt desert scrub. Nearly half ( $\bar{x} = 16$ ) of the 40 species with the 5 pinyon or juniper cover types. Few ( $\leq 5$ ) species were associated with barren/rock/lava, aspen, playa, and marsh/wetland types ([Table 6.1](#)).

*Amount of Habitat*—Within the 29.3 million-ha Great Basin, amount of habitat for the 40 species of concern ranged from slightly  $>1$  million ha for Wyoming ground squirrel to nearly 25 million ha for striped whipsnake, Great Basin spadefoot, and nightsnake ([Fig. 6.1, Table 6.3](#)). Habitat for these 3 broadly-distributed species encompassed  $>80\%$  of the ecoregion ([Appendix 4, Fig. 5](#)). Among the 10 species with the greatest amount of habitat in the ecoregion were 1 small mammal, 4 herptiles, and 5 raptors (notably, no passerine birds and only 1 mammal were included in this group; [Fig. 6.1, Table 6.3](#)). These 10 species not only have ranges that span nearly the entire ecoregion ([Appendix 4, Figs. 3, 5](#)), but also use a broad array of habitats, ranging from 26 cover types for

common sagebrush lizard to 35 for Swainson's hawk. By contrast, the Wyoming ground squirrel occurs only in the northernmost portion of the ecoregion (Appendix 4, Fig. 1) and was associated with only 10 cover types as habitat, the fewest of any species other than sage-grouse (Table 6.2).

Within the ecoregion, the mean amount of habitat per species was 13.9 million ha. These means varied among vertebrate taxa: 21.3 million ha for the 6 raptor species, 12.1 million ha for other birds, 15.2 million ha for herptiles, and 11.1 million ha for mammals (Table 6.3).

Results for habitat amount in Nevada paralleled those found in the Great Basin, with Wyoming ground squirrel having the least amount of habitat (2.7 million ha), and striped whipsnake the most (26 million ha; Fig. 6.2, Table 6.4). The 10 species with the most abundant habitat in Nevada were identical to those in the Great Basin, with the exception of the inclusion of loggerhead shrike and prairie falcon and the exclusion of ferruginous hawk and Ord's kangaroo rat (Fig. 6.2, Table 6.4). The mean amount of habitat in Nevada across all species (15.1 million ha) was slightly more than that in the ecoregion, despite the somewhat smaller size of the state (28.1 million ha) in comparison to the ecoregion. Mean amount of habitat for suites of vertebrates was as follows: 22.9 million ha for raptors, 13.1 million ha for other birds, 16.5 million ha for herptiles, and 12.2 million ha for mammals.

Habitat for greater sage-grouse within its current range was less abundant than that for all other avian species at either spatial extent, and was among the least abundant of all 40 species (Figs. 6.1, 6.2). Compared to the Great Basin, habitat for sage-grouse was 50% more abundant in Nevada (8.7 million ha versus 5.8 million ha). Pygmy rabbit also had comparatively little habitat at both extents, and had more habitat (about 17%) in Nevada than in the Great Basin (Table 6.3).

*Reliance on Sagebrush Habitats*— Nearly half ( $n = 19$ ) of the 40 species in our assessment were associated with all 8 sagebrush cover types found in the Great Basin as habitat; on average, 6 of the sagebrush types were used by a species (Table 6.2). The relative reliance on sagebrush, as measured by the percentage of all cover types used as habitat that were sagebrush types, varied greatly among species (Table 6.2). Greater sage-grouse had the highest percentage (80%), followed by Wyoming ground squirrel (60%) and pygmy rabbit (57%). Chisel-toothed kangaroo rat was associated with the lowest number of sagebrush types ( $n = 1$ ), as well as the lowest percentage of habitat cover types in sagebrush (8%).

Regarding the absolute amount of habitat in sagebrush versus other cover types, species in our assessment tended to fall into 2 groups: those that used all or nearly all of the sagebrush cover types (e.g., common sagebrush lizard, greater sage-grouse, sagebrush vole, pygmy rabbit), and those that used only a small subset of the sagebrush types (e.g., desert horned lizard, desert spiny lizard, long-nosed leopard lizard). These 3 lizard species were associated only with black, low, and silver sagebrush (Table 6.1). This pattern existed at both spatial extents of our analyses (Figs. 6.1, 6.2). The total amount of sagebrush habitat for species with extensive ranges, such as striped whipsnake, that used most or all sagebrush types was nearly equal to the total amount of sagebrush in both the Great Basin (8.3 million ha) and Nevada (10.2 million ha).

We also observed high variability among species in their percentage of habitat that was sagebrush (Figs. 6.3, 6.4). Greater sage-grouse had nearly complete reliance on sagebrush habitats (95% in Nevada and 93% in the Great Basin), primarily Wyoming-basin big sagebrush; however, substantial habitat for sage-grouse occurred in mountain big sagebrush and black sagebrush communities (Tables 1, 41 in Appendix 4). Other species typically referred to as sagebrush obligates, such as sage thrasher, sage sparrow, and pygmy rabbit (Braun et al. 1976, Wilde 1978, Paige and Ritter 1999), also relied heavily on sagebrush habitats, in both the Great Basin and Nevada (Figs. 6.3, 6.4; Tables 6.3, 6.4). By contrast, some species, such as Merriam's kangaroo rat and groundsnake, had very little habitat in sagebrush, often <10%.

*Habitat at Risk from Cheatgrass*—Within the Great Basin, the percentage of habitat at high risk of displacement by cheatgrass ranged from 57% for Merriam’s kangaroo rat to only 2% for Brewer’s blackbird. The percentage of habitat with no risk from cheatgrass was more uniform among species compared to habitat at high risk, ranging from 22% for Great Basin collared lizard to 0% for greater sage-grouse (Fig. 6.5, Table 6.3). Among all 40 species, the mean percentage of habitat at high risk in the ecoregion was 36%, followed by low risk (27%), moderate risk (25%), and no risk (12%). Thirty-three of the 40 species in the Great Basin had >50% of their habitat at moderate or higher risk (i.e., moderate and high risk combined).

The absolute amount of habitat at high risk varied, depending on the size of the species’ range, the amount of habitat present in the ecoregion for the species, and where those habitats were located in relation to environmental conditions under which cheatgrass is predicted to thrive (e.g., lower-elevation sites in the southern portion of the ecoregion). Ten species, all widely distributed in the ecoregion, each had >8 million ha of habitat at high risk from cheatgrass: Great Basin spadefoot, common sagebrush lizard, nightsnake, striped whipsnake, Swainson’s hawk, Northern harrier, prairie falcon, short-eared owl, western burrowing owl, and Ord’s kangaroo rat (Table 6.3; see also Appendix 4, Figs. 3, 5). Habitats at high risk of displacement by cheatgrass were most often found in the lower-elevation portions of species’ ranges in our assessment area, such as the Lahontan Basin in northern and central Nevada or the Bonneville Basin in western Utah (Fig. 4.1; Appendix 4, Figs. 1-5).

For herptiles and raptors, non-sagebrush habitats were uniformly at greater risk, as measured by the percentage of habitat at high risk, than were sagebrush habitats (Tables 6.3, 6.4). By contrast, for some other birds (e.g., gray flycatcher, sage thrasher) and several mammals (e.g., Merriam’s shrew, white-tailed jackrabbit), a greater percentage of their sagebrush habitats was at high risk compared to their non-sagebrush habitats. For the moderate risk category, percentages for sagebrush habitats were uniformly higher than those for non-sagebrush, with the exception of 1 species, Brewer’s blackbird (Table 6.3).

Patterns of habitat at risk to displacement by cheatgrass in Nevada were similar to those in the Great Basin, but overall risk was somewhat lower when measured at this spatial extent. Within the state, the percentage of habitat at high risk ranged from 45% for both Merriam’s and chisel-toothed kangaroo rat to 2% for Brewer’s blackbird (Fig. 6.6, Table 6.4). The percentage of habitat at no risk ranged from 39% for Merriam’s kangaroo rat to 0% for greater sage-grouse. Overall risk, as measured by the mean percentage of risk by category across all species, also was lower in Nevada than in the Great Basin: the dominant risk category was low risk (35%), followed by high (28%), moderate (20%), and none (17%). About half ( $n = 21$ ) of the species in Nevada, compared to >3/4 in the Great Basin, had >50% of their habitat at moderate or higher risk (Fig. 6.6, Table 6.4).

This pattern of somewhat lower risk in Nevada was also seen in the amount of habitat at high risk—no species in Nevada had >8 million ha of habitat at high risk, compared to 10 species in the Great Basin, as mentioned previously (Table 6.4). Seven species did, however, have >7 million ha of habitat at high risk in Nevada; these species included 1 amphibian, 2 reptiles, and 4 raptors. Similar to the Great Basin, non-sagebrush habitats were at greater risk, compared to sagebrush habitats, for herptiles and raptors.

Compared to most other species in our assessment, habitats for greater sage-grouse and pygmy rabbit were at relatively low risk of displacement by cheatgrass. In the Great Basin, 19% of sage-grouse habitat was at high risk, and 22% for pygmy rabbit, compared to the mean of 35% for all species in the ecoregion. Pygmy rabbit was ranked 30<sup>th</sup> and sage-grouse 31<sup>st</sup> in the percentage of habitat at moderate or greater risk in the Great Basin; their ranks were similar in Nevada (Figs. 6.5, 6.6).

Species whose habitats were at highest risk of displacement by cheatgrass were generally those with less reliance on sagebrush habitats, e.g., Merriam's kangaroo rat, Great Basin collared lizard, and long-nosed leopard lizard (Figs. 6.3-6.6). Although this inverse relationship (i.e., percent habitat in sagebrush versus percent habitat at high risk from cheatgrass) was consistent across most species ( $r = -0.66$ ), some exceptions occurred (Fig. 6.7). For example, although Brewer's blackbird had the lowest percentage (2%) of habitat at high risk from cheatgrass in the Great Basin, it also was among the species with the lowest percentage of habitat in sagebrush (18%). Conversely, Wyoming ground squirrel not only had a substantial percentage of its habitat in sagebrush (78%), but also a substantial percentage (43%) of its total habitat at high risk.

Species fell into 4 distinct clusters when plotting the relation between percent habitat in sagebrush compared with percent habitat at high risk of displacement by cheatgrass, with the exception of Brewer's blackbird and Wyoming ground squirrel, as mentioned above (Fig. 6.7). Those in the cluster "A" were strongly associated with sagebrush, and included greater sage-grouse, sage thrasher, sage sparrow, vesper sparrow, and pygmy rabbit. Species in cluster "B" were those that used sagebrush habitats in combination with pinyon-juniper woodlands (Brewer's sparrow, gray flycatcher, green-tailed towhee, Merriam's shrew, sagebrush vole, and white-tailed jackrabbit; see also Appendix 4, Tables 5, 29-33). Cluster "C" was composed of species that were more habitat generalists; these species used not only sagebrush, but also a wide variety of other shrublands, grasslands, and woodlands. This large cluster included the 6 raptor species (see Table 6.2), several small mammals (Ord's kangaroo rat, dark kangaroo mouse, little pocket mouse, Northern grasshopper mouse), 4 herptiles (common sagebrush lizard, Great Basin spadefoot, nightsnake, and striped whipsnake), 3 passerines (loggerhead shrike, black-throated sparrow, and lark sparrow), and 2 large mammals (kit fox and pronghorn). The last cluster, "D," was composed exclusively of species strongly associated with the salt desert scrub cover type: Great Basin collared lizard, long-nosed leopard lizard, desert horned lizard, desert spiny lizard, long-nosed snake, groundsnake, Merriam's kangaroo rat, and chisel-toothed kangaroo rat.

*Habitat at Risk from Pinyon-Juniper Woodlands*—Based on the percentage of sagebrush at high risk, habitat for Brewer's blackbird was most at risk of displacement by pinyon-juniper woodlands (high risk = 42%), followed by pronghorn (37%) and green-tailed towhee (36%; Fig. 6.8, Table 6.5). By contrast, Great Basin collared lizard, desert spiny lizard, and groundsnake each had <17% of their sagebrush habitat at high risk. The dominant risk category, as measured by the mean percentage across all species ( $n = 39$ ) that occurred in these 3 provinces, was low risk ( $\bar{x} = 62\%$ ), followed by high ( $\bar{x} = 33\%$ ) and moderate ( $\bar{x} = 5\%$ ). (Note that there was no category of "no risk" to sagebrush habitats by pinyon-juniper displacement; see Chapter 4 for details.) Only 1 species, Brewer's blackbird, had >50% of its habitat at moderate and high risk combined (Fig. 6.8, Table 6.5).

Absolute amount of habitat at risk of displacement by pinyon-juniper varied depending on what portion of each species' range intersected the 3 provinces, in addition to what proportion of a species' habitat was in sagebrush cover types. Twelve species (31%) each had about 1.6 million ha of sagebrush habitats at high risk: Great Basin spadefoot, common sagebrush lizard, striped whipsnake, Swainson's hawk, northern harrier, prairie falcon, short-eared owl, western burrowing owl, Brewer's sparrow, Merriam's shrew, Ord's kangaroo rat, and sagebrush vole (Table 6.5). Not only do all 12 of these species use all 8 sagebrush cover types as habitat, but also they are widely distributed in these 3 ecological provinces. The total amount of sagebrush habitat for the 12 species in the provinces was about 4.7 million ha, which equals 98% of the total area of sagebrush at this extent; thus, nearly a third of the sagebrush habitat for these species was at high risk.

Although Brewer's blackbird had the largest percentage of habitat at high risk, it had a relatively small amount of habitat in this category (312,000 ha), ranking 34<sup>th</sup> of the 39 species for which pinyon-juniper risk was modeled (Table 6.5). Similarly, although sagebrush habitats for Great Basin collared lizard, desert spiny lizard, and groundsnake were at relatively low risk in the area modeled, these reptiles had very little sagebrush habitat overall in the 3 provinces (Table 6.5).

Pygmy rabbit ranked 24<sup>th</sup> ( $n = 39$ ) and greater sage-grouse 25<sup>th</sup> in percentage of sagebrush habitat at high risk from pinyon-juniper (34% for both species). Based on absolute amount of sagebrush habitat at high risk, pygmy rabbit ranked 16<sup>th</sup>, with 1.5 million ha, whereas sage-grouse ranked 26<sup>th</sup>, with 1.1 million ha (Table 6.5). Overall patterns of habitat at risk from pinyon-juniper for these 2 high-profile species were similar to those for most species in our analyses (Fig. 6.8).

## Discussion

Although our prototype assessment focused on the evaluation of habitats for species associated with the sagebrush ecosystem, the percentage of total habitat in sagebrush varied widely for the 40 species in our analyses. Though all species in our assessment used sagebrush cover types as habitat, sagebrush composed less than half of the habitat for most species. This pattern of habitat association had ramifications in the degree of risk to habitats. As discussed in Chapter 4, sagebrush cover types generally were predicted to be at lower risk of displacement by cheatgrass than were more arid shrubland types, such as salt desert scrub. Thus, species that used these arid shrubland types, e.g., salt desert scrub, saltbush, and shadscale, tended to have a larger proportion of their habitat at high risk from cheatgrass, particularly in the southern extremes of the ecoregion and Nevada. All herptiles and raptors (16 species total) in our assessment used salt desert scrub as habitat, and most were broadly distributed in our study area; this combination rendered habitats for these species among the most at risk in our prototype assessment.

Several species of concern in our assessment are associated not only with sagebrush but also with pinyon-juniper woodland habitats; these species include gray flycatcher, green-tailed towhee, and white-tailed jackrabbit. Such species tend to be most closely tied to early and mid-successional stages of woodland habitats, rather than those dominated by mature trees (Dobbs et al. 1998, Noson et al. submitted). Such stages are increasingly rare, because fire suppression has reduced the frequency of wildfire needed to maintain these younger woodland stages (Tausch 1999, Miller and Tausch 2001). Consequently, habitats for species in this group are threatened in 2 ways: by encroachment of pinyon-juniper into sagebrush habitats, and by the replacement of early and mid-successional woodlands by mature trees.

Our analyses predicted an overall high degree of risk to habitats for sagebrush-associated species of concern in the Great Basin. This risk extended not only to species of federal regulatory concern (e.g., greater sage-grouse, pygmy rabbit) or state-level interest (e.g., Merriam's shrew; Table 5.1), but also to a suite of species, such as chisel-toothed kangaroo rat and common sagebrush lizard, associated with a diverse array of shrubland habitats in the Great Basin. Several of these species, including gray flycatcher, sage thrasher, black-throated sparrow, and Brewer's sparrow, achieve their highest breeding densities in the Great Basin region (Sauer et al. 2003). Based on Breeding Bird Survey route data, population trends for black-throated sparrow, Brewer's sparrow, and sage thrasher are negative in both Utah and Nevada for 1982-2002 (Sauer et al. 2003).

Greater sage-grouse are of particular interest to land and wildlife managers, having been petitioned for listing under the Endangered Species Act throughout their entire range (Kritz 2003). In our assessment, habitat for this species was less abundant than that for most species, owing to its

limited range within the spatial extents of our assessment as well as the species' nearly exclusive reliance on sagebrush cover types as habitat. Habitat for sage-grouse was relatively more abundant, however, in Nevada compared to the Great Basin Ecoregion. This disparity resulted from the dense band of sagebrush that extends across the northern portion of the state that was not included in the ecoregional boundary. Although the species has experienced a contraction of 50% in its range from historical to current times, range contraction is far less for the State of Nevada—only 16% (C. Wolff Meinke, unpublished data based on Schroeder 2000). Within the Great Basin Ecoregion, the range has contracted 40%, similar to the contraction range-wide.

The outright loss of sagebrush and other native shrubs from wildfire in the Great Basin over the last 20 years has generated intensive interest in the welfare of species associated with shrub-steppe systems, especially greater sage-grouse. Our findings indicate that the management attention focused on sage-grouse should be extended to a host of other species associated with sagebrush. Habitat loss at an unprecedented magnitude may occur for most of the species of concern in our assessment unless drastic management actions are undertaken during the next decade.

### Assumptions and Limitations

- Knowledge about habitats that contribute to population persistence is limited, even for well-studied species (see [Chapter 9](#)). Thus, our designation of cover types as habitat may lead to overestimation of the amount of habitat that functions in the way in which we defined habitat (i.e., contributing to stationary or positive population growth rates) for the species in our assessment.
- The range map polygons used in our analyses 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 fuller discussion of species' ranges). Consequently, it is possible that some habitats associated with a species within its range may not be occupied, resulting in overestimation of habitat amount. In such cases, the absence of a species from these habitats is likely explained by other, non-habitat factors not accounted for in our assessment (see [Chapter 9](#)).
- Our estimates of the amount of habitat at risk to displacement by pinyon-juniper woodlands and cheatgrass were based on models whose performance is still being evaluated. As such, these models serve to guide the development of competing hypotheses about factors affecting risk to native vegetation in the Great Basin. Until our models are fully evaluated with additional field data, use by managers of our habitat projections must consider the uncertainty associated with our estimates of habitat at risk.

### Key Findings

- The 40 species in our assessment were associated with a wide array of cover types as habitat; 7 broadly distributed species, including 4 raptors and 3 herptiles, were associated with  $\geq 30$  of the 42 cover types found in the Great Basin.

- Cover types most commonly identified as habitat for these species were shrubs, including winterfat (used by 34 species), rabbitbrush (33 species), and low sagebrush-Wyoming big sagebrush (32 species).
- Although all species in our assessment were associated with sagebrush habitats, the strength of that association varied widely among species, as evidenced by their disparate association with sagebrush cover types as habitat and differences in the absolute amount of habitat composed of sagebrush.
  - Nineteen (48%) of the species of concern were associated with all 8 sagebrush cover types as habitat.
  - Among all 40 species of concern, greater sage-grouse demonstrated the strongest association with sagebrush, both in terms of the percentage of cover types used that were sagebrush (80%) and the percentage of its total habitat that was in sagebrush (93% in the Great Basin).
  - Pygmy rabbit also was closely associated with sagebrush: 57% of its habitat was sagebrush, and this species ranked 5<sup>th</sup> in the Great Basin in the percentage (75%) of its total habitat in sagebrush.
  - On average, 41% of the habitat for each species of concern in the Great Basin was sagebrush.
- Total amount of habitat for species in our assessment averaged 13.9 million ha in the Great Basin (about 50% of the total area of the ecoregion) and 15.1 million ha in Nevada; in the Great Basin, amount of habitat ranged from 1 million ha for Wyoming ground squirrel to 25 million ha for striped whipsnake. Habitat was most abundant for raptors and least abundant for mammals.
- Greater sage-grouse had comparatively little habitat in the Great Basin or Nevada, due in part to the species' restricted range; sage-grouse had the least habitat among the 17 avian species in our assessment.
- Although the Great Basin Ecoregion and the State of Nevada are about the same size, habitat for sage-grouse was more abundant (by 50%) in Nevada, with 8.7 million ha of sage-grouse habitat in the state versus 5.8 million ha in the ecoregion.
- Patterns for amount of habitat for each species in the State of Nevada typically paralleled those found in the Great Basin.
- For risk of habitat displacement by cheatgrass in the Great Basin, "high" risk was the dominant category ( $\bar{x} = 36\%$ ,  $n = 40$  species); in Nevada, low risk was the dominant class ( $\bar{x} = 35\%$ ), followed by high risk ( $\bar{x} = 28\%$ ).
- For 33 species (83%) addressed in our assessment, >50% of their habitat in the Great Basin was at moderate or greater risk of displacement by cheatgrass.
- Relative to other species in our assessment, habitats for greater sage-grouse and pygmy rabbit were at less risk of displacement by cheatgrass. For example, 19% of sage-grouse habitat and

22% of pygmy rabbit habitat were at high risk, compared to a mean of 35% across all 40 species of concern.

- Patterns of habitat at risk of displacement by cheatgrass were similar between Nevada and the Great Basin; however, risk was generally lower in Nevada compared to the Great Basin.
- Sagebrush habitat also is at risk of displacement by pinyon-juniper woodlands; for 12 species of concern, about 30% of their sagebrush habitat was at high risk in the 3 provinces in which this risk was modeled.
- Sagebrush habitats for greater sage-grouse and pygmy rabbit were similar in terms of risk from pinyon-juniper when compared to all 40 species, with about 33% of these habitats at high risk for both species.

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Table 6.2. Sagebrush versus non-sagebrush land cover types identified as habitat for 40 species of conservation concern in the Great Basin Ecoregion.

Species	No. land cover types	No. sagebrush cover types	% Cover types in sagebrush
<b><i>Amphibians</i></b>			
Great Basin spadefoot	31	8	25.8
<b><i>Reptiles</i></b>			
Great Basin collared lizard	15	2	13.3
Long-nosed leopard lizard	16	3	18.8
Desert horned lizard	16	3	18.8
Common sagebrush lizard	26	8	30.8
Desert spiny lizard	16	3	18.8
Nightsnake	31	8	25.8
Striped whipsnake	33	8	24.2
Long-nosed snake	19	4	21.1
Groundsnake	17	4	23.5
<b><i>Birds</i></b>			
Ferruginous hawk	33	8	24.2
Swainson's hawk	35	8	22.9
Northern harrier	30	8	26.7
Prairie falcon	27	8	29.6
Greater sage-grouse	10	8	80.0
Short-eared owl	30	8	26.7
Western burrowing owl	29	8	27.6
Gray flycatcher	19	5	26.3
Sage thrasher	14	4	28.6
Loggerhead shrike	24	5	20.8
Sage sparrow	16	6	37.5
Black-throated sparrow	17	4	23.5
Lark sparrow	27	5	18.5
Green-tailed towhee	20	4	20.0
Vesper sparrow	18	7	38.9
Brewer's sparrow	22	8	36.4
Brewer's blackbird	12	2	16.7
<b><i>Mammals</i></b>			
Merriam's shrew	17	8	47.1
Kit fox	11	5	45.5
Pronghorn	18	8	44.4
Wyoming ground squirrel	10	6	60.0
Merriam's kangaroo rat	17	4	23.5
Chisel-toothed kangaroo rat	13	1	7.7
Ord's kangaroo rat	27	8	29.6
Dark kangaroo mouse	15	6	40.0

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Species	No. land cover types	No. sagebrush cover types	% Cover types in sagebrush
Little pocket mouse	19	6	31.6
Northern grasshopper mouse	26	8	30.8
Sagebrush vole	19	8	42.1
White-tailed jackrabbit	26	8	30.8
Pygmy rabbit	14	8	57.1

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Table 6.3. Amount of habitat for 40 species of conservation concern within each species' range in the Great Basin, summarized for sagebrush and non-sagebrush habitats by risk of displacement by cheatgrass. (See [Chapter 4](#) for definitions of risk categories of displacement by cheatgrass.)

Species	Risk category								Total habitat	
	None		Low		Moderate		High		Ha	% total
	Ha	% total	Ha	% total	Ha	% total	Ha	% total		
<b><i>Amphibians</i></b>										
Great Basin spadefoot										
Sagebrush	0	0.0	3,489,309	42.2	3,136,134	37.9	1,650,034	19.9	8,275,477	33.3 <sup>a</sup>
Non-sagebrush	2,937,668	17.7	3,913,424	23.6	2,632,305	15.8	7,125,900	42.9	16,609,297	66.7
Total	2,937,668	11.8	7,402,733	29.7	5,768,438	23.2	8,775,934	35.3	24,884,774	100.0
<b><i>Reptiles</i></b>										
Great Basin collared lizard										
Sagebrush	0	0.0	379,323	52.1	286,214	39.4	62,001	8.5	727,539	7.5
Non-sagebrush	2,104,679	23.4	311,387	3.5	1,371,177	15.3	5,180,717	57.8	8,967,960	92.5
Total	2,104,679	21.7	690,710	7.1	1,657,391	17.1	5,242,719	54.1	9,695,499	100.0
Long-nosed leopard lizard										
Sagebrush	0	0.0	954,334	53.3	684,311	38.2	152,167	8.5	1,790,813	15.0
Non-sagebrush	1,630,979	16.1	364,511	3.6	1,740,922	17.2	6,398,496	63.1	10,134,909	85.0
Total	1,630,979	13.7	1,318,845	11.0	2,425,234	20.3	6,550,664	54.9	11,925,722	100.0
Desert horned lizard										
Sagebrush	0	0.0	956,612	53.0	691,575	38.3	156,862	8.7	1,805,049	15.1
Non-sagebrush	1,632,226	16.1	364,758	3.6	1,742,264	17.2	6,404,489	63.1	10,143,777	84.9
Total	1,632,226	13.7	1,321,370	11.1	2,433,839	20.4	6,561,352	54.9	11,948,786	100.0
Common sagebrush lizard										



Species	Risk category								Total habitat	
	None		Low		Moderate		High			
	Ha	% total	Ha	% total	Ha	% total	Ha	% total	Ha	% total
Sagebrush	0	0.0	2,992,693	41.1	2,731,171	37.6	1,550,359	21.3	7,274,223	34.7
Non-sagebrush	2,188,251	16.0	3,493,651	25.6	2,206,977	16.1	5,776,500	42.3	13,665,379	65.3
Total	2,188,251	10.4	6,486,344	31.0	4,938,148	23.6	7,326,859	35.0	20,939,602	100.0
Swainson's hawk										
Sagebrush	0	0.0	3,188,688	41.1	2,967,683	38.2	1,602,259	20.7	7,758,630	33.1
Non-sagebrush	2,732,858	17.4	3,576,861	22.8	2,459,035	15.7	6,910,261	44.1	15,679,016	66.9
Total	2,732,858	11.7	6,765,549	28.9	5,426,718	23.1	8,512,521	36.3	23,437,646	100.0
Northern harrier										
Sagebrush	0	0.0	3,489,463	42.2	3,137,090	37.9	1,650,061	19.9	8,276,614	39.6
Non-sagebrush	2,696,489	21.3	886,136	7.1	2,062,997	16.3	6,993,359	55.3	12,638,981	60.4
Total	2,696,489	12.9	4,375,599	20.9	5,200,087	24.9	8,643,420	41.3	20,915,596	100.0
Prairie falcon										
Sagebrush	0	0.0	3,489,463	42.2	3,137,096	37.9	1,650,066	19.9	8,276,625	39.9
Non-sagebrush	2,523,139	20.2	886,136	7.1	2,063,017	16.6	6,994,256	56.1	12,466,548	60.1
Total	2,523,139	12.1	4,375,599	21.1	5,200,113	25.1	8,644,322	41.7	20,743,172	100.0
Greater sage-grouse										
Sagebrush	0	0.0	2,604,825	48.4	1,864,997	34.7	910,826	16.9	5,380,649	92.9
Non-sagebrush	8,418	2.1	85,625	20.9	117,291	28.6	198,307	48.4	409,641	7.1
Total	8,418	0.1	2,690,450	46.5	1,982,288	34.2	1,109,133	19.2	5,790,290	100.0
Short-eared owl										
Sagebrush	0	0.0	3,489,463	42.2	3,137,090	37.9	1,650,046	19.9	8,276,599	39.6
Non-sagebrush	2,696,104	21.3	886,136	7.1	2,062,989	16.3	6,992,537	55.3	12,637,766	60.4
Total	2,696,104	12.9	4,375,599	20.9	5,200,079	24.9	8,642,583	41.3	20,914,365	100.0
Western burrowing owl										
Sagebrush	0	0.0	3,489,463	42.2	3,137,090	37.9	1,650,058	19.9	8,276,612	39.9
Non-	2,533,520	20.3	886,136	7.1	2,062,995	16.5	6,993,099	56.1	12,475,750	60.1







Species	Risk category								Total habitat	
	None		Low		Moderate		High			
	Ha	% total	Ha	% total	Ha	% total	Ha	% total	Ha	% total
mouse										
Sagebrush	0	0.0	1,642,341	37.5	1,837,764	41.9	904,354	20.6	4,384,460	35.8
Non-sagebrush	1,326,661	16.8	359,548	4.6	1,492,930	19.0	4,694,515	59.6	7,873,654	64.2
Total	1,326,661	10.8	2,001,890	16.3	3,330,693	27.2	5,598,870	45.7	12,258,114	100.0
Northern grasshopper mouse										
Sagebrush	0	0.0	3,245,008	43.1	2,862,403	38.0	1,421,322	18.9	7,528,733	42.8
Non-sagebrush	1,382,007	13.7	705,836	7.0	1,889,515	18.8	6,091,501	60.5	10,068,858	57.2
Total	1,382,007	7.9	3,950,845	22.4	4,751,918	27.0	7,512,822	42.7	17,597,592	100.0
Sagebrush vole										
Sagebrush	0	0.0	3,488,098	42.2	3,135,431	37.9	1,649,171	19.9	8,272,700	56.5
Non-sagebrush	1,545,737	24.3	3,279,190	51.6	848,700	13.3	688,233	10.8	6,361,860	43.5
Total	1,545,737	10.6	6,767,288	46.2	3,984,131	27.2	2,337,404	16.0	14,634,560	100.0
White-tailed jackrabbit										
Sagebrush	0	0.0	2,216,934	43.5	1,806,512	35.5	1,071,227	21.0	5,094,672	50.5
Non-sagebrush	1,595,638	31.9	2,316,871	46.3	601,202	12.0	488,829	9.8	5,002,540	49.5
Total	1,595,638	15.8	4,533,804	44.9	2,407,714	23.8	1,560,056	15.5	10,097,212	100.0
Pygmy rabbit										
Sagebrush	0	0.0	2,695,106	40.6	2,562,687	38.7	1,375,342	20.7	6,633,135	75.0
Non-sagebrush	1,200,380	54.3	201,459	9.1	263,127	11.9	546,804	24.7	2,211,770	25.0
Total	1,200,380	13.6	2,896,565	32.8	2,825,814	31.9	1,922,146	21.7	8,844,904	100.0

<sup>a</sup>The percentage reported in the row for “sagebrush” is the percentage of the species’ habitat in the Great Basin composed of sagebrush; likewise, the percentage reported in the line “non-sagebrush” is the percentage of habitat in land cover types other than sagebrush.

Table 6.4. Amount of habitat for 40 species of conservation concern within each species' range in Nevada, summarized for sagebrush and non-sagebrush habitats by risk of displacement by cheatgrass. (See [Chapter 4](#) for definitions of risk categories of displacement by cheatgrass.)

Species	Risk category								Total habitat	
	None		Low		Moderate		High		Ha	% total
	Ha	% total	Ha	% total	Ha	% total	Ha	% total		
<b><i>Amphibians</i></b>										
Great Basin spadefoot										
Sagebrush	0	0.0	5,797,765	57.0	2,890,376	28.4	1,482,665	14.6	10,170,806	42.2 <sup>a</sup>
Non-sagebrush	2,942,503	21.2	3,268,480	23.5	2,109,355	15.2	5,582,930	40.1	13,903,267	57.8
Total	2,942,503	12.2	9,066,244	37.7	4,999,731	20.8	7,065,595	29.3	24,074,073	100.0
<b><i>Reptiles</i></b>										
Great Basin collared lizard										
Sagebrush	0	0.0	463,148	57.0	286,640	35.3	62,837	7.7	812,624	7.6
Non-sagebrush	3,889,998	39.2	259,044	2.6	1,218,050	12.3	4,557,182	45.9	9,924,275	92.4
Total	3,889,998	36.3	722,193	6.7	1,504,690	14.0	4,620,019	43.0	10,736,900	100.0
Long-nosed leopard lizard										
Sagebrush	0	0.0	1,566,133	64.6	699,390	28.9	157,261	6.5	2,422,785	18.0
Non-sagebrush	3,750,319	34.0	305,799	2.8	1,546,132	14.0	5,438,263	49.2	11,040,513	82.0
Total	3,750,319	27.8	1,871,933	13.9	2,245,523	16.7	5,595,524	41.6	13,463,298	100.0
Desert horned lizard										
Sagebrush	0	0.0	1,495,422	63.3	705,981	29.9	161,975	6.8	2,363,378	17.6
Non-sagebrush	3,747,565	33.9	305,109	2.8	1,544,881	14.0	5,441,919	49.3	11,039,473	82.4
Total	3,747,565	28.0	1,800,531	13.4	2,250,862	16.8	5,603,893	41.8	13,402,852	100.0
Common sagebrush lizard										



Species	Risk category								Total habitat	
	None		Low		Moderate		High			
	Ha	% total	Ha	% total	Ha	% total	Ha	% total	Ha	% total
Sagebrush	0	0.0	4,856,272	55.9	2,447,916	28.2	1,382,818	15.9	8,687,006	40.5
Non-sagebrush	3,855,430	30.2	2,828,640	22.2	1,664,092	13.0	4,419,642	34.6	12,767,803	59.5
Total	3,855,430	18.0	7,684,911	35.8	4,112,008	19.2	5,802,460	27.0	21,454,809	100.0
Swainson's hawk										
Sagebrush	0	0.0	5,692,925	57.2	2,813,379	28.2	1,450,279	14.6	9,956,582	41.3
Non-sagebrush	3,659,754	25.9	3,069,139	21.7	2,006,447	14.1	5,416,830	38.3	14,152,170	58.7
Total	3,659,754	15.2	8,762,064	36.3	4,819,826	20.0	6,867,109	28.5	24,108,753	100.0
Northern harrier										
Sagebrush	0	0.0	5,799,649	56.9	2,899,711	28.5	1,483,625	14.6	10,182,985	44.1
Non-sagebrush	4,465,029	34.6	896,698	7.0	1,781,685	13.8	5,748,579	44.6	12,891,990	55.9
Total	4,465,029	19.4	6,696,346	29.0	4,681,396	20.3	7,232,204	31.3	23,074,975	100.0
Prairie falcon										
Sagebrush	0	0.0	5,799,649	56.9	2,899,711	28.5	1,483,625	14.6	10,182,985	44.4
Non-sagebrush	4,335,269	34.0	896,698	7.0	1,781,685	14.0	5,748,579	45.0	12,762,230	55.6
Total	4,335,269	18.9	6,696,346	29.2	4,681,396	20.4	7,232,204	31.5	22,945,215	100.0
Greater sage-grouse										
Sagebrush	0	0.0	5,119,696	57.2	2,085,724	29.5	1,055,963	13.3	8,261,384	95.1
Non-sagebrush	12,116	2.8	116,270	27.1	106,422	24.9	193,461	45.2	428,269	4.9
Total	12,116	0.1	5,235,966	60.3	2,192,146	25.2	1,249,424	14.4	8,689,652	100.0
Short-eared owl										
Sagebrush	0	0.0	5,799,649	56.9	2,899,711	28.5	1,483,625	14.6	10,182,985	44.1
Non-sagebrush	4,465,029	34.6	896,698	7.0	1,781,685	13.8	5,748,579	44.6	12,891,990	55.9
Total	4,465,029	19.4	6,696,346	29.0	4,681,396	20.3	7,232,204	31.3	23,074,975	100.0
Western burrowing owl										
Sagebrush	0	0.0	5,799,649	56.9	2,899,711	28.5	1,483,625	14.6	10,182,985	44.4
Non-	4,348,357	34.1	896,698	7.0	1,781,685	13.9	5,748,579	45.0	12,775,318	55.6







Species	Risk category								Total habitat	
	None		Low		Moderate		High			
	Ha	% total	Ha	% total	Ha	% total	Ha	% total	Ha	% total
mouse										
Sagebrush	0	0.0	2,796,943	47.6	2,018,532	34.3	1,066,308	18.1	5,881,783	36.0
Non-sagebrush	3,545,743	33.9	355,436	3.4	1,460,505	14.0	5,095,888	48.7	10,457,572	64.0
Total	3,545,743	21.7	3,152,379	19.3	3,479,037	21.3	6,162,197	37.7	16,339,355	100.0
Northern grasshopper mouse										
Sagebrush	0	0.0	5,607,292	58.6	2,613,918	27.3	1,342,770	14.1	9,563,980	55.9
Non-sagebrush	1,335,759	17.7	575,137	7.6	1,482,654	19.7	4,141,141	55.0	7,534,691	44.1
Total	1,335,759	7.8	6,182,429	36.1	4,096,572	24.0	5,483,911	32.1	17,098,672	100.0
Sagebrush vole										
Sagebrush	0	0.0	5,793,293	57.1	2,876,050	28.3	1,477,434	14.6	10,146,776	65.4
Non-sagebrush	1,902,038	35.4	2,628,846	48.9	523,977	9.7	324,145	6.0	5,379,006	34.6
Total	1,902,038	12.3	8,422,139	54.2	3,400,027	21.9	1,801,579	11.6	15,525,782	100.0
White-tailed jackrabbit										
Sagebrush	0	0.0	4,066,012	59.6	1,720,941	25.2	1,040,280	15.2	6,827,233	65.2
Non-sagebrush	1,146,389	31.4	1,907,609	52.3	373,669	10.3	217,276	6.0	3,644,943	34.8
Total	1,146,389	10.9	5,973,621	57.1	2,094,611	20.0	1,257,556	12.0	10,472,177	100.0
Pygmy rabbit										
Sagebrush	0	0.0	5,034,195	58.9	2,274,797	26.6	1,234,894	14.5	8,543,886	82.7
Non-sagebrush	1,142,205	64.0	228,567	12.8	169,379	9.5	244,248	13.7	1,784,399	17.3
Total	1,142,205	11.0	5,262,761	51.0	2,444,176	23.7	1,479,143	14.3	10,328,285	100.0

<sup>a</sup> The percentage reported in the row for “sagebrush” is the percentage of the species’ habitat in Nevada composed of sagebrush; likewise, the percentage reported in the line “non-sagebrush” is the percentage of habitat in land cover types other than sagebrush.

Table 6.5. Amount of sagebrush habitat at risk of displacement by pinyon-juniper woodlands for 40 species of conservation concern in the Great Basin, encompassing the High Calcareous, Central High, and Bonneville Ecological Provinces in western Utah and eastern Nevada. (See [Chapter 4](#) for definitions of risk categories of displacement by pinyon-juniper.)<sup>a</sup>

Species	Risk category						Total sagebrush habitat	
	Low		Moderate		High		Ha	% Total
	Ha	% total	Ha	% total	Ha	% total		
<b><i>Amphibians</i></b>								
Great Basin spadefoot	2,796,745	60.1	257,868	5.5	1,603,859	34.4	4,658,472	100.0
<b><i>Reptiles</i></b>								
Great Basin collared lizard	110,869	66.5	28,457	17.1	27,378	16.4	166,704	100.0
Long-nosed leopard lizard	613,985	61.8	50,049	5.0	329,792	33.2	993,826	100.0
Desert horned lizard	613,988	61.8	50,052	5.0	329,792	33.2	993,833	100.0
Common sagebrush lizard	2,796,719	60.1	257,861	5.5	1,603,836	34.4	4,658,416	100.0
Desert spiny lizard	128,869	81.6	3,251	2.0	25,880	16.4	158,000	100.0
Nightsnake	2,777,807	60.0	254,155	5.5	1,599,231	34.5	4,631,192	100.0
Striped whipsnake	2,796,766	60.0	257,880	5.6	1,603,863	34.4	4,658,508	100.0
Long-nosed snake	607,466	61.8	45,960	4.7	329,368	33.5	982,794	100.0
Groundsnake	578	86.3	11	1.7	80	12.0	669	100.0
<b><i>Birds</i></b>								
Ferruginous hawk	2,548,845	60.6	228,750	5.4	1,429,050	34.0	4,206,645	100.0
Swainson's hawk	2,796,762	60.0	257,882	5.6	1,603,866	34.4	4,658,510	100.0
Northern harrier	2,796,700	60.0	257,857	5.6	1,603,800	34.4	4,658,357	100.0
Prairie falcon	2,796,715	60.0	257,865	5.6	1,603,806	34.4	4,658,387	100.0
Greater sage-grouse	2,012,847	60.5	173,383	5.2	1,141,214	34.3	3,327,444	100.0
Short-eared owl	2,796,702	60.0	257,857	5.6	1,603,803	34.4	4,658,362	100.0
Western burrowing owl	2,796,701	60.0	257,857	5.6	1,603,803	34.4	4,658,361	100.0
Gray flycatcher	2,182,753	59.5	207,824	5.7	1,274,051	34.8	3,664,628	100.0
Sage thrasher	2,182,678	59.5	207,792	5.7	1,273,987	34.8	3,664,456	100.0
Loggerhead shrike	2,182,730	59.5	207,811	5.7	1,274,034	34.8	3,664,574	100.0
Sage sparrow	2,182,678	59.5	207,791	5.7	1,273,987	34.8	3,664,455	100.0
Black-throated	2,459,147	64.8	74,761	2.0	1,259,266	33.2	3,793,174	100.0

Species	Risk category						Total sagebrush habitat	
	Low		Moderate		High		Ha	% Total
	Ha	% total	Ha	% total	Ha	% total		
sparrow								
Lark sparrow	2,182,783	59.6	207,820	5.7	1,274,077	34.8	3,664,680	100.0
Green-tailed towhee	2,249,325	58.4	224,607	5.8	1,377,559	35.8	3,851,490	100.0
Vesper sparrow	2,667,952	60.0	255,753	5.8	1,522,456	34.2	4,446,161	100.0
Brewer's sparrow	2,796,699	60.1	257,872	5.5	1,603,816	34.4	4,658,387	100.0
Brewer's blackbird	297,536	39.9	136,317	18.3	311,880	41.8	745,733	100.0
<b><i>Mammals</i></b>								
Merriam's shrew	2,796,739	60.1	257,876	5.5	1,603,854	34.4	4,658,470	100.0
Kit fox	2,427,487	64.6	106,398	2.8	1,224,164	32.6	3,758,049	100.0
Pronghorn	1,128,273	58.7	93,380	4.8	701,279	36.5	1,922,932	100.0
Wyoming ground squirrel	111,908	68.7	9,778	6.0	41,240	25.3	162,926	100.0
Chisel-toothed kangaroo rat	523,267	66.7	7,385	1.0	253,629	32.3	784,281	100.0
Ord's kangaroo rat	2,796,745	60.1	257,868	5.5	1,603,852	34.4	4,658,465	100.0
Dark kangaroo mouse	1,731,991	68.4	46,736	1.8	754,528	29.8	2,533,255	100.0
Little pocket mouse	1,134,897	62.3	41,743	2.3	644,917	35.4	1,821,556	100.0
Northern grasshopper mouse	2,709,706	60.2	233,723	5.2	1,560,991	34.6	4,504,420	100.0
Sagebrush vole	2,796,655	60.1	257,863	5.5	1,603,854	34.4	4,658,372	100.0
White-tailed jackrabbit	1,824,374	60.4	185,175	6.1	1,012,037	33.5	3,021,586	100.0
Pygmy rabbit	2,573,400	60.0	246,975	5.7	1,470,361	34.3	4,290,736	100.0

<sup>a</sup> Habitat for Merriam's kangaroo rat does not occur in the three provinces for which the pinyon-juniper risk model was run.

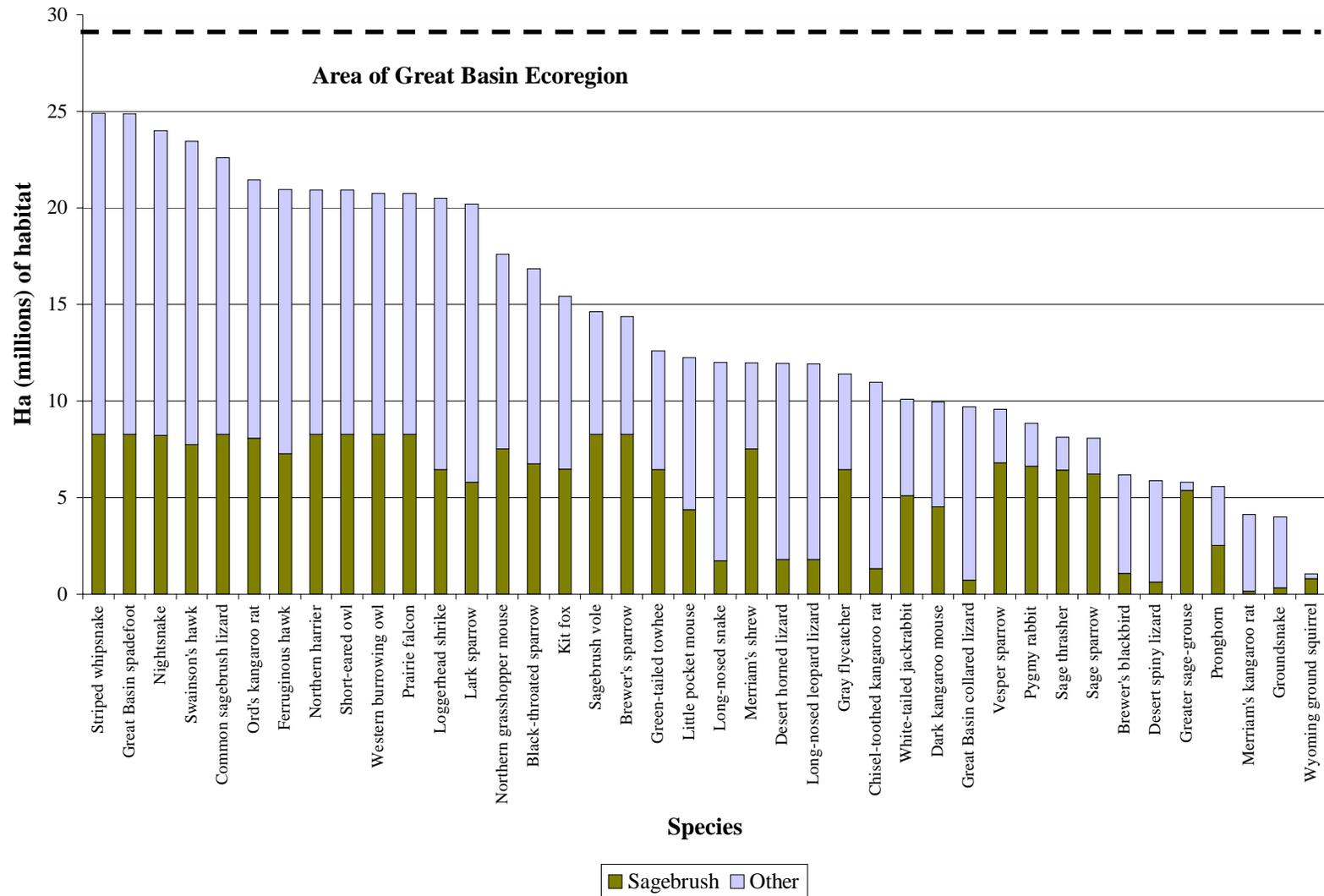


Fig. 6.1. Amount of habitat for 40 species of conservation concern in the Great Basin Ecoregion, in decreasing order of total amount in the ecoregion. Sagebrush habitats are distinguished to highlight differences among species in their association with sagebrush habitats in the ecoregion.

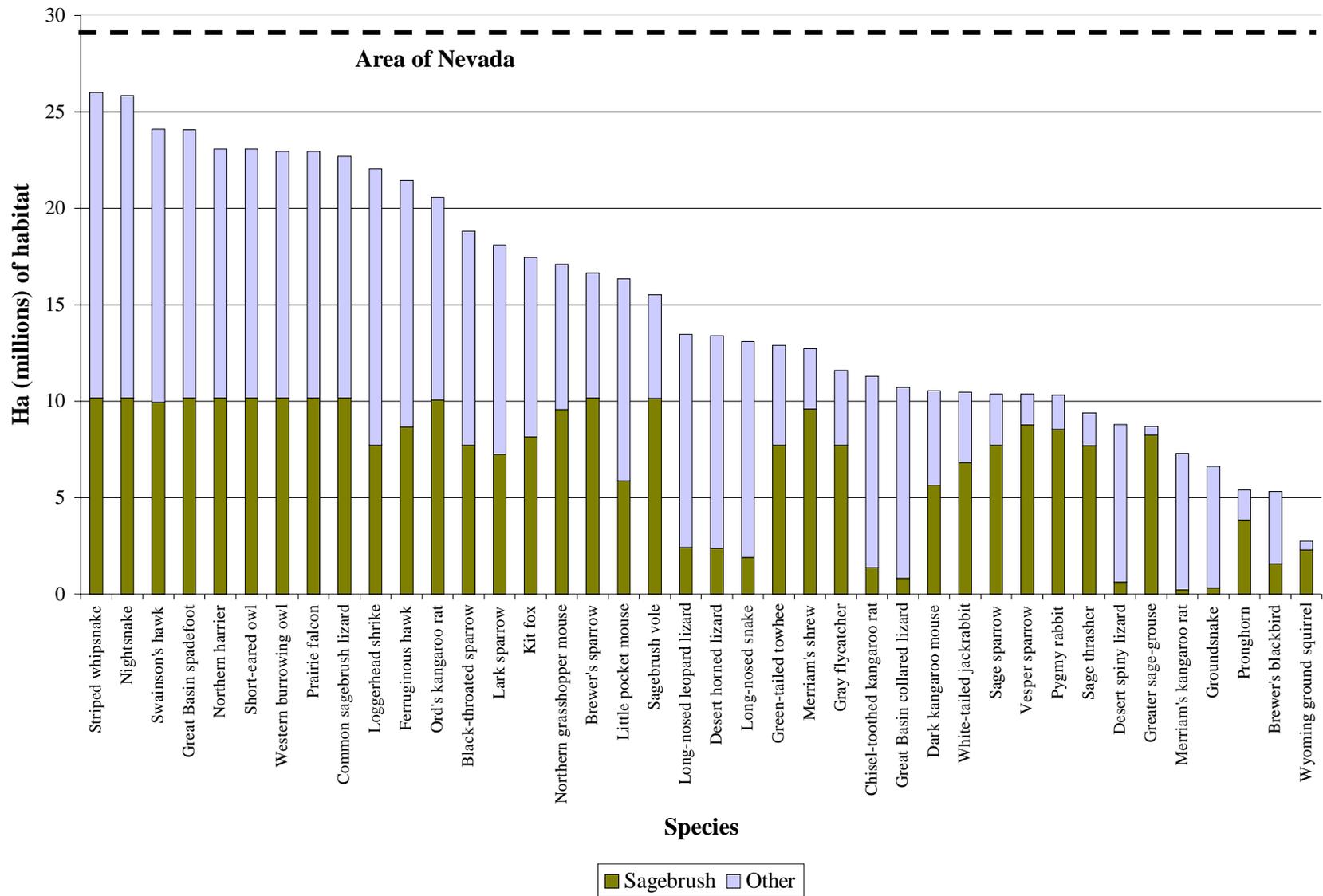


Fig. 6.2. Amount of habitat for 40 species of conservation concern in the State of Nevada, in decreasing order of total amount in the ecoregion. Sagebrush habitats are distinguished to highlight differences among species in their association with sagebrush in the state.

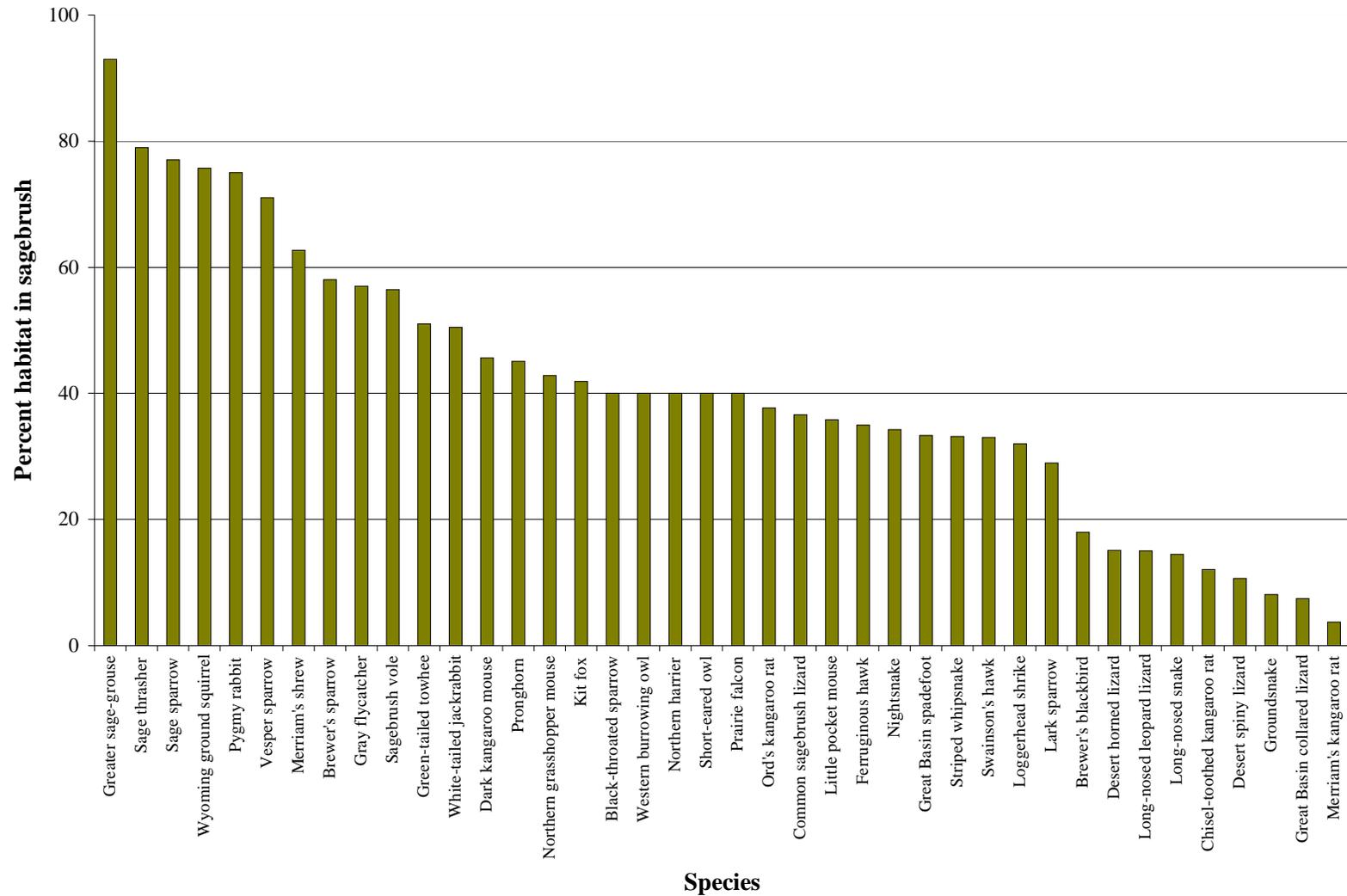


Fig. 6.3. Percentage of total habitat comprised of sagebrush for each of 40 species of conservation concern in the Great Basin Ecoregion.

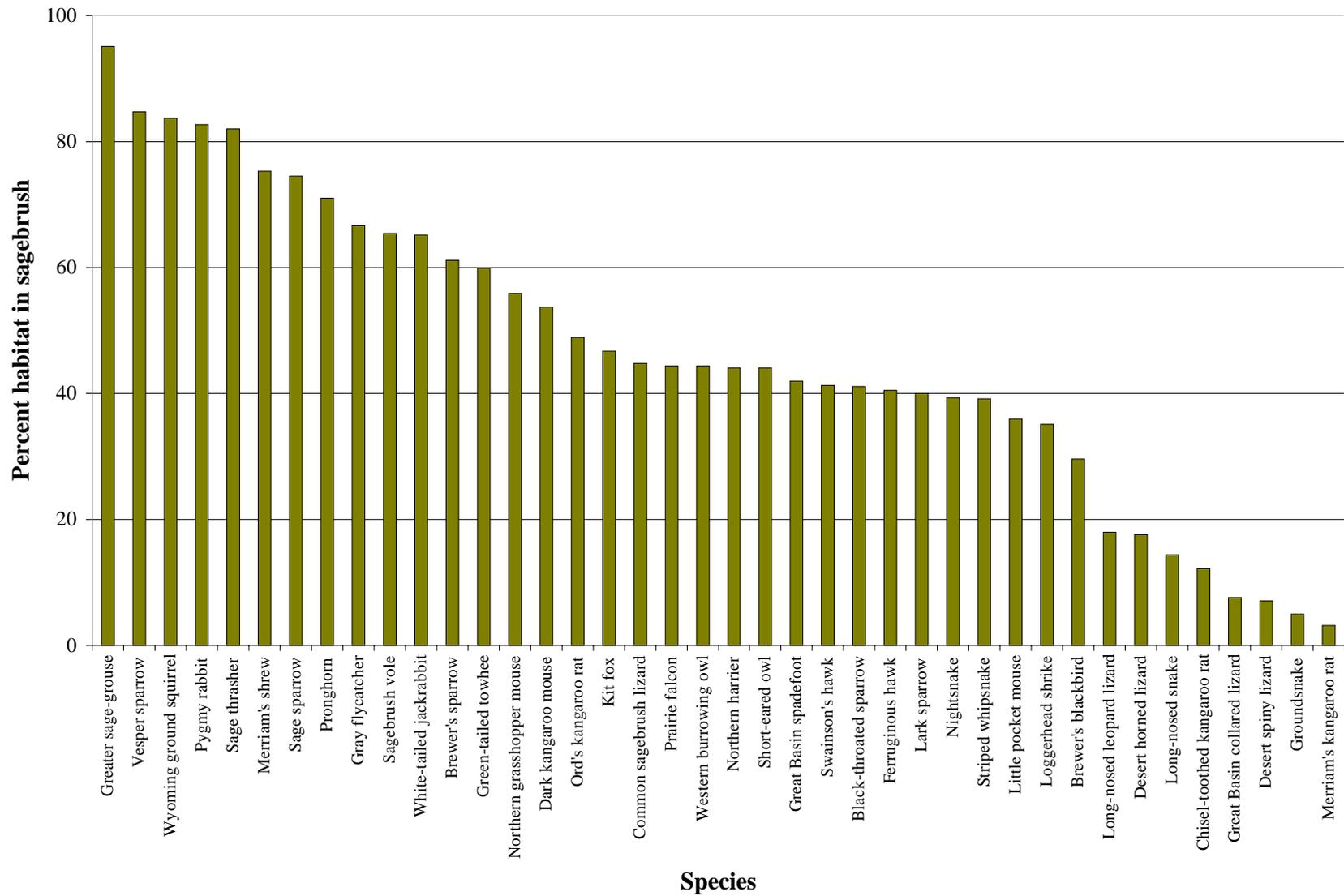


Fig. 6.4. Percentage of total habitat comprised of sagebrush for each of 40 species of conservation concern in Nevada.

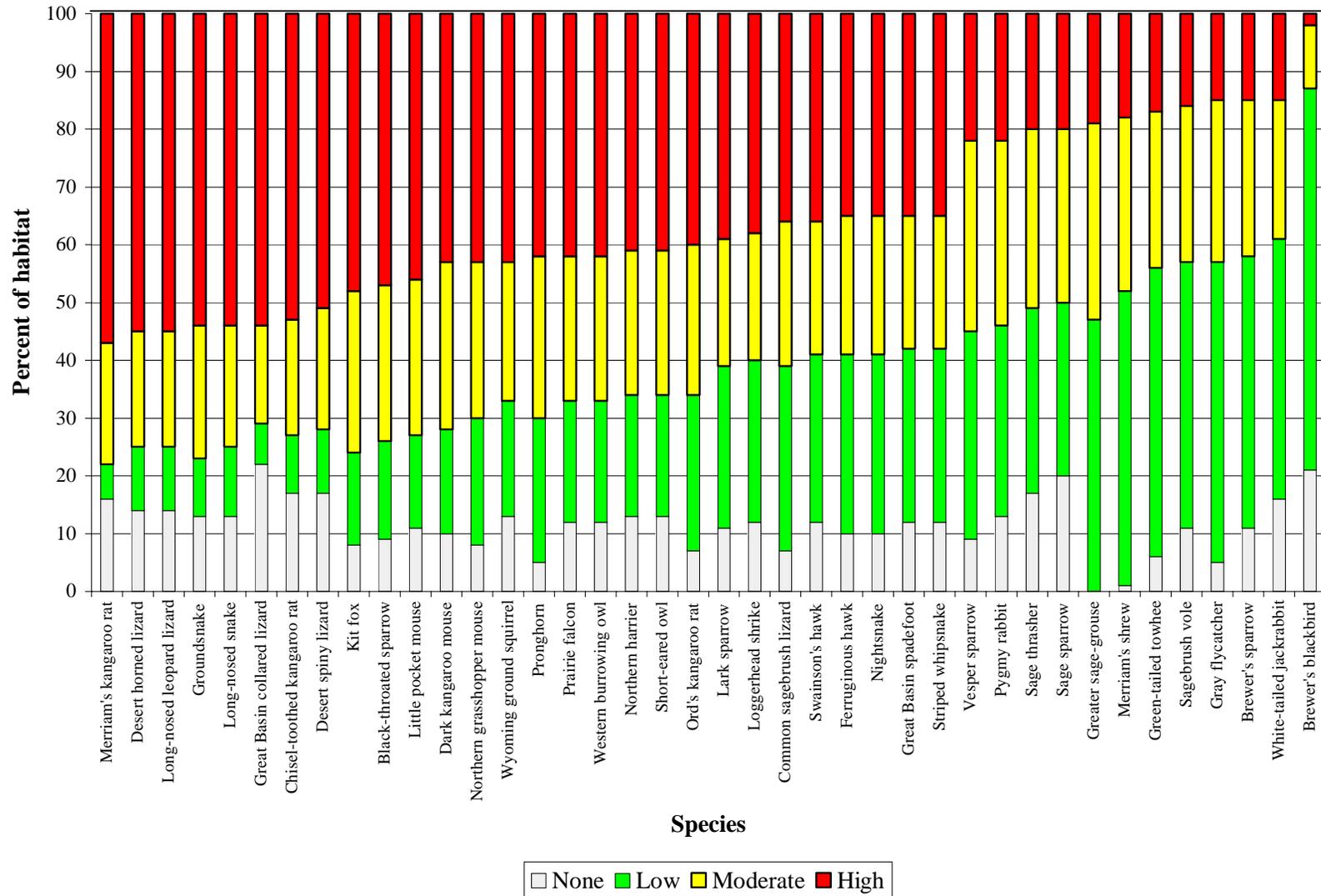


Fig. 6.5. Percentage of habitat at risk of displacement by cheatgrass for 40 species of conservation concern in the Great Basin Ecoregion (see [Chapter 4](#) for definitions of risk categories).

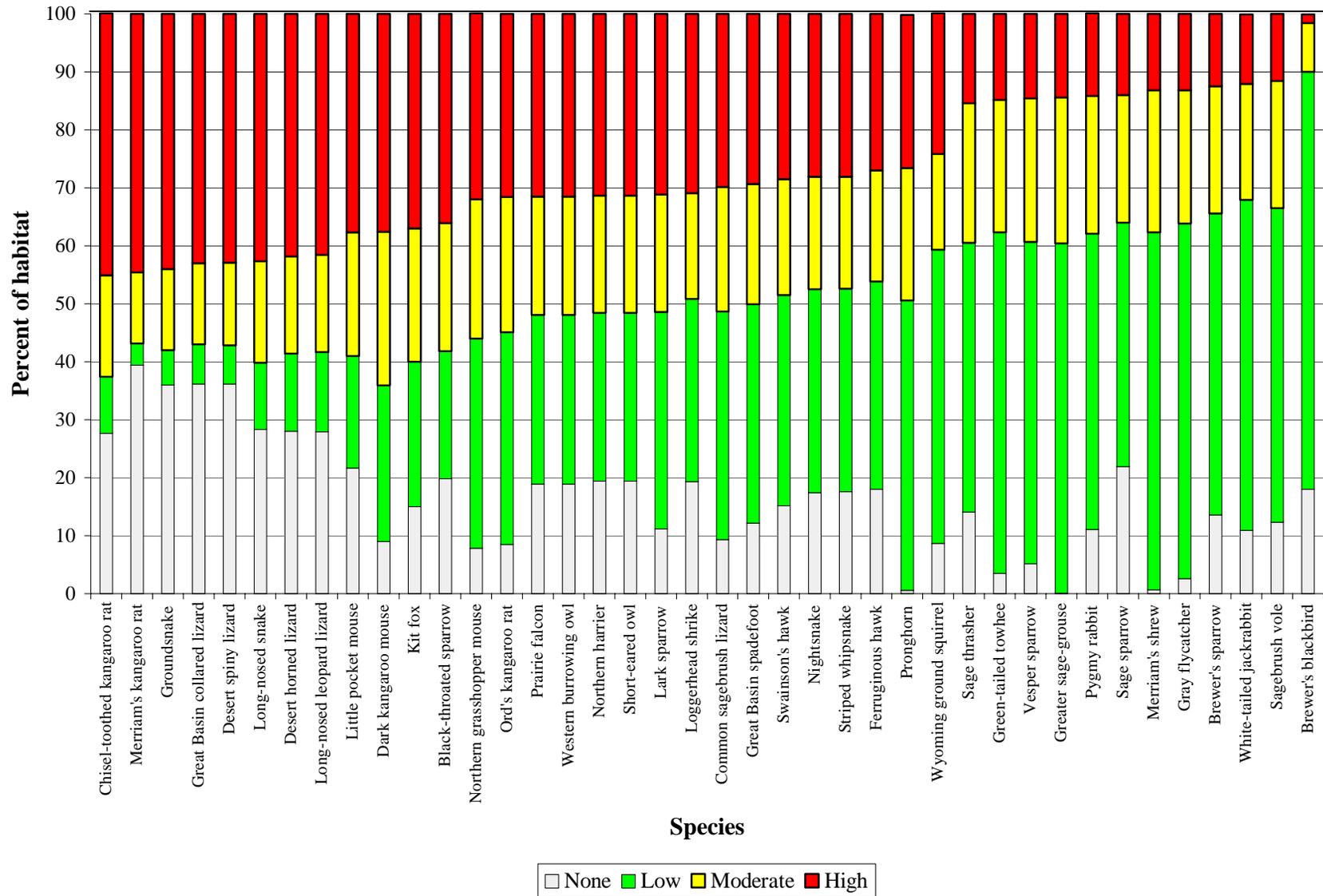


Fig. 6.6. Percentage of habitat at risk of displacement by cheatgrass for 40 species of conservation concern in Nevada (see [Chapter 4](#) for definitions of risk categories).

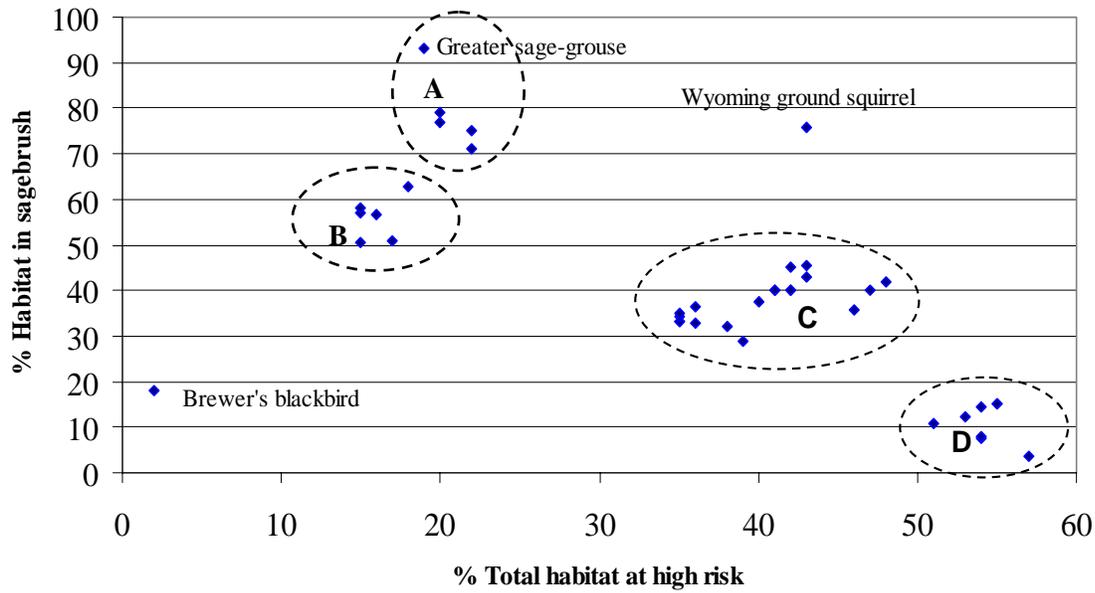


Fig. 6.7. Relation between habitat at risk of displacement by cheatgrass and percent habitat in sagebrush in the Great Basin Ecoregion. Species in Group A are primarily sagebrush-dependent, whereas those in Group B are associated with a mix of sagebrush and pinyon-juniper habitats. Species in Group C are habitat generalists, relying on a broad array of habitats, and species in Group D are strongly associated with salt desert scrub habitats. See [Chapter 6](#) for membership of species in each of the 4 clusters, and [Chapter 4](#) for definition of high risk.)

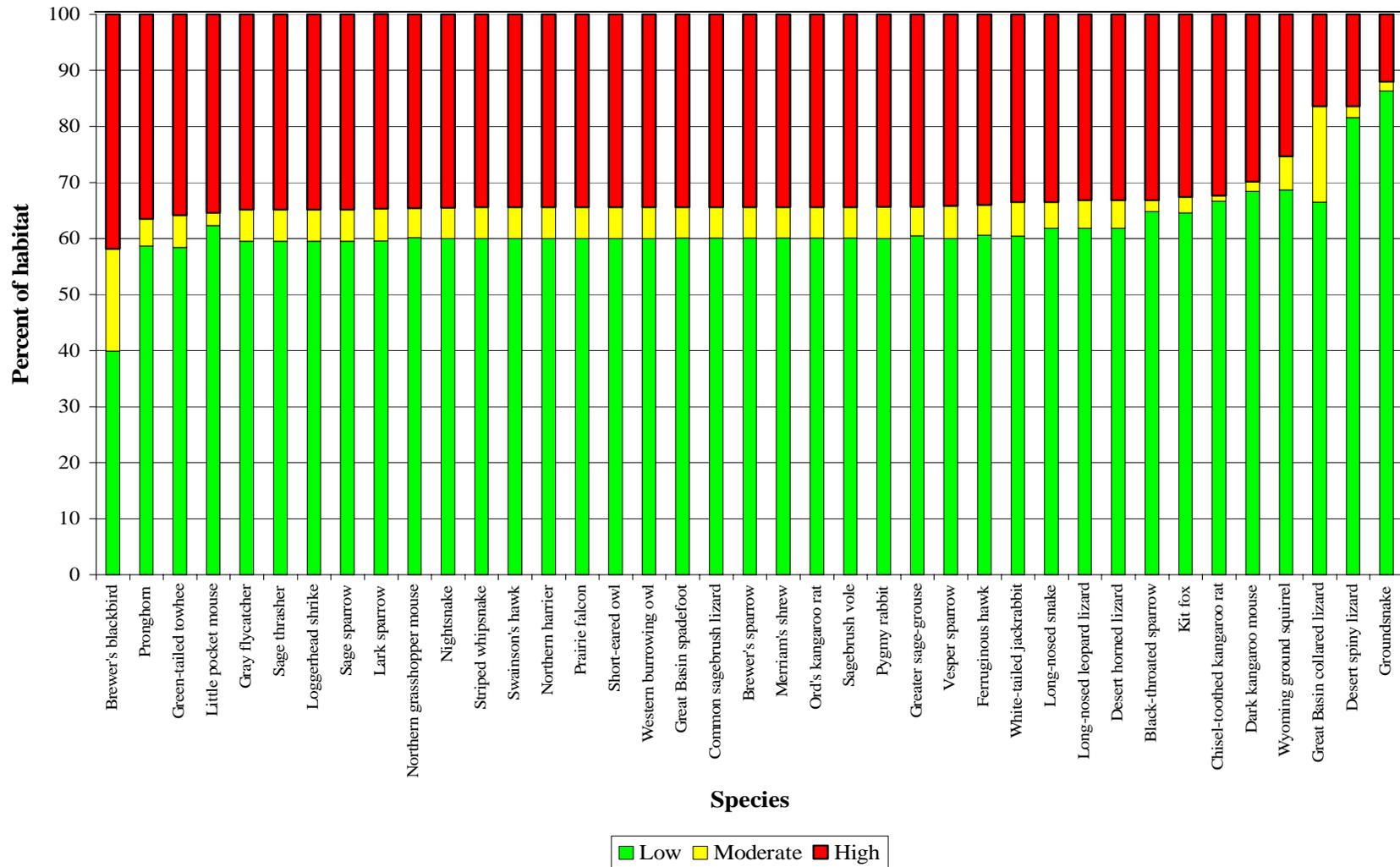


Fig. 6.8. Percentage of habitat at risk of displacement by pinyon-juniper woodlands for 39 species of conservation concern within the Central High, High Calcareous, and Bonneville Ecological Provinces in eastern Nevada and western Utah (see [Chapter 4](#) for definitions of risk categories).