

Chapter 10 : CONCLUSIONS AND MANAGEMENT IMPLICATIONS

In this chapter, we summarize the major conclusions from our work and describe the associated management implications. The major point of each conclusion is presented in bold text, followed by supporting details and implications. Conclusions and implications follow the order of Chapters 3 - 8, and thus are not arranged by priority. Instead, we consider all conclusions and implications described below to be equally relevant to managers of native habitats for species of conservation concern in Nevada and the Great Basin Ecoregion (Great Basin). Consequently, our list is comprehensive. Literature and findings in support of our conclusions and implications can be found in [Chapters 3 - 8](#).

Vegetation in Nevada and the Great Basin ([Chapter 3](#))

3.1 Conclusion.—Vegetation in Nevada and the Great Basin is dominated by a combination of salt desert scrub, sagebrush, and pinyon-juniper cover types. Salt desert scrub was the single most abundant cover type at both spatial extents in our assessment. Nonetheless, the sagebrush and pinyon-juniper plant communities also occupy a substantial proportion of land in the Great Basin and Nevada.

Implications.—Land managers in Nevada and the Great Basin are confronted with a diverse mix of native shrublands and woodlands that are challenging to understand and manage. Little is known about the ecological relationships and responses of salt desert scrub communities to fire and exotic plant invasions. By contrast, management and research has focused on sagebrush and pinyon-juniper communities. Increased management focus and research on the mosaic of salt desert scrub, sagebrush, and pinyon-juniper communities is warranted, given the combined dominance of these cover types in the Great Basin. Moreover, there is a compelling need for increased recognition of, and management emphasis on, the vast complex of salt desert scrub communities in the Great Basin.

3.2 Conclusion.—The number and size of wildfires across the Great Basin and Nevada have increased dramatically in the last 20 yrs, and that trend continues (see [Fig. 3.1](#)). Large portions of the areas burned since the early 1990s previously supported sagebrush or salt desert scrub communities; many of these cover types were not adapted to frequent, high-intensity fires and have been converted to cheatgrass.

Implications.—Management of all cover types of sagebrush and salt desert scrub needs to consider and address the changing role of wildfire. Reducing the spread of cheatgrass in these native shrublands, through mitigation of pervasive human disturbances that facilitate its spread, is probably the most important consideration in reducing the frequency, intensity, and area of associated, undesirable wildfires (see additional conclusions and implications below for mitigation of cheatgrass risk).

Vegetation at Risk (Chapter 4)

4.1 *Conclusion.*—**A substantial area of existing sagebrush (>1.7 million ha) in the eastern Great Basin is at high risk to displacement by pinyon-juniper woodlands over the next 30 yrs.**

Sagebrush cover types at high risk from displacement by pinyon-juniper encompass 35% of the sagebrush included in the High Calcareous, Central High, and Bonneville ecological provinces in the eastern Great Basin. Mountain big sagebrush was predicted to be the sagebrush cover type most susceptible to displacement by pinyon-juniper woodlands.

Implications.—The substantial area of sagebrush habitats at high risk to displacement by pinyon-juniper woodlands deserves immediate management attention. Retention of existing sagebrush in these stands, with the use of prescribed fire or mechanical treatments to reduce density and biomass of pinyon-juniper, is likely to be more effective and efficient than attempts to restore sagebrush habitats already lost to pinyon-juniper.

Reducing the threat posed by pinyon-juniper to mountain big sagebrush is likely to be effective with an aggressive program of prescribed burning. Other sagebrush cover types at high risk to pinyon-juniper may not respond as well to burning; in these situations, mechanical control of pinyon-juniper may be needed to mitigate threat of sagebrush loss. Additional field research is needed to validate our estimates of risk that pinyon-juniper woodlands will displace existing sagebrush in the Great Basin and in Nevada.

4.2 *Conclusion.*—**Almost 60% of the existing sagebrush (>2.8 million ha) in the eastern Great Basin is at low risk to displacement by pinyon-juniper woodlands.**

Implications.—Sagebrush habitats at low risk to displacement by pinyon-juniper are likely to function as habitat strongholds (i.e., to support ideal amounts, quality, and arrangement of habitats) for sagebrush-associated species in the future, assuming these habitats also are at low risk to displacement by cheatgrass. Protection of these low-risk habitats from pervasive disturbance factors (e.g., energy developments, inappropriate grazing) is essential in maintaining these habitats as functional environments for species of concern.

4.3 *Conclusion.*—**Nearly 6 million ha of the salt desert scrub cover type, or about 80% of this cover type in the ecoregion, and ≥1.5 million ha of existing sagebrush (20%) are at high risk of displacement by cheatgrass in the Great Basin during the next 30 yrs.**

Implications.—The substantial area of salt desert scrub and sagebrush habitats at high risk to future displacement by cheatgrass presents a daunting management challenge. Understories of these stands are likely to be dominated by cheatgrass at the current time. Consequently, any fires occurring in these stands would facilitate further conversion to cheatgrass. Fire suppression, when feasible, is desirable but would be a stop-gap, short-term mitigation. In the long term, the use of chemical or other treatments to reduce biomass of cheatgrass in understories of these stands is needed, combined with reseeding of native grasses and forbs. These treatments are expected to prevent conversion of salt desert scrub and sagebrush habitats to cheatgrass.

Once these native shrublands are converted to cheatgrass, it may be difficult or impossible to restore them. In sagebrush habitats, management treatments to mitigate the high risk of cheatgrass displacement would require less area to be treated compared to salt desert scrub, due to the smaller area of sagebrush at high risk. Additional field research is needed to

validate our estimates of risk that cheatgrass will displace existing sagebrush, salt desert scrub, and other susceptible cover types in the Great Basin and Nevada.

4.4 Conclusion.—Over 2 million ha of salt desert scrub and approximately 3 million ha of sagebrush are at moderate risk to future displacement by cheatgrass.

Implications.—As with shrublands at high risk of displacement by cheatgrass, the vast area of salt desert scrub and sagebrush habitats at moderate risk of loss from cheatgrass also presents a daunting management challenge. However, management to mitigate or reduce a moderate risk of displacement by cheatgrass may have a substantially higher chance of success than efforts to treat areas at high risk.

Understories of stands at moderate risk are likely to have cheatgrass present in varying amounts, in combination with native grasses and forbs. Such stands may be sensitive to inappropriate grazing by domestic and wild ungulates, which would result in the eventual reduction or elimination of native grasses and forbs, thereby conveying competitive advantage to cheatgrass. In such cases, stocking rates and grazing systems for domestic ungulates, as well as management regimes for wild ungulates, should be designed to allow native plants to successfully compete with cheatgrass.

If cheatgrass dominates the understory in these stands, any subsequent fire will further enhance the spread and dominance of cheatgrass across the landscape. Fire should not be considered the cause of the cheatgrass problem, but rather the resulting process that follows pervasive disturbances (e.g., road construction and use, inappropriate grazing, energy development, mining, recreational activities). Consequently, prudent management of pervasive disturbance agents in areas at moderate risk to cheatgrass displacement is an important factor in maintaining these areas as habitats for species of conservation concern.

4.5 Conclusion.—Sagebrush cover types presently at low risk of displacement by cheatgrass cover 3.5 and 5.7 million ha in the Great Basin and Nevada, respectively, or >40% of existing sagebrush.

Implications.—Sagebrush cover types at low risk of displacement by cheatgrass are likely to be more resilient to disturbances associated with fire and grazing, and current management practices in relation to fire and grazing management may not increase this low risk. Such cover types are likely to be maintained in the future with current methods of managing vegetation. Moreover, frequent fire (i.e., 5-15 yrs) is an important component of mountain sagebrush habitats, and these habitats are mostly at low risk to cheatgrass. Consequently, extensive use of prescribed fire to maintain the health of low-risk stands is an important management consideration. Sagebrush cover types at low risk of displacement by cheatgrass are likely to function as habitat strongholds for the associated species of concern in the future. In that context, protection of these low-risk habitats from pervasive human disturbances, such as mining, energy, powerline, and road developments, is essential in maintaining these habitats as functional environments for many species of concern. Consequently, mitigation of these additional threats, beyond the risks posed by cheatgrass, will be important in maintaining these resilient habitats.

4.6 Conclusion.—Over 3.7 million ha of the salt desert scrub cover type is at low risk of displacement by cheatgrass. These low-risk areas encompass vast expanses of the Great Basin

and Nevada, but are much less abundant than the salt desert scrub at moderate or high risk of loss from cheatgrass.

Implications.—Salt desert scrub habitats at low risk of displacement by cheatgrass are likely to serve as habitat strongholds in the future for associated species of concern. However, these salt desert scrub habitats may not be as resilient to management practices as sagebrush habitats at low risk to cheatgrass. Knowledge of how salt desert scrub communities respond to disturbances such as fire, grazing, and road development is less certain, even for habitats at low risk to cheatgrass. In that context, protection of these low-risk salt desert scrub habitats from pervasive human disturbances, such as mining, energy, powerline, inappropriate grazing, and road developments, is perhaps even more critical in maintaining these habitats as functional environments for species of concern than is protection of sagebrush habitats. Consequently, mitigation of these additional threats, beyond the risks posed by cheatgrass, will be important in maintaining persistence of these low-risk habitats.

Species of Conservation Concern ([Chapter 5](#))

5.1 Conclusion.—Sagebrush-associated species of conservation concern in the Great Basin include 133 plants, 11 invertebrates, and 63 vertebrates; 40 of the vertebrate species were appropriate for our regional assessment, whereas the remaining species are appropriate for local assessment.

Implications.—The combination of a high number of plant species of concern and their lack of suitability for regional assessment illustrates the compelling need for local assessments to estimate and monitor habitat and population status and trends for these species. Moreover, invertebrates are understudied and may be most vulnerable to population declines (see [Chapter 5](#)). Consequently, plants and animals of concern beyond the 40 that we included in our regional assessment deserve attention through local assessments and subsequent management.

5.2 Conclusion.—The 40 vertebrate species of conservation concern identified for our regional assessment include 1 amphibian, 9 reptiles, 17 birds, and 13 mammals, each widely distributed within the Great Basin and Nevada.

Implications.—Identification of all species of concern is essential for comprehensive planning and management of associated habitats, to ensure that the needs of species most at risk are addressed in land management strategies developed at regional scales. Our list of 40 vertebrates of concern far exceeds the few high-profile species, such as pygmy rabbit and greater sage-grouse, that often receive attention in management and research in sagebrush ecosystems. Many of these additional species of concern also have large ranges that encompass all or a large portion of the Great Basin and Nevada. Consequently, a comprehensive management approach would help address conservation needs of these 40 species at regional scales that encompass areas far beyond typical management jurisdictions (e.g., BLM District or Field Office, National Forest).

Habitats for Species of Concern (Chapter 6)

6.1 Conclusion.—Although our assessment focused on sagebrush-associated species of conservation concern, the strength of that association varied widely among species, based on each species' use of sagebrush cover types as habitat and the absolute amount of habitat composed of sagebrush. Species in our assessment used a broad array of cover types as habitat, with 16 species using at least half of the 42 cover types that occur in the Great Basin. In addition, nearly half ($n = 19$) of the species were associated with all 8 sagebrush cover types present in the ecoregion; some species, such as greater sage-grouse, Wyoming ground squirrel, and pygmy rabbit, were strongly associated with sagebrush cover types. Although all species in our assessment used at least 1 sagebrush cover type as habitat, the percentage of total habitat composed of sagebrush was less than 50% for most species.

Implications.—If habitat needs for species of concern are to be addressed adequately in the Great Basin, land managers must consider the entire complex of native shrubland and woodland habitats on which these species depend. That is, management focused solely on sagebrush habitats will not fully address the needs of most sagebrush-associated species of concern in the Great Basin and Nevada, with the exception of sagebrush obligates such as greater sage-grouse and pygmy rabbit. Consequently, explicit consideration of the composite habitat needs of all 40 vertebrates of concern is needed.

6.2 Conclusion.—Thirty-three of the 40 species of concern in the Great Basin had >50% of their total habitat (i.e., sagebrush and other types combined) at moderate or high risk of displacement by cheatgrass. Among all 40 species, the mean percentage of habitat at high risk from cheatgrass in the ecoregion was 36%, followed by low risk (27%), moderate risk (25%), and no risk (12%).

Implications.—Habitats at moderate to high risk to cheatgrass must be managed specifically to mitigate or reduce the probability of widespread loss of these habitats for species of concern. The implications discussed above for Chapter 4 apply here. Without concerted efforts to conserve existing native habitats of sagebrush and other shrublands, through a combination of passive and active management, it is possible that many of the species of concern assessed here may experience regional extirpations within the Great Basin and Nevada.

6.3 Conclusion.—Species whose habitats are most at risk from cheatgrass were those strongly associated with salt desert scrub. Species more closely associated with sagebrush habitats face substantially lower risk of habitat loss from cheatgrass.

Implications.—The species of concern most strongly associated with salt desert scrub deserve immediate conservation and management attention to prevent substantial losses of populations and habitats in the near future. Moreover, species associated with a complex of salt desert scrub and sagebrush habitats also deserve management attention, owing to the abundance of habitat at high risk of loss from cheatgrass. Nonetheless, species associated more exclusively with sagebrush habitats also deserve management attention, owing to the substantial area of their habitats at high risk to displacement by cheatgrass. However, such species have a lower percentage of their habitat at high risk to cheatgrass displacement than do other species in our assessment.

Management implications discussed earlier for salt desert scrub and sagebrush cover types at high risk to cheatgrass apply to species with high habitat risk from cheatgrass. See implications discussed above for conclusions from [Chapter 4](#).

6.4 Conclusion.—On average, 25% of the habitat for species in our assessment was at moderate risk to displacement by cheatgrass; these habitats may be the most critical for management.

Implications.—Understories of stands at moderate risk are likely to have cheatgrass present in varying amounts, in combination with native grasses and forbs. Such stands may be sensitive to inappropriate grazing by domestic and wild ungulates, which could result in the eventual reduction or elimination of native grasses and forbs, thereby conveying competitive advantage to cheatgrass. (See implications for [Chapter 4](#) above.) Consequently, prudent management of pervasive disturbance agents in areas at moderate risk to cheatgrass displacement is an important factor in maintaining these areas as habitats for species of conservation concern.

It is likely that moderate-risk areas would benefit most from a combination of passive and active management (e.g., changes in livestock management, prescribed burning, seeding) designed to convey a competitive advantage to native grasses and forbs over cheatgrass. Alternatively, continuation of management practices that act as spatially-pervasive disturbances (e.g., road construction, inappropriate grazing) may cause these areas to transition to high risk, and eventually convert to homogeneous stands of cheatgrass. Consequently, management focused on habitats moderate risk from cheatgrass appears to be a critical and prudent investment for species of conservation concern.

6.5 Conclusion.—Approximately 35% of the sagebrush habitat for species in our assessment was predicted to be at high risk of loss from displacement by pinyon-juniper woodlands.

Implications.—The substantial proportion of sagebrush habitats at high risk to displacement by pinyon-juniper woodlands deserves immediate management attention. Retention of existing sagebrush in these stands, with the use of prescribed fire or mechanical treatments to reduce density and biomass of pinyon-juniper, is likely to be more effective and efficient than attempts to restore sagebrush habitats already lost to pinyon-juniper.

Management focus on stands that currently exist as pinyon-juniper is problematic, in that some of these stands existed before European settlement, while other stands have encroached and replaced sagebrush more recently. Many species of concern in the Great Basin, including some in our assessment, have strong associations with pinyon-juniper. Consequently, management focused on preventing or curtailing further conversions of sagebrush to pinyon-juniper, rather than attempting to restore sagebrush habitats already lost to pinyon-juniper, appears prudent and cost-effective.

6.6 Conclusion.—Potential conflicts may occur regarding appropriate ways to address the dual threats of cheatgrass and pinyon-juniper in some sagebrush habitats. In certain areas, sagebrush habitats are threatened by both pinyon-juniper encroachment from higher elevations (i.e., sites above the sagebrush stands) and cheatgrass invasion from lower elevations.

Implications.—Integrated management of both threats is needed to conserve sagebrush habitats affected by both cheatgrass and pinyon-juniper expansion. For example, prescribed burning of some sagebrush habitat may curtail pinyon-juniper encroachment, but also may

enhance the expansion of cheatgrass on sites where this invasive species is already present. Alternatively, combinations of mechanical treatments to reduce pinyon-juniper density, followed by chemical treatments to reduce cheatgrass, may effectively reduce the combined risks posed by both cheatgrass and pinyon-juniper woodlands.

Habitats for Groups of Species (Chapter 7)

7.1 Conclusion.—Each of the 5 groups of species identified for our assessment (sagebrush, salt desert scrub, shrubland, sagebrush-woodland, and generalist) had distinctive associations with cover types in the Great Basin. The sagebrush and salt desert scrub species groups were associated primarily with sagebrush or salt desert scrub cover types, respectively. By contrast, the shrubland group was associated with a mosaic of both sagebrush and salt desert scrub types, while the sagebrush-woodland group was associated with a mosaic of sagebrush and pinyon-juniper. Moreover, the generalist group was associated with a combination of sagebrush and a myriad of other cover types that occur in Nevada and the Great Basin.

Implications.—The differences in habitat characteristics associated with each of the 5 groups of species suggested that the 5 groups met our objective to generalize the broad habitat patterns represented by the 40 species of conservation concern. Use of species groups may be an efficient way to design management strategies to benefit the underlying 40 species of concern.

7.2 Conclusion.—Habitat abundance, habitat risk, and composite conditions of abundance and risk varied widely by species group and watershed across Nevada and the Great Basin. In general, the salt desert scrub and sagebrush groups had less abundant habitats, whereas the salt desert scrub and shrubland groups had the habitats at highest risk.

Implications.—Different combinations of habitat abundance and habitat risk across watersheds result in different implications for conservation and restoration. Watersheds with relatively more habitat and lower risk may represent habitat strongholds for a group of species; such habitats are likely to persist in the future, given adequate protection from other risk factors (e.g., energy development).

Similarly, watersheds with comparatively less habitat and higher risk may be substantially sub-optimal or degraded in relation to a group's requirements. Sub-optimal or degraded habitats in a watershed likely would have the following habitat characteristics: smaller patch size, lower quality, and lower connectivity in relation to the requirements of the group. These points suggest that regional strategies could be developed for watersheds in each condition to identify appropriate conservation and restoration prescriptions needed to meet management goals for each group of species.

Greater Sage-grouse as an Umbrella Species (Chapter 8)

8.1 Conclusion.—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 protection under the umbrella concept. Overlap of species' ranges, habitat associations, habitat amount, and habitat at risk within the range and habitats of greater sage-grouse in the

Great Basin was generally low (typically <50%). Species in the sagebrush group had the greatest overlap with sage-grouse, based on the criteria we used.

Implications.—Greater sage-grouse does not appear suitable as an umbrella species for most of the other species of conservation concern in the Great Basin, largely because of the typically low (<50%) overlap between species' ranges and habitats with those of sage-grouse in the ecoregion. Thus, management directed at sage-grouse within its current range in the Great Basin will not address about half of the habitat for most species of concern in our assessment.

In place of the umbrella species concept, management for groups of species, or similar approaches, may provide a more comprehensive and efficient way to account for the needs of the 40 species that we evaluated in our assessment. Any management direction based on groups of species, however, requires management verification that the assumed benefits associated with management extend to all individual species within each group (see Chapter 7). Management verification is needed to demonstrate that the use of species groups is an efficient way to manage and benefit individual species in a given watershed in which the regional management direction is to be applied.

8.2 Conclusion—Species with the lowest overlap of habitat characteristics with those of greater sage-grouse were species in the salt desert scrub group. Low overlap with sage-grouse habitat characteristics also was observed for species in the shrubland and generalist groups.

Implications.—Our assessment addressed species of concern that were associated, in varying degrees, with sagebrush habitats. Within this context, it is critical to understand that management of sagebrush habitats will only partially address the needs of many of these species in the Great Basin. That is, to conserve and restore habitats effectively for a large number of the 40 species we assessed, it is not enough to simply manage sagebrush habitats. Other habitats, many of which are at high risk to displacement by cheatgrass, also require high priority for beneficial management change. This is especially true for species using salt desert scrub habitats.

8.3 Conclusion.—There exists a large disparity in scale between the size of areas occupied by individual sage-grouse and sage-grouse populations and those of many other sagebrush-associated species.

Implications.—Given the large differences in average home range sizes and seasonal ranges of sage-grouse versus many other species, especially herptiles, declining trends in sage-grouse populations may not be apparent until populations of other species of concern have undergone far more drastic declines. Thus, management of species of concern in sagebrush ecosystems must include careful monitoring of population trends for species beyond sage-grouse.