Figure 75—Ranges of species in group 25 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

breeding area, whereas some do not migrate at all (Squires and Reynolds 1997). The degree to which goshawks migrate during winter may relate to prey availability. In the Yukon Territory in winter, goshawk-numbers fluctuate with snowshoe hare numbers (Doyle and Smith 1994). Some goshawks may travel short distances in winter to lower elevations or more open habitats (Squires and Reynolds 1997), and migrations may consist of predominately immature birds (Sibley 1993).

Source habitats are found in old forest and unmanaged young forests in montane, lower montane, and riparian woodland community groups and chokecherry-serviceberry-rose (vol. 3, appendix 1, table 1). Also, contrary to summer source habitats, winter source habitats include all of the upland woodland types.

Important attributes of goshawk prey habitat include snags, downed logs, woody debris, large trees, openings, herbaceous and shrubby understories, and an intermixture of various forest structural stages (Reynolds and others 1992).

Broad-scale changes in source habitats—Goshawk winter source habitats were projected to be broadly distributed, primarily throughout the forested areas of the basin, in historical times (fig. 76A). Source habitats are still widely available, although more disjunct in many areas, and there has been an increase in habitats in some areas that provided little or no source habitats historically (fig. 76B).

Trends in source habitat availability differed geographically (fig. 76C). Most areas with strong negative trends were in the northeast portion of the basin, within the Northern Glaciated Mountains, Lower Clark Fork, and Upper Clark Fork ERUs, where habitat loss was generally greater than 90 percent (figs. 76C and 77; vol. 3, appendix 1, table 3). A preponderance of watersheds in the Northern Cascades, Blue Mountains, Snake Headwaters, and Central Idaho Mountains ERUs had moderate and strong negative trends (fig. 77). The most significant gains in source habitats occurred in the Upper Klamath and Northern Great Basin ERUs (fig. 77). About 50 percent of the watersheds in the Columbia Plateau, Owyhee Uplands,

Figure 76—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 25 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

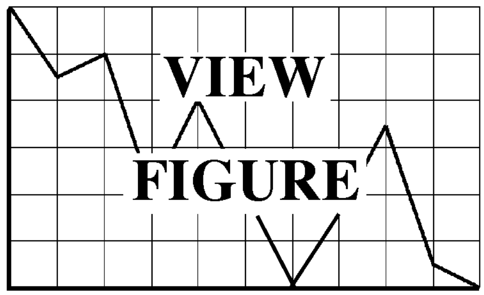

Figure 77—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 25, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of >20 percent but <60 percent; and -2 = a decrease of >60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

and Upper Snake ERUs also experienced strongly increasing trends (fig. 77). Trends in source habitats in the Southern Cascades showed a slight decrease (fig. 77).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—In areas with negative trends, projected declines occurred in nearly all source habitats, though predominately in the old-forest types (vol. 3, appendix 1, table 4). Some old-forest types increased in the Southern Cascades, Upper Klamath, and Blue Mountains ERUs. Further elaboration of the changes in old forest for the goshawk is found in the results for group 5, which includes goshawk (summer).

Large increases in juniper/sagebrush in the Upper Klamath, Northern Great Basin, Columbia Plateau, Blue Mountains, Upper Snake, and Snake Headwaters ERUs contributed to much of the increases in these ERUs or parts of these ERUs (fig. 77; vol. 3, appendix 1, table 4). Areas with increasing trends in source habitats correspond closely with the increases in upland woodlands as shown in map 3.58 in Hann and others (1997).

Other factors affecting the group—Little is known about population dynamics of goshawks, though it is thought that food availability may play an important role (Squires and Reynolds 1997). Goshawks prey primarily on relatively large-bodied mammals and birds, including tree squirrels, ground squirrels, lagomorphs, galliformes, corvids, piciforms, and passerines. Several studies have documented a positive relation of prey abundance with nest success (Doyle and Smith 1994, Linden and Wikman 1983, Ward and Kennedy 1996). Important components of habitat for many of the prey species listed above are snags, downed logs, woody debris, openings, large trees, herbaceous and shrubby understories, and interspersion of different vegetation structural stages (Reynolds and others 1992). In many areas in the basin, fire suppression, timber harvesting, and livestock grazing have resulted in a decrease in many of the attributes listed above as important characteristics of prey habitat for goshawks (Hann and others 1997).

Some evidence indicates that diet composition may change drastically during the nonbreeding season in Sweden, but winter food habits are unknown in North American populations (Squires and Reynolds 1987, Widen 1987).

Effects of falconry, shooting, and trapping of goshawks in North America are thought to be minimal (Squires and Reynolds 1987).

Human disturbance at nest sites can cause failure, but there is no information on the effects of human activities during the nonbreeding or winter season (Anon. 1989, Boal and Mannan 1994, Speiser 1992, Squires and Reynolds 1987).

Population status and trend—The BBS data for the goshawk were insufficient to determine population trends for the basin (Saab and Rich 1997) or for any state or physiographic region within the basin (Sauer and others 1996), because of low detection of goshawks by using the BBS survey method. Sufficient data, however, were available for western North America to indicate a stable trend in numbers between the years 1966 and 1995 (Sauer and others 1996).

A separate trend estimate was derived from fall migration counts conducted by Hawkwatch International at four locations in Utah and New Mexico. These data indicated an average rate of decline in migrating goshawks of about 4 percent annually between 1977 and 1991 (Hoffman and others 1992). The extent to which the migration data represented local declines near the survey stations was not determined.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 25 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Conservation issues for goshawk winter habitat, based on results of our analysis of source habitats in combination with empirical literature, include the following:

1. Reduction in the amount of old forests in the montane, lower montane, and riparian woodland community groups.

2. Possibly unsustainable conditions of old forests where there have been large transitions from shade-intolerant to shade-tolerant tree species. This issue stems from the exclusion of fire from many forested communities, which has resulted in increased susceptibility to stand-replacing fires (USDAForest Service 1996).

3. Loss of important attributes of prey habitat, including large trees, snags, downed logs, forest openings, and herbaceous and shrubby understories because of fire suppression, timber harvesting, and livestock grazing.

Potential strategies—Potential strategies that would be effective for maintaining source habitats for wintering goshawks within the basin are as follows:

1. (To address issues no. 1 and no. 2) Especially in the northern areas of the basin, promote greater diversity in forest structure at the landscape scale. Mid-seral stages currently predominate and do not provide source habitats. Maintain stands with active goshawk nests in old-forest condition, and identify opportunities to increase the representation of old forests in individual watersheds.

2. (To address issue no. 2) Reduce the risk of loss of habitat by focusing old-forest retention and restoration efforts on areas with low probability of stand-replacing fires. In ERUs where old-forest habitat has remained stable or increased from historical conditions, efforts could be focused on retaining existing habitat in areas with lower fire and insect risk while managing other areas to reduce risks of catastrophic loss of habitat.

3. (To address issues no. 1 and no. 3) Throughout the basin, provide for an abundant and sustainable prey base for goshawks by increasing the abundance of large trees, snags, downed logs, forest openings, and herbaceous and shrubby understories across the landscape.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) In the northern basin, identify representative stands of old forests for retention, and mid-successional stages for development into old-forest conditions. Priority should be given to large blocks having high interior-to-edge ratios and few large openings.

2. (In support of strategies no. 1 and no. 3) Actively recruit snags and logs from green trees to increase the representation of old-forest structures (snags and logs) in mid-seral stands and in old forests where snags and logs are in low density or absent.

3. (In support of strategy no. 2 and no. 3) Thin small-diameter trees, either through hand equipment or prescribed burns, to reduce fuel loading and increase herbaceous and shrubby understories for prey habitat and improve growth of overstory trees.

Group 26—Yuma Myotis, Long-Eared Myotis, Fringed Myotis, and Long-Legged Myotis

Results

Species ranges, source habitats, and special habitat features—Group 26 is comprised of four species of bats: the Yuma myotis, long-eared myotis, fringed myotis, and long-legged myotis. All four species are year-round residents of the basin, active from spring through fall and hibernating during winter. The species in group 26 are similar in their use of a broad range of forest and woodland habitats for foraging.

The ranges of the long-legged myotis and long-eared myotis encompass the entire basin (fig. 78). The Yuma myotis occurs across most of the basin except for an area in the southeast portion (fig. 78). The fringed myotis occurs in the western half of the basin and in the Upper Clark Fork ERU (fig. 78).

Source habitats shared by all members of group 26 are all cover types in the montane, lower montane, riparian woodland, and upland woodland community groups, and the mountain hemlock cover type in the subalpine community group (vol. 3, appendix 1, table 1). The long-eared myotis ranges somewhat higher than the other species and uses whitebark pine, whitebark pine-alpine larch, and Engelmann spruce-subalpine fir as source habitats. Source habitats for the

Figure 78—Ranges of species in group 26 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Yuma myotis and long-eared myotis extend into big sagebrush, mountain big sagebrush, and low sage cover types (vol. 3, appendix 1, table 1).

The long-eared and fringed myotis forage primarily by hover-gleaning insects off of foliage (Barclay 1991, Nagorsen and Brigham 1993, Perkins 1996). The long-eared myotis consumes moths, beetles, and other insects (Whitaker and others 1977, 1981), and the fringed myotis consumes mostly beetles (Black 1974, cited in O'Farrell and Studier 1980). Surveys based on bat vocalizations indicate that in forested habitats, foraging is highest in clearcuts and mature stands, and low in precommercially thinned and young, unthinned stands (Erickson and West 1996). The Yuma myotis is primarily found in association with rivers, lakes, ponds, and streams, where it forages over water and eats midges and emergent aquatic insects (Whitaker and others 1977).

Several special habitat features were identified for group 26 (vol. 3, appendix 1, table 2). Large-diameter (>53 cm [21 in]) snags with exfoliating bark provide maternity roosts for the long-legged myotis (Nagorsen and Brigham 1993, Ormsbee and McComb 1998, Rabe and others 1998), the fringed myotis (Chung-MacCoubrey 1996, Rabe and others 1998), and the long-eared myotis (Chung-MacCoubrey 1996, Rabe and others 1998). Caves, mines, and buildings provide maternity roosts for the fringed myotis, Yuma myotis, and long-eared myotis (Christy and West 1993, Nagorsen and Brigham 1993). Caves and mines also are used as hibernacula by all four species (Nagorsen and Brigham 1993). Various structures are used for day and night roosts, including exfoliating bark, rock crevices, mines, caves, and buildings (Manning and Knox-Jones 1989, Nagorsen and Brigham 1993, O'Farrell and Studier 1980). Ormsbee and McComb (1998) found that snags extending above the canopy were most frequently used by long-legged myotis for day roosts.

Rabe and others (1998) suggested that snag-roosting bats may require higher densities of snags than cavity-nesting birds, because the stage at which snags are suitable for bat roosts (exfoliating bark) is extremely short lived, requiring the use of several snags over the course of a lifetime of a bat. Bats frequently shift maternity roosts, possibly to find snags with better thermal conditions when the bark on the previous roost is no longer suitable (Rabe and others 1998).

The presence of water is considered a special habitat feature for the Yuma myotis because it forages mostly by flying low over water (permanent or seasonal) and feeding on emerging aquatic insects (Whitaker and others 1977). Although less dependent on water, long-legged myotis (Ormsbee and McComb 1998) and long-eared myotis (Ports and Bradley 1996) forage over or near water, and the fringed myotis frequently forages over thickets along streams (Nagorsen and Brigham 1993). In shrubland habitats, nearby riparian woodlands may provide the only available roost sites. Thus, all species in group 26 have a strong association with water and riparian vegetation.

Broad-scale changes in source habitats—When the need for suitable roost sites is ignored, few changes have occurred in the extent of source habitats between historical and current periods (figs. 79A, B). Declining trends were most pronounced in the northern half of the Columbia Plateau and in the Upper Snake ERU, and increasing trends occurred mostly in the southern half of the Columbia Plateau, and in a few watersheds of the Northern Glaciated Mountains, Upper Klamath, Central Idaho Mountains, and Snake Headwaters ERUs (fig. 79C). Neutral trends in habitat extent were found in 59 percent of watersheds within the basin, and neutral trends predominated in all 13 ERUs (fig. 80). In most ERUs, the number of watersheds with increasing trends exceeded those with declining trends (fig. 80).

Interpreting Results

Composition and structure associated with changes in source habitats—Neutral trends in habitat extent reflect the ability of species in group 26 to use a wide variety of cover types and nearly all structural stages of forests as source habitats. The basin has experienced dramatic declines in old-forest structural stages of all forest cover types (Hann and others 1997; vol. 3, appendix 1, table 4). For group 26, however, these losses have been offset by increases in mid-seral stages that also serve as source habitats, as long as suitable roost sites are available.

Declines in the northern portion of the Columbia Plateau, the southern portion of the Central Idaho Mountains, and portions of the Owyhee Uplands and Upper Snake ERUs are due to losses of big sagebrush and mountain big sagebrush to agriculture (Hann and others 1997). Increases in the Northern Glaciated

Figure 79—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 26 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

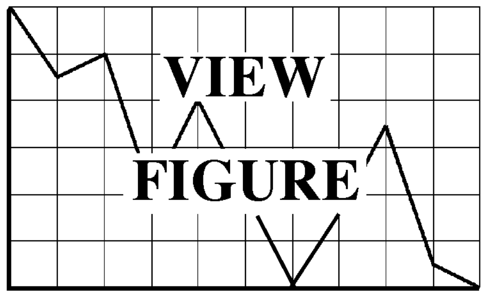

Figure 80—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 26, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

Mountains are due primarily to areal increases in managed young forests of interior Douglas-fir and interior ponderosa pine (vol. 3, appendix 1, table 4). Increases in the Central Idaho Mountains are due primarily to areal increases in managed young forests and understory reinitiation stages of several forest cover types, including Engelmann spruce-subalpine fir, interior Douglas-fir, grand fir-white fir, lodgepole pine, and western larch (vol. 3, appendix 1, table 4).

Within the riparian woodlands community group, old forests had strongly declining trends throughout the basin (vol. 3, appendix 1, table 4) and generally remain only in stands smaller than the 1-km^2 (0.4-mi^2) mapping unit used in this analysis. These losses occurred from changes in historical hydrologic regimes: reservoirs have eliminated many aspen and cottonwood-willow stands, a lowered water table has reduced others, and loss of periodic flooding has prevented establishment of seedlings (Merigliano 1996, Rood and Heinze-Milne 1989).

Condition of special habitat features—The number of caves has not changed significantly from historical to current times, but human disturbance from recreation has increased, causing some caves to be less available to hibernating bats. Mines proliferated in the early part of the historical period and provided additional habitat, but during the 1980s, thousands of abandoned mines throughout the West were closed with no input from biologists, thereby resulting in unknown loss of established roosts (Idaho State Conservation Effort 1995). The extent of cliffs and rocky areas has not changed since the historical period, but habitat quality of some cliffs has declined because of human disturbances (Lehmkuhl and others 1997).

Large-diameter snags >53 cm (21 in) have been reduced basin-wide in roaded areas with a history of timber sales (Hann and others 1997, Hessburg and others 1999, Quigley and others 1996). Consequently, the neutral trends in source habitats for the long-legged myotis may give a more positive assessment of habitat availability than is actually the case.

In addition to riparian woodlands large enough to map at the broad scale, smaller patches of riparian vegetation have declined in extent basin-wide, because of disruption of hydrologic regimes from dams, water diversions, and road construction, along with grazing and trampling of riparian vegetation by livestock and increased recreational use along stream courses (USDA Forest Service 1996). These fine-scale changes have caused additional declines in bat foraging habitat and potential roost sites.

Other factors affecting the group—Roost availability has greatly influenced the distribution of all Nearctic bat species (Humphrey 1975), and the conservation of group 26 bats is largely dependent on maintaining suitable roost sites. The most straightforward source of impact is destruction of the structure, that is, loss of snags through timber harvests, and removal of old buildings and bridges or closure of mines and caves for safety reasons (Perlmeter 1995, Pierson and others 1991). Perkins and Peterson (1997) attributed the low detection of bats in the Owyhee Mountains to the lack of suitable roosts, particularly in the form of cottonwood and juniper snags.

The second source of impact is disturbance of roosting bats, primarily by recreational activities in or near caves but also from mining, road construction, road access and any other activities near roosts (Pierson and others 1991). During winter, rising out of torpor requires a large caloric output, and repeated disturbances can drain the energy reserves of a bat and lead to starvation (Nagorsen and Brigham 1993). Recreational use of caves during the hibernation and nursery periods seriously affects persistence of individual colonies if disturbances are frequent (Nagorsen and Brigham 1993).

The third source of impacts at roost sites is purposeful killing of bats. Because of their high visibility at colonial roosts, bats have suffered high mortality rates; total loss of colonies has occurred from shooting by individuals who often are guided by negative folklore regarding bats (Nagorsen and Brigham 1993). Destruction of a single colony may represent a significant impact across large areas because of the patchy distribution of bats related to roost availability.

Roads may indirectly affect bat species by increasing human access to roost sites. Caves have become more accessible, thereby increasing the amount of human visitation and potential harassment of bats. The presence of roads increases the likelihood that snags will be cut for safety concerns or fuel wood (see Hann and others 1997). The additional loss of snags in areas where snag densities are currently low could limit populations of group 26 species.

Direct contact with pesticides can cause illness or death in bats. Although most organochlorine pesticides that cause accumulation of chemicals up the food chain have been banned or highly restricted in the United States, the relatively short-lived organophospates can provide high risks during application (Clark 1988). For example, a large die-off of bats observed in Arizona after application of methyl parathion was believed to be linked to direct contact with this chemical (Clark 1988).

Population status and trends—There are insufficient population data on any species in group 26 to determine population trends. In general, however, bats in the basin are believed to be declining because of increased human disturbance of roosts, declining snag densities, decrease of late-seral lower montane and montane forests, decreased acreage and quality of riparian areas, pesticide use, direct killing, and decreases in water quality (Lehmkuhl and others 1997).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 26 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Our results, combined with literature and other empirical information, suggest that the following issues are important for group 26:

1. Basin-wide loss of large-diameter snags (>53 cm [21 in]) for the long-legged myotis maternity roosts and day roosts.

2. Destruction of roosts, disturbance of roosting bats, or both.

3. Degradation and loss of native riparian vegetation.

4. Impacts of pesticides on bats and their prey.

5. Lack of information on hibernacula, including locations, special features, and numbers of bats associated with them.

6. Lack of population trend data.

Potential strategies—The following strategies could be used to maintain and improve habitat for these bat species:

1. (To address issue no. 1) Actively manage for the retention and recruitment of large-diameter snags in all forest cover types and structural stages.

2. (To address issue no. 2) Protect all roosts and reduce human disturbances near roosts.

3. (To address issue no. 3) Maintain and improve the condition of riparian and wetland vegetation for bat foraging areas.

4. (To address issue no. 4) Alleviate impacts of pesticides on bat populations.

5. (To address issues no. 5 and no. 6) In cooperation with other state, Federal, and tribal agencies, establish a coordinated approach to search for hibernacula, and to protect these sites.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Retain existing snags, particularly if >53 cm (21 in) and provide measures for snag replacement. Review existing snag guidelines or develop guidelines that reflect local ecological conditions and address snag numbers, diameter, height, decay class, species, and distribution. Retain snags in clusters to provide adjacent roosts for maternity colonies. Maintain snags at higher than historical levels to restore loss in previously harvested areas (ICBEMP 1996d).

2. (In support of strategy no. 1) Emphasize retention of snags that provide best solar exposure to bark or cavity roost sites (Betts 1996).

3. (In support of strategy no. 1) Reduce road densities in managed forests where snags are currently in low abundance. Close roads after timber harvests and other management activities, and minimize the period when such roads are open to minimize removal of snags along roads. In addition or as an alternative to road management, actively enforce fuel wood regulations to minimize removal of snags.

4. (In support of strategy no. 1) Restrict fuel wood permits to disallow snag cutting where snags are in low abundance, and particularly where existing roads cannot be closed. Blair and others (1995) recommend that public fuel wood harvest should be limited to trees <38 cm (15 in) d.b.h.

5. (In support of strategy no. 2) Monitor known roosts for potential human disturbances, and initiate closures of recreational or construction activity near roost sites.

6. (In support of strategy no. 2) If possible, stabilize old structures that are important for maternity roosts and hibernacula.

7. (In support of strategy no. 2) Survey caves, mines, and abandoned buildings before removal or closure, and protect roosting bats from human presence and disturbance. During closures, use specialized gates designed to allow continued use of mines and caves by bats (Pierson and others 1991).

8. (In support of strategy no. 2) Assure that construction of roads and rights-of-way are not going to cause siltation, slumping, or water run-off to enter cave habitats or alter other roosting structures (Perkins 1992-1994).

9. (In support of strategy no. 3) Identify areas of existing riparian and wetland habitats that are important bat foraging areas, and design conservation measures to protect and enhance foraging opportunities for bats.

10. (In support of strategy no. 3) Modify grazing practices to improve condition of degraded riparian areas for bat foraging and roosting.

11. (In support of strategy no. 3) Restore degraded areas by appropriate mechanical treatments and with seedings of appropriate native species.

12. (In support of strategy no. 4) Avoid pesticide use in areas of high bat foraging activity or near nursery colonies.

13. (In support of strategy no. 5) Use existing interagency cooperative agreements, or develop agreements where needed to conduct surveys for hibernacula.

14. (In support of strategy no. 5) Use individual project planning (such as timber sales, road construction, mineral extraction, or recreational development) as opportunities for conducting surveys for new roost sites and to assess population status of known roosts.

Group 27—Pine Siskin and Townsend’s Big-Eared Bat

Results

Species ranges, source habitats, and special habitat features—Group 27 includes the pine siskin and the Townsend’s big-eared bat, both of which are year-round residents of the basin. The pine siskin occurs throughout the basin except for low-elevation, non-forested areas, and the Townsend’s big-eared bat is found basin-wide (fig. 81).

Both species are forest generalists within the subalpine, montane, upland woodland, and riparian woodland community groups. Most cover types within these community groups are source habitats for both species, but Engelmann spruce-subalpine fir is considered source habitat for only the pine siskin, whereas aspen is used only by the big-eared bat. Source habitat for both species was considered to be in all structural stages except the stem-exclusion and stand-initiation stages (vol. 3, appendix 1, table 1). Source habitats for the big-eared bat also include several cover types within the upland shrubland, upland herbland, and riparian shrubland community groups (vol. 3, appendix 1, table 1).

No special habitat features were identified for the pine siskin. Breeding takes place in various conifer species, including ornamentals, and foraging occurs in trees, shrubs, and grassy areas (Dawson 1997). Diet consists primarily of small seeds from annual plants, conifers, and deciduous trees (Dawson 1997). Pine siskin populations are highly irruptive on a continental scale, causing local abundance or scarcity of siskins from one year to the next, apparently in response to food availability (Bock and Lepthien 1976, Dawson 1997).

The Townsend’s big-eared bat is colonial in its use of caves and cavelike structures for nursery colonies, day roosts, and hibernacula (Idaho State Conservation Effort 1995, Nagorsen and Brigham 1993; vol. 3,

Figure 81—Ranges of species in group 27 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

appendix 1, table 2). Big-eared bats do not roost in crevices like many other bat species but rather restrict their roosting sites to the ceilings of cavelike structures (caves, mines, and buildings), where they aggregate in large colonies. A stable, cold temperature and moderate airflow may be important criteria for hibernation (Genter 1986, Humphrey and Kunz 1976). The distribution of big-eared bats is patchy across the basin because of their restrictive roosting requirements.

The big-eared bat is a moth specialist (Idaho State Conservation Effort 1995; Nagorsen and Brigham 1993; Whitaker and others 1977, 1981). In central Oregon, they forage in sagebrush, bitterbrush, and open ponderosa pine forests (Dobkin and others 1995).

Broad-scale changes in source habitats—Source habitats were widespread across the basin historically, with greatest concentrations in the mountains of the Northern Cascades, Southern Cascades, Upper Klamath, Blue Mountains, Northern Glaciated Mountains, Upper Snake, and Snake Headwaters ERUs (fig. 82A). Extensive shrubland and grassland habitats suitable only for the big-eared bat occurred in the Columbia Plateau, Northern Great Basin, and Owyhee Uplands. The current extent of habitat is similar to the historical distribution (fig. 82B), although the abundance of habitat has changed in some areas. Watersheds with declining trends were primarily in the northern half of the Columbia Plateau, the Upper Snake, and Snake Headwaters ERUs (figs. 82C and 83). Watersheds with increasing trends were mostly in the Upper Klamath, Blue Mountains, Northern Glaciated Mountains, and Central Idaho Mountains (figs. 82C and 83). Basin-wide, the number of watersheds with declining, increasing, or static trends was nearly equal, representing 34, 34, and 31 percent of watersheds, respectively (fig. 83).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Mixed trends in habitat extent reflect the association of both species in group 27 with several cover types and nearly all structural stages of forests as source habitats. The basin has experienced dramatic declines in old-forest structural stages of all forest cover types (Hann and others 1997; vol. 3, appendix 1, table 4), but for group 27, these losses have been offset by increases in mid-seral stages that also serve as source habitats. Increases in the areal extent of habitats in the Upper Klamath were due to transitions from the fescue-bunchgrass cover type to mixed-conifer woodlands and an areal increase in the extent of interior Douglas-fir, historically less than 2 percent, but currently 15 percent of the ERU (Hann and others 1997). In the Blue Mountains, Northern Glaciated Mountains, and Central Idaho Mountains, increasing trends were largely due to increases in the areal extent of grand fir-white fir. Engelmann spruce-subalpine fir increased in the Central Idaho Mountains as well (Hann and others 1997; vol. 3, appendix 1, table 4).

Static trends in nonforested habitats are partially due to transitions from big sagebrush to juniper/sagebrush and juniper woodlands (Hann and others 1997), which have resulted in no net change in source habitats for the big-eared bat. Declines have occurred in the northern portion of the Columbia Plateau because of transitions from big sagebrush to agriculture (Hann and others 1997).

Condition of special habitat features—The number of caves likely has stayed the same from historical to present periods, but human disturbance from recreation has increased, thereby causing some caves to be abandoned by big-eared bats (Idaho State Conservation Effort 1995). Mines proliferated in the early part of the historical period and provided additional habitat, but during the 1980s, thousands of abandoned mines throughout the West were closed with no input from biologists, thereby resulting in unknown loss of established roosts (Idaho State Conservation Effort 1995).

Other factors affecting the group—Pine siskin foraging behavior, geographic location, and population levels are highly influenced by the combination of current population level and food availability—an abundance of seeds will cause the population to expand, and if the next year's crop is unable to support the expanded population, the birds will move elsewhere (Bock and Lepthien 1976).

Because the distribution of Townsend's big-eared bats is dependent on specialized roosting requirements, alterations and disturbances of any structures used for day roosts, nursery colonies, or hibernacula (caves, mines, old buildings) could affect the persistence of individual colonies. The most straightforward

Figure 82—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 27 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

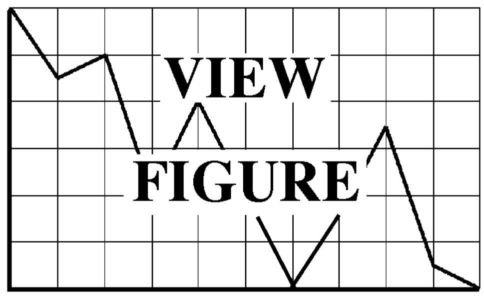

Figure 83—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 27, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

source of impact is destruction of the structure, that is, removal of old buildings or closure of mines and caves for safety reasons (Pierson and others 1991).

The second source of impact is disturbance of roosting bats, primarily by recreational activities in or near caves but also from mining, road construction, and any other activities near roosts (Idaho State Conservation Effort 1995). Females at nursery colonies are alert and readily take flight if disturbed (Perkins and Schommer 1992), and frequent interruptions are known to result in abandonment of the roost site (Idaho State Conservation Effort 1995, Nagorsen and Brigham 1993). During winter, rising out of torpor requires a large caloric output, and repeated disturbances can drain the energy reserves of a bat and lead to starvation (Nagorsen and Brigham 1993). Recreational use of caves during the hibernation and nursery periods seriously affects persistence of individual colonies if disturbances are frequent (Idaho State Conservation Effort 1995, Nagorsen and Brigham 1993).

The third source of impacts at roost sites is purposeful killing of roosting bats (Idaho State Conservation Effort 1995). Because of their high visibility at colonial roosts, big-eared bats have suffered high mortality rates and sometimes total loss of a colony from shooting by individuals who often are guided by negative folklore (Nagorsen and Brigham 1993). Destruction of a single colony may represent a significant impact on big-eared bats across large areas because of the patchy distribution of bats related to roost availability.

The big-eared bat is negatively affected by the presence of roads. Increased road networks have made caves more accessible and have increased the amount of human visitation and potential harassment.

Because the big-eared bat is insectivorous, use of insecticides in foraging areas has the potential to impact bat species, primarily by reducing the prey base. For example, forest spraying for tussock and spruce budworm moths, although targeted at the larval stage of these insects, ultimately affects the number of flying adults and can cause a sufficient reduction in the prey base to suppress a year or two of Townsend’s bat reproduction (Perkins and Schommer 1992). Also, exposure to insecticides can directly affect the health of bats. Although most organochlorine pesticides that cause accumulation of chemicals up the food chain have been banned in the United States or their use highly restricted, the relatively short-lived organophospates can cause illness or death to bats during application (Clark 1988).

Population status and trends—Population trends for the pine siskin are difficult to obtain because the irruptive tendencies of this species result in highly variable annual numbers at any given locale (Dawson 1997). The BBS data show no significant population trends in most states, Canadian provinces, or BBS physiographic regions because of wide fluctuations in numbers or insufficient routes to determine a trend (Sauer and others 1996). Two areas with significant annual declines from 1966 to 1995, however, have been reported, which reflect possible population trends in the basin: an annual decline of 4.5 percent (n = 52, $P < 0.01$) has occurred on BBS routes in Washington, and an annual decline of 4.1 percent (n = 196, $P < 0.01$) has occurred in USDI Fish and Wildlife Service Region 1 (five Western states) (Sauer and others 1996).

Wintering populations of the big-eared bat seem to have declined, based on a comparison of counts made at hibernacula in central Oregon in the 1960s compared to the 1980s (Perkins 1987). In general, several species of bats in the basin have declined because of increased human disturbance of roosts, declining snag densities, decrease of late-seral lower montane and montane forests, decreased acreage and quality of riparian areas, pesticide use, direct killing, and decreases in water quality (Lehmkuhl and others 1997).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 27 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Our results, combined with literature and other empirical information, suggest that the following issues are important for group 27:

1. Unknown causes for population declines of pine siskins.

2. Direct loss of big-eared bat roosts because of cave and mine closures and destruction of abandoned buildings.

3. Excessive disturbance of roosting bats because of human activities.

4. High mortality of roosting bats or total loss of colonies because of vandalism and shooting.

5. Reduction in bat prey base (moths) through excessive use of insecticides.

Potential strategies—Strategies for reversing the declining trends in pine siskin populations are difficult to formulate because of the irruptive nature of siskin populations at the continental scale. The following strategies have been identified to reverse broad-scale declines in populations of the big-eared bat:

1. (To address issue no. 2) Protect all known roost sites (nursery, day roosts, and hibernacula) of big-eared bats and restore historical roosts where feasible.

2. (To address issue no. 3) Reduce levels of human activities around known bat roosts.

3. (To address issue no. 4) Reduce vandal-related mortalities of roosting bats

4. (To address issue no. 5) Reduce impacts of insecticide use on principal prey of big-eared bats.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Survey all mines and caves scheduled for public closure for big-eared bats before closure. If roosting colonies are found, or if the structure has potential as a roosting colony, carry out the closure with gates that allow bats to enter and exit the structure. Unless superseded by other designs, use the bat gate designs in Tuttle and Taylor (1994), also presented in appendix B of Idaho's conservation strategy for Townsend's big-eared bat (Idaho State conservation Effort 1995). If possible, stabilize old structures that are important for maternity and hibernacula sites (Perkins 1992-1994).

2. (In support of strategy no. 2) Initiate seasonal public closures of caves used as big-eared bat roosts during critical time periods, by using signs, road closures, and bat gates.

3. (In support of strategy no. 2) Reduce surveys to the minimum needed for assessing colony health and population status. Coordinate research efforts to minimize entry of roosts for data collection.

4. (In support of strategy no. 3) Increase public education and awareness of bat ecology and the current conservation status of big-eared bats.

5. (In support of strategies no. 2 and no. 3) Reduce human access to bat roosting structures by closing roads that facilitate access to such habitat.

6. (In support of strategy no. 4) Avoid or minimize application of pesticides near bat roosts (Perkins 1992-1994). Utilize a 3.2-km (2-mi) "no-spray" buffer zone around roost sites (Idaho State Conservation Effort 1995). Within a 16-km (10-mi) radius of known roosts, use a strip-spraying technique to reduce the amount of area sprayed.

Group 28—Spotted Bat, Pallid Bat, and Western Small-Footed Myotis

Results

Species ranges, source habitats, and special habitat features—Group 28 consists of three bat species that generally are associated with low-elevation woodlands and shrublands: the spotted bat, pallid bat, and western small-footed myotis. The spotted bat and pallid bat occur in low numbers throughout eastern Washington and Oregon, and the spotted bat also occurs in eastern and southern Idaho (fig. 84). The small-footed myotis is somewhat more abundant and occurs throughout the basin except for high-elevation sites in the Cascade Range (fig. 84).

This analysis addresses year-round source habitat for all three species. The small-footed myotis is known to hibernate in the basin, but it is not known whether the spotted bat and pallid bat hibernate or leave the basin

Figure 84—Ranges of species in group 28 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

during winter (Nagorsen and Brigham 1993). With no migratory information, we have assumed that source habitats for all three species include winter hibernacula.

Cover types used as source habitats by all species in group 28 include interior ponderosa pine, juniper woodland, juniper/sagebrush, big sagebrush, mountain big sagebrush, and low sage (vol. 3, appendix 1, table 1). Additional cover types used as source habitats by one or two group members include cottonwood-willow (small-footed myotis), interior Douglas-fir and shrub wetlands (spotted bat), and salt desert shrub (spotted and pallid bats). Within interior ponderosa pine, the pallid bat is limited to old-forest structural stages, whereas the spotted bat and small-footed myotis also use young forest and understory reinitiation stages (vol. 3, appendix 1, table 1). All three species use both open- and closed-canopy structures of the shrub cover types.

A special habitat feature associated with all source habitats is the presence of cliffs or other rocky areas for roost sites (vol. 3, appendix 1, table 2). For the spotted and pallid bats, it is not necessary for roost structures to be adjacent to foraging areas because the spotted bat is known to travel up to 10 km (6.2 mi) between day roosts and feeding areas (Wai-Ping and Fenton 1989), and the pallid bat commutes up to 4 km (2.5 mi) (Nagorsen and Brigham 1993). Distances farther than these, however, would render shrub habitats unsuitable as source foraging areas. Commuting distances have not been reported for the small-footed myotis, but it seems to be versatile in its selection of roost sites, using boulders, vertical banks, and talus slopes in addition to cliffs (Nagorsen and Brigham 1993). Within this group, the spotted bat appears most limited in roost site selection, with all roosts reported in crevices of high cliffs (Nagorsen and Brigham 1993, Sarell and McGuinness 1993, Wai-Ping and Fenton 1989). The pallid bat primarily roosts in rock crevices but also uses tree cavities, buildings, and mines (Nagorsen and Brigham 1993).

The small-footed myotis and spotted bat are both aerial feeders, with diets that differ according to local prey availability (Nagorsen and Brigham 1993). In eastern Oregon, the small-footed myotis was reported to consume primarily moths, true bugs, and flies (Whitaker and others 1981). In eastern British Columbia, the spotted bat consumed mostly moths (Wai-Ping and Fenton 1989). The pallid bat can aerial feed, but mostly gleans prey from vegetation and the ground. In eastern Oregon, the diet was grasshoppers and moths (Whitaker and others 1981).

Broad-scale changes in source habitats—Historically, source habitats for group 28 were concentrated in the Columbia Plateau, Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs, and patchily distributed elsewhere in the basin (fig. 85A). The current distribution of habitats resembles the historical extent; significant losses of habitat in the Columbia Plateau and total loss of the former patchy habitats have occurred in the Upper Clark Fork ERU (fig. 85B). Trends in habitat extent were variable across the basin, but in general, habitats declined in the northern portion of the basin and were static to increasing in the south, except for the Snake Headwaters, a southern ERU with declining trends (fig. 85C).

About one-third of the watersheds within the basin had static trends in the areal extent of source habitats, but nearly half had declining or strongly declining trends (fig. 86). Eighty percent of watersheds in the Lower Clark Fork and 54 percent of watersheds in the Columbia Plateau had declining and strongly declining trends (fig. 86). Increasing and strongly increasing trends were projected in 43 percent of the watersheds in the Southern Cascades and 50 percent of the watersheds in the Upper Klamath (fig. 86). These represent the two ERUs with the highest percentages of increasing habitat extent for group 28.

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Throughout the basin, declines in source habitats of shrubland bats were associated with declines in big sagebrush, mountain big sagebrush, and old-forest structural stages of interior ponderosa pine and interior Douglas-fir (vol. 3, appendix 1, table 4). Source habitats declined in the Columbia Plateau and Snake Headwaters because of the conversion of 46 and 41 percent of the big sagebrush cover type to agriculture within each ERU, respectively (Hann and others 1997). In the Lower Clark Fork ERU, 66 percent of the interior ponderosa pine cover type was replaced by grand fir-white fir (Hann and others 1997), a cover type that does not serve as source habitat for group 28.

Figure 85—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 28 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

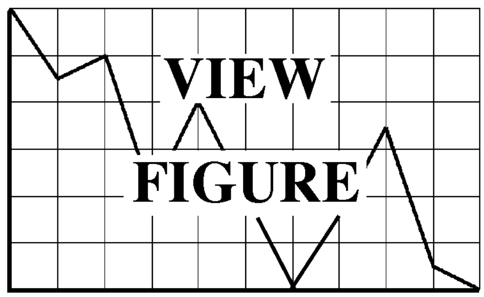

Figure 86—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 28, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

Increases in habitat extent generally were due to increases in juniper woodlands and juniper/sagebrush cover types (vol. 3, appendix 1, table 4). These increases often occurred in ERUs that experienced declines in native shrublands, resulting in overall mixed trends (for example, in the Owyhee Uplands) (vol. 3, appendix 1, table 4).

Condition of special habitat features—The extent of cliffs and rocky areas in the basin has not changed since the historical period, but the habitat quality of some cliffs has declined because of human disturbances (Lehmkuhl and others 1997).

Other factors affecting the group—Human disturbance can affect bat nursery colonies by disrupting young during the critical periods of growth and development. For spotted and pallid bats, nursery colonies are often inaccessible, and therefore disturbance potentials are low. The exception could occur if one or more rock climbing routes passed through a nursery colony and were visited frequently by climbers. Currently, no situation of this kind has been identified in the basin, but this may be due to a lack of monitoring rather than an absence of nursery colony-climber interactions.

Human activities can result in habitat degradation or disturbance at day roosts. Examples include road construction, dam building, mineral extraction, and the stabilizing of hazardous falling rocks above developments (Sarell and McGuinness 1993).

Direct contact with pesticides can cause illness or death in bats. Although most organochlorine pesticides that cause accumulation of chemicals up the food chain have been banned in the United States or their use highly restricted, the relatively short-lived organophospates can provide high risks during application (Clark 1988). For example, a large die-off of bats was observed in Arizona after the application of methyl parathion, and was believed to be linked to direct contact with this chemical (Clark 1988).

Pesticides also can impact bat populations by reducing the availability of arthropods that serve as prey. Bats in group 28 are impacted by the spraying of forests and agricultural crops for insect pests.

Population status and trends—Population estimates for bat species in the basin are either unknown or local in scale. Lehmkuhl and others (1997), however, reported that habitat conditions for most bat species have declined significantly from historical conditions because of the conversion of native vegetation to agriculture and urban development, increased human disturbance of roosts, reduced large snag densities, decreased acreage and distribution of late-seral montane and lower montane forests, and reduced acreage and quality of riparian areas.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 28 with broader, ecosystem-based objectives for all other resources.

Issues—Our results and the conclusions drawn from published literature suggest the following issues are important for group 28:

1. Loss of native shrub vegetation.

2. Disturbances at nursery and day roosts.

3. Impacts of pesticides on bats and their prey.

4. Lack of information on hibernacula, including locations, special habitat features, and numbers of bats associated with them.

5. Lack of population trend data.

Potential strategies—The following strategies could be used to maintain and improve habitat for these bat species:

1. (To address issue no. 1) Maintain and improve the condition of native shrublands to provide foraging areas.

2. (To address issue no. 2) Reduce human disturbances near known roosts.

3. (To address issue no. 3) Alleviate impacts of pesticides on bat populations.

4. (To address issues no. 4 and no. 5) In cooperation with other state, Federal, and tribal agencies, establish a coordinated approach to search for hibernacula.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Identify areas of existing native shrubland that could be managed for long-term persistence of native shrub cover types.

2. (In support of strategy no. 1) Explore options under the CRP (Johnson and Igl 1995), or develop other incentive programs to encourage restoration of agricultural areas to native cover types. Focus on areas that would increase patch size or links with existing source habitat patches.

3. (In support of strategy no. 1) Restore degraded areas by appropriate mechanical treatments and with seedings of native shrub, grass, and forb species.

4. (In support of strategy no. 2) Monitor known nursery roosts for potential disturbances, and initiate seasonal closures of recreational activity where appropriate. For example, seasonal restrictions on rock climbing would be appropriate if climbing routes passed through spotted bat nursery colonies.

5. (In support of strategy no. 2) Provide access for bats when mines are permanently closed.

6. (In support of strategy no. 2) Conduct surveys for bat roosts and hibernacula before road construction, mineral extraction, or slope stabilization where such activities are scheduled to occur near cliffs or caves with potential roosts. Provide mitigation or seasonal restrictions of potentially disturbing activities within the appropriate planning documents.

7. (In support of strategy no. 3) Avoid pesticide use in areas of high bat foraging activity or near nursery colonies.

8. (In support of strategy no. 4) Use existing interagency cooperative agreements, or develop agreements where needed to conduct surveys for hibernacula.

Group 29—Western Bluebird

Results

Species ranges, source habitats, and special habitat features—Group 29 consists of migratory breeding habitat for western bluebirds. Within the basin, western bluebirds are distributed across eastern Oregon and Washington, northern and western Idaho, and northwestern Montana (fig. 87). They are present in all ERUs except the Upper Snake and Snake Headwaters.

Western bluebirds use open forest stands and woodlands in combination with shrub and grass habitats. Specific source habitats (vol. 3, appendix 1, table 1) include old forest, single-storied western white pine and ponderosa pine; old-forest aspen; stand-initiation stages of most montane forest and lower montane forest community groups; juniper and white oak woodlands; the open-canopy low-medium shrub stage of most of the upland shrub community type; and native bunchgrasses and forbs. Additionally, burned pine forests created by stand-replacing fires likely are source habitats (Saab and Dudley 1998). Burned habitats, however, were not identified for this analysis.

Juxtaposition of forested and open areas is a necessary characteristic of source habitats for western bluebirds because they typically nest in tree cavities and forage for insects in adjacent openings (DeGraaf and others 1991; vol. 3, appendix 1, table 2). Because juxtaposition of cover types is important for nesting western bluebirds, they are considered a “contrast” species, and a finer scale analysis is needed to fully evaluate the status of their source habitats.

Western bluebirds are secondary cavity-nesters, so snags are a special habitat feature (vol. 3, appendix 1, table 2). They will use old woodpecker holes, natural cavities, and nest boxes (Brawn and Balda 1988, DeGraaf and others 1991). Their nests are located in open forests or at forest edges. In burned ponderosa pine forests of western Idaho, nesting western bluebirds favored partially salvage-logged compared to unlogged stands (0.44 nests per km surveyed [0.71 nests per mi] in logged vs. 0.16 nests per km [0.26 nests per mi] in unlogged) (Saab and Dudley 1998). Openings in partially logged, burned forests likely provided greater opportunities for aerial foraging by the bluebirds. In salvaged units, snag (>23 cm [9 in] d.b.h.)

Figure 87—Ranges of species in group 29 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

densities at bluebird nest sites (*n* = 65) averaged 65 ± 5.9 snags per ha (26.3 ± 2.4 snags per acre), and at nonnest random sites (*n* = 180) 31.4 ± 1.9 snags per ha (12.7 ± 0.8 snags/acre). Average diameter of nest trees in the burned forests of western Idaho was 34.8 ± 1.5 cm (13.7 ± 0.6 in).

Broad-scale changes in source habitats—Source habitats for western bluebirds declined strongly throughout most of the basin. Throughout the basin, source habitats for western bluebird had declined strongly in 50 percent of watersheds and moderately in another 25 percent of watersheds (figs. 88 and 89). The apparent strong negative trends were in seven ERUs: the Northern Cascades, Southern Cascades, Columbia Plateau, Blue Mountains, Northern Glaciated Mountains, Lower Clark Fork, and Upper Clark Fork (fig. 89). More moderate declining trends were projected for the Upper Klamath and Central Idaho Mountains (fig. 89), whereas there was little change in source habitats from historical to current in the Northern Great Basin and Owyhee Uplands (fig. 89).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Hann and others (1997, see table 3.139) reported ecologically significant basin-wide declines for four of the terrestrial communities that support components of western bluebird source habitats. Communities that declined significantly were early-seral lower montane forest, late-seral lower montane single-layer forest, upland shrublands, and upland herblands. Of the terrestrial communities providing source habitats for bluebirds, only upland woodlands showed a basin-wide significant increase from historical to current (table 3.139 in Hann and others 1997). Decreases in habitats important to western bluebirds were also significant at the level of individual ERUs. The upland herb community declined significantly in all 11 ERUs within the range of the western bluebird, early-seral lower montane forest and late-seral lower montane single-layer forest declined in 10 ERUs, upland shrub declined in 8 ERUs, and early-seral montane forest declined in 6 ERUs (tables 3.141 through 3.165 in Hann and others 1997). Late-seral single-layer montane forest declined

Figure 88—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 29 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

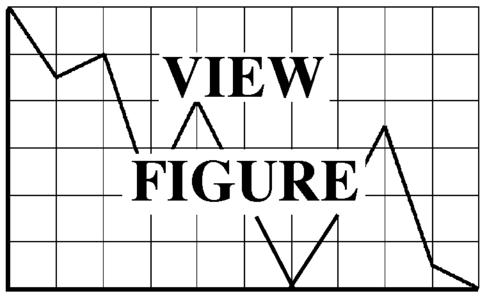

Figure 89—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 29, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

in four ERUs while increasing in five ERUs, and upland woodlands declined in three ERUs while increasing in six ERUs. Our evaluation at the broad scale did not assess the distribution of foraging habitat in relation to that for nesting habitat. Additional analysis of the juxtaposition of foraging with nesting habitats is needed at a finer scale of resolution. Results for source habitats shown here for both the current and historical time periods are likely overestimates as they do not take into account the need for juxtaposition of habitats.

Condition of special habitat features—Densities of large-diameter snags (>53 cm [21 in] d.b.h.) have declined basin-wide from historical to current levels (Hann and others 1997, Hessburg and others 1999, Quigley and others 1996). Trends in densities of smaller snags are variable (Hann and others 1997).

The scale of the analysis does not allow determination of change in the amount of edge or amount of edge habitat. Thus, this special habitat feature was not evaluated for changes in source habitats presented in the above results. Some levels of decrease in total habitat area may be associated with increases in edge habitat. Consequently, the large decreases reported here for western bluebird habitat may be somewhat mitigated by increases in edge as habitat blocks are harvested.

Other factors affecting the group—Some western bluebirds that breed in the basin migrate to California and Baja California in winter (DeGraaf and others 1991). Conditions on these wintering grounds could affect the status of populations in the basin. Western bluebirds respond positively to artificially constructed nest boxes in areas where the availability of cavities is limiting. In one study (Brawn and Balda 1988), bluebird densities increased from 8 to 31 pairs per 40 ha (100 acres) after the construction of nest boxes. Usurpation of nest cavities by Lewis' woodpeckers (Saab and Dudley 1995) could have negative effects on western bluebirds. Stress and elevated energetic costs could be associated with territorial encounters with Lewis' woodpeckers and potentially reduce reproductive success of western bluebirds.

Population status and trends—Saab and Rich (1997) reported that western bluebird populations in the basin were stable over the period 1968-94 based on BBS data. Stable population trends also have been reported for this western species throughout its range for the period 1966-96 (Sauer and others 1996). Specialized monitoring techniques may be needed for better estimates of bluebird population trends (Saab and Rich 1997).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 29 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Primary issues affecting source habitats of western bluebirds are as follows:

1. Reductions in snag densities.

2. Reductions in early- and late-seral montane and lower montane forests.

3. Possibly unsustainable conditions in late-seral montane and lower montane forests where there have been large transitions from shade-intolerant to shade-tolerant species.

4. Reductions and degradation of native upland shrublands and herblands.

Potential strategies—Habitat for western bluebirds could be improved by implementing the following strategies:

1. (To address issue no. 1) Maintain large remnant trees and snags in all seral stages of montane, lower montane, and woodland forests.

2. (To address issue no. 2) Maintain and restore early- and late-seral montane and lower montane forests where those types have been reduced in extent. Both the extent and pattern of these habitats are of concern because source habitats for western bluebirds are found in edge areas. Where possible, retention efforts for late-seral forests should be focused on areas where the potential for stand-replacing fires is low (USDAForest Service 1996).

3. (To address issue no. 3) Restore fire regimes that maintain a natural mosaic of shrublands and forests in those ERUs and portions of ERUs where substantial habitat remains (for example, Northern

Great Basin, Owyhee Uplands, southern portion of Columbia Plateau). In some areas, such strategies will result in temporary declines and periodic fluctuations in habitat abundance.

4. (To address issue no. 4) Restore native upland shrub and herblands.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Snag management practices could be designed to retain snags along forest edges in areas used by nesting western bluebirds, and artificial nest boxes could be used to help support western bluebird populations in areas where snags are not available as nesting structures.

2. (In support of strategy no. 1) In burned ponderosa pine-Douglas-fir forests selected for postfire salvage logging, retain about 65 snags per ha (26 per acre) of snags >23 cm (9 in) d.b.h.

3. (In support of strategies no. 2 and no. 3) Use wildfire and prescribed fire to restore natural forest openings and enhance shrub understories to attract insect prey.

4. (In support of strategy no. 3) Accelerate development of mid-successional stages of ponderosa pine to old forests by silvicultural treatments of prescribed underburning and thinning of small-diameter trees (<25 cm [9 in] d.b.h.).

5. (In support of strategy no. 4) Discourage spread of exotic plants by minimizing human-associated disturbance activities.

Group 30—Ash-Throated Flycatcher and Bushtit

Results

Species ranges, source habitats, and special habitat features—Group 30 consists of the bushtit and ash-throated flycatcher. The bushtit is a year-long resident in the basin, whereas the ash-throated flycatcher is a summer migrant. For both the ash-throated flycatcher and the bushtit, the basin constitutes the northern edge of their ranges. Both species have similar distributions within the basin, occurring along the western and southern extent of the basin (fig. 90).

The bushtit and ash-throated flycatcher depend on a similar mix of source habitats (vol. 3, appendix 1, table 1), including mixed-conifer woodlands, juniper/sagebrush woodlands, Oregon white oak, and mountain mahogany. Cottonwood/willow in the old-forest multi-storied structural stage also is considered source habitat for the ash-throated flycatcher.

Ash-throated flycatchers nest in cavities (either natural, woodpecker-excavated, or human-made [nest boxes]) of taller trees and snags (Austin and Russell 1972, Dunning and Bowers 1990, Sharp 1992). Snags were identified as a special habitat feature for ash-throated flycatchers (vol. 3, appendix 1, table 2). Bushtits place their nests in tall shrubs. Both species forage on arthropods.

Broad-scale changes in source habitats—Source habitats for this group historically were distributed within the western and southern parts of the basin, and watersheds with habitat appeared to be disjunct (fig. 91A). Currently, source habitats are more abundant and in some areas more continuous in distribution (fig. 91B). The largest concentration of both current and historical habitats is within the southern part of the Columbia Plateau (figs. 91A, B). The watersheds with increases in source habitats were most often the same as or adjacent to watersheds that supported source habitats historically (figs. 91A, B).

Overall, source habitats for this group strongly increased within the basin. Over 60 percent of the watersheds in the basin had strongly increasing trends, whereas about 17 percent had decreasing trends (fig. 92). Nearly 50 percent or more of the watersheds in seven of the nine ERUs with greater than 1 percent of the area as source habitats had strongly increasing trends since the historical period (fig. 92). These were the Upper Klamath, Northern Great Basin, Columbia Plateau, Blue Mountains, Owyhee Uplands, Upper Snake, and Snake Headwaters. Only the Northern Cascades had a greater number of watersheds with decreasing rather than increasing amounts of source habitat (fig. 92). The Southern Cascades generally had no net trend (fig. 92). The amount of source habitat in the Northern Glaciated Mountains is minimal (<1 percent of the ERU) (vol. 3, appendix 1, table 3).

Figure 90—Ranges of species in group 30 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 91—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 30 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

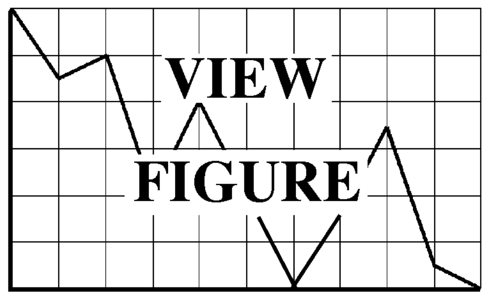

Figure 92—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 30, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—The increasing trend in source habitats was attributed to increases in the juniper/sagebrush cover type (vol. 3, appendix 1, table 4). The extent of juniper/sagebrush woodlands has more than doubled in the basin, primarily because of excessive livestock grazing and fire suppression (Hann and others 1997).

Broad-scale trends in the other source habitat types, especially old-forest cottonwood-willow, Oregon white oak, and mountain mahogany, are difficult to determine at the 1-km^2 (0.4-mi^2) scale of analysis because of small patch size or linear configuration of these cover types across the basin.

Condition of special habitat features—The trend and condition of nest cavities for ash-throated flycatchers are unknown. Presumably, as the number of juniper trees increases, the aging of these junipers will produce natural cavities as snags develop and older branches fall off.

Other factors affecting the group—The primary prey for these species during the breeding season is insects (Ehrlich and others 1988, Sharp 1992). Native understory shrubs and grasses provide important substrates for production of insects, and excessive grazing can reduce or eliminate many of these key substrates for insects.[12]

A common management action is to reduce the densities of juniper especially where encroachment of or densities of junipers have increased. Removal of juniper may improve rangeland productivity and restore native biodiversity in some areas; however, management efforts to remove juniper trees would negatively affect source habitats for group 30.

Population status and trends—Data for ash-throated flycatchers and bushtits in the basin were insufficient to determine a population trend. Because both species have naturally low population numbers and narrow distributions, specialized monitoring techniques are required to estimate their numbers (Saab and Rich 1997).

[12] Personal communication. 1997. David Dobkin, wildlife biologist, High Desert Ecological Research Institute, 15 SWColorado, Suite 300, Bend, OR 97702.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 30 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Primary issues affecting source habitats for ash-throated flycatchers and bushtits are as follows:

1. For ash-throated flycatchers, loss of trees with natural cavities or trees suitable for excavation by other species because of juniper removal.

2. Degradation and loss of native understory shrubs and grasses that provide substrates for arthropod prey.

Potential strategies—The issues identified above suggest the following broad-scale strategies would be effective in contributing to the long-term persistence of bushtits and ash-throated flycatchers:

1. (To address issue no. 1) Retain contiguous blocks of mature juniper/sagebrush, especially in areas containing old junipers with cavities and hollow centers for potential nest sites of ash-throated flycatchers. Old-growth specimens usually have round or flat tops as compared to young, actively growing individuals that have a symmetrical, cone-shaped top (Oregon Department of Fish and Wildlife 1994)

2. (To address issue no. 2) Protect and restore native understory shrubs and grasses in source habitats.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Consider site-specific ecological potential and response to management before removing juniper trees.

2. (In support of strategy no. 1) Retain junipers with cavities and hollow centers that are potential nest sites for ash-throated flycatchers.

3. (In support of strategy no. 1) Retain blocks of old-growth juniper during juniper control projects.

4. (In support of strategy no. 2) Restrict the use of herbicides, pesticides, and grazing in areas with contiguous blocks of source habitat that have intact native understories.

5. (In support of strategy no. 2) Restore native understories through seedings and plantings of native shrubs and grasses.

6. (In support of strategy no. 2) Minimize the likelihood of invasion of exotic vegetation by minimizing human-associated disturbances such as road building, motorized activity, grazing, and mining.

Group 31—Ferruginous Hawk, Burrowing Owl, Short-Eared Owl, Vesper Sparrow, Lark Sparrow, Western Meadowlark, and Pronghorn

Results

Species ranges, source habitats, and special habitat features—Group 31 consists of breeding habitat for the migratory ferruginous hawk, burrowing owl, vesper sparrow, lark sparrow, and western meadowlark, and year-round habitat for the short-eared owl and pronghorn. The short-eared owl, vesper sparrow, and western meadowlark are the most widely distributed species within this group (fig. 93), occurring throughout the basin. Less widely distributed are the burrowing owl and lark sparrow, which are both absent from the mountainous portions of central and northern Idaho (fig. 93). The ferruginous hawk uses less of the basin but is still widespread in the lower elevations (fig. 93). The least widely distributed species in this group is the pronghorn, which currently occupies most of the Northern Great Basin ERU, a large part of the Owyhee Uplands ERU, and small, disjunct areas over the southern half of the basin (fig. 93). In contrast, the historical range of the pronghorn included almost all of southern Idaho and eastern Oregon (fig. 93). Nelson (1925) stated that pronghorn historically occurred in Washington as well, but Yoakum (1978) disagreed. We have followed the recommendations of the latter author.

Source habitats for this group include various shrub, grass, and herbaceous cover types (vol. 3, appendix 1, table 1). All seven species have source habitats in big sagebrush and fescue-bunchgrass cover types, six share low sagebrush, and five have source habitats in juniper/sagebrush, mountain big sagebrush, native forb, and wheatgrass bunchgrass types. Whereas particular plant species may differ geographically, a key feature of this group is their preference for open cover types with a high percentage of grass and forbs in the understory. All species use the shrub component of the vegetation directly for nest sites, perch sites, or hiding cover. Pronghorn move into areas of higher shrub cover during winter. The ferruginous hawk is the only species that will use trees, especially junipers, which provide preferred nest sites in some geographic areas.

Burrowing owls depend on burrows and natural cavities in lava flows or rocky areas for nest sites; thus, burrows are a special habitat feature for this species (vol. 3, appendix 1, table 2). Burrows are almost always provided by burrowing mammals such as ground squirrels, marmots, prairie dogs, coyotes, and badgers, and the use of an area by owls may be closely tied to populations of these mammals (Haug and Oliphant 1990, Rich 1986, Thomsen 1971).

Populations (White and Thurow 1985) and productivity (Bechard and Schmutz 1995, Schmutz and Hungle 1989, Steenhof and Kochert 1985) of the ferruginous hawk fluctuate in response to prey population densities. Similarly, breeding populations of the short-eared owl are nomadic, and high densities of breeding birds may occur when rodent densities are high (Marti and Marks 1989). Thus, the status of all three raptors in this group is rather closely tied to the status of various mammal populations. Notably, these three raptor species are more tolerant of degraded shrub-steppe habitats with exotic vegetation than are other species in this group.

Significant correlations were documented between the coverage of grass and the densities of western meadowlark ($r = 0.62$, $P < 0.001$) and lark sparrow ($r = 0.37$, $P < 0.05$) (Wiens and Rotenberry 1981). Similar correlations occurred for the coverage of litter and these songbird species ($r = 0.36$, $P < 0.05$ and $r = 0.34$, $P < 0.05$, respectively).

Pronghorn may depend on free water during summers of dry years when they cannot meet water requirements from succulent forbs (Beale and Smith 1970,

Figure 93—Ranges of species in group 31 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 93—Ranges of species in group 31 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 94—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 31 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

Clemente and others 1995). In most years, however, availability of free water probably does not affect pronghorn habitat use (Deblinger and Alldredge 1991).

Broad-scale change in source habitats—Historically, source habitats for this group were widely available throughout the basin, but particularly in the Northern Great Basin, Columbia Plateau, Owyhee Uplands, and Upper Snake ERUs (fig. 94A). The most contiguous shrub-steppe habitat occurs at lower elevations, and source habitats for this group become less extensive at higher elevations. This is demonstrated by the narrow band of watersheds with 25 to 50 and 0 to 25 percent of area in source habitats within higher elevation ERUs (fig. 94B).

The projected extent of decreasing and strongly decreasing trends in source habitats was dramatic (fig. 94C). The Columbia Plateau and Upper Snake ERUs were dominated by decreasing trends, the latter having no watersheds with increasing trends. In contrast, large, contiguous portions of the Northern Great Basin and Owyhee Uplands ERUs, areas of higher elevation and precipitation, show a stable trend and continue to provide source habitats for this group.

Basin-wide, 54 percent of the watersheds had moderately or strongly declining trends in source habitats (fig. 95). The Columbia Plateau ERU historically provided the most watersheds with source habitats for this group (fig. 95), but over 72 percent of the watersheds in that ERU had moderately or strongly declining trends. The second most important ERU, the Owyhee Uplands, had stable trends in about 81 percent of its watersheds, but another 19 percent were moderately or strongly declining. The number of watersheds with moderately or strongly declining trends in source habitats outnumbered those with increasing trend in all other ERUs (fig. 95) except the Central Idaho Mountains.

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—The single largest loss in cover types within the basin has been the decline in big sagebrush (Hann and others 1997). Habitat losses were also significant for fescue-bunchgrass and wheatgrass bunchgrass (Hann and others 1997). This loss was most striking in the Columbia Plateau and Upper Snake ERUs (figs. 94C and 95). Other notable reductions include the near complete loss of source habitats in the Upper Clark Fork and Lower Clark Fork ERUs.

In the Columbia Plateau, major losses from historical conditions occurred in big and mountain sagebrush types, which declined by nearly half and over three-fourths, respectively (vol. 3, appendix 1, table 4). Native grass cover types also were heavily impacted, with a three-fourths decline in wheatgrass bunchgrass, and a nearly total loss of fescue-bunchgrass (Hann and others 1997). In the lower elevations of the Owyhee Uplands, big sagebrush was reduced by 25 percent (Hann and others 1997). Fescue-bunchgrass types had significant negative declines in nine ERUs (Hann and others 1997). Nearly all of the native forb cover type, source habitats for five of these species, was converted to other cover types (Hann and others 1997). Native forbs were projected to have covered a small portion of the basin historically but likely provided important local breeding habitats within larger blocks of more xeric vegetation.

In the Central Idaho Mountains ERU, nearly 33 percent of the watersheds had strongly increasing trends (fig. 95). This was attributed to large relative increases in juniper/sagebrush, juniper woodlands, and low sagebrush, all of which covered only a small fraction of the unit. A similar situation resulted in strongly increasing trends in the Northern Cascades, Blue Mountains, Northern Great Basin, and Snake Headwaters ERUs (fig. 95; vol. 3, appendix 1, table 4; Hann and others 1997). Any increases in wheatgrass bunchgrass or native forb cover types (vol. 3, appendix 1, table 4) should be viewed with caution because these cover types can be dominated by exotic vegetation, which is not considered source habitat for species of this group.

Several factors contributed to large-scale losses of sagebrush and fescue-bunchgrass habitats; foremost was conversion to agriculture. Agricultural lands have increased significantly in every ERU in the basin (vol. 3, appendix 1, table 4). In fact, the largest transitions among terrestrial communities from the historical to current periods were that of upland shrubland and upland herbland to agriculture (Hann and others 1997). This transition explains much of the pattern evident in figure 94C.

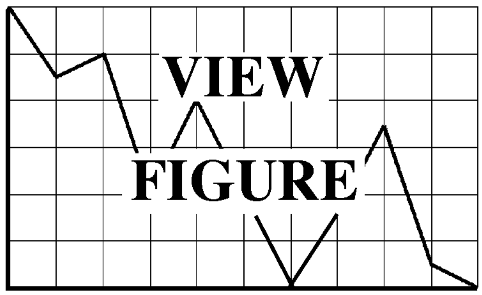

Figure 95—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 31, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

A second factor contributing to loss of sagebrush habitat was conversion of shrub-steppe vegetation to exotic forbs and annual grass. Notable portions of the Owyhee Uplands and Upper Snake ERUs underwent a conversion from upland shrubland to exotic herbland (Hann and others 1997). Conversion of native vegetation to exotics was augmented by the increased frequency of wildfire and by improper grazing (Quigley and others 1996, USDAForest Service 1996).

Condition of special habitat features—Burrowing owls rely on burrows provided by burrowing mammals for nest sites (Haug and Oliphant 1990, Rich 1986, Thomsen 1971). Populations of many burrowing mammals have declined because of various pest control programs, which may have reduced nest site availability for burrowing owls. No special habitat features were identified for other members of this group.

Other factors affecting the group—Losses of native perennial grass and forb understories within the sagebrush types, associated with intensive livestock grazing, cheatgrass invasions, and noxious weed invasions, are microhabitat changes that could not be evaluated by our broad-scale analysis. Because species in group 31 favor grass or shrub-grass types for nesting, foraging, or hiding, we know that the grass component of historical shrublands was important (for example, Wiens and Rotenberry 1981, Marti and Marks 1989). Removal of grass cover by livestock potentially has detrimental effects on the short-eared owl (Marti and Marks 1989). Finer scale analysis is needed to determine the extent of this problem because the broad-scale data may show source habitats in upland shrub types, where the shrubs are present but the understory is gone. The presence of livestock also may attract brown-headed cowbirds and subsequently increase the incidence of brood parasitism (Robinson and others 1995). The western meadowlark and vesper sparrow are common cowbird hosts, whereas the lark sparrow is only occasionally parasitized (Ehrlich and others 1988).

Ferruginous hawks prefer trees for nest sites, particularly junipers (Jasikoff 1982), and are most common in the juniper/sagebrush ecotone (Powers and others 1973, Smith and Murphy 1973, Thurow and others 1980). Expansion of juniper woodlands and juniper/sagebrush in the basin as a result of fire suppression likely has benefitted the species.

Fields of hay and cereal grains attract vesper sparrows (Perritt and Best 1989) and western meadowlarks (Lanyon 1994) for nesting, where nests, young, or adults may be destroyed during harvest. Short-eared owls and lark sparrows also likely are affected by this process. These fields function as sinks for local populations.

Species in this group evolved in shrub-steppe habitats where microbiotic crusts were broadly distributed (see Kaltenecker and Wicklow-Howard 1994). Microbiotic, or cryptogamic, crusts consist of lichens, bryophytes, algae, microfungi, cyanobacteria, and bacteria growing on or just below the soil surface in arid and semiarid environments (Kaltenecker and Wicklow-Howard 1994); these crusts developed without large herds of grazing ungulates (St. Clair and Johansen 1993). In addition, these crusts are projected to have been widely distributed throughout the source habitats for this group, particularly in the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs but also scattered in the Columbia Plateau ERU (Hann and others 1997, map 3.59). Increasing evidence suggests that microbiotic crusts improve soil stability, productivity, and moisture retention, moderate extreme temperatures at the soil surface, and enhance seedling establishment of vascular plants (Belnap and Gardner 1993, Harper and Pendleton 1993, Johansen and others 1993, St. Clair and others 1993), thus contributing to high ecological integrity of shrub-steppe habitats. Idaho BLM has recognized the potential importance of microbiotic crusts by proposing standards for rangeland health that include the maintenance of these crusts to ensure proper functioning and productivity of native plant communities (USDI Bureau of Land Management 1997). These crusts were widely destroyed by trampling during the excessive livestock grazing of the late 1800s and early 1900s (Daubenmire 1970, MacCracken and others 1983, Mack and Thompson 1982, Poulton 1955). Currently, high-intensity grazing and altered fire regimes modify shrub-steppe plant communities and threaten the maintenance and recovery of microbiotic crusts (Belnap 1995, Kaltenecker 1997, St. Clair and Johansen 1993).

Roads, human activities, and domestic dogs are known to impact ferruginous hawks, short-eared owls, burrowing owls (Bechard and Schmutz 1995, Green and Anthony 1989, Lokemoen and Duebbert 1976, Olendorff and Stoddart 1974, Ramakka and Woyewodzic 1993, Schmutz 1984, White and

Thurow 1985) and western meadowlarks (Lanyon 1994). Harassment of pronghorn by snowmachine and all-terrain vehicles stresses animals at all times of the year (Autenrieth 1978). Pronghorn also avoid sheep dogs (Yoakum and O'Gara 1990). Human disturbance might be especially significant for those species that are attracted to features of the agricultural-shrubland or agricultural-grassland contact zones; that is, burrowing owl, short-eared owl, and pronghorn.

Recreational shooting of marmots and ground squirrels impacts burrowing owls because the owls are accidentally or deliberately shot, whereas more general illegal shooting impacts short-eared owls (Marti and Marks 1989). Pesticide use leads to direct mortality in burrowing owls, short-eared owls (Marti and Marks 1989), and western meadowlarks (Griffin 1959) and an indirect loss in burrowing owls through a reduction in the populations of burrowing mammals.

Pronghorn movement is restricted or completely impeded by net-wire and other fences that prevent them from crossing beneath the lower strand (Helms 1978, Oakley and Riddle 1974, Yoakum 1980). Roads are readily crossed by pronghorn, but snow accumulating in roadside ditches also might present barriers to movement during winter (Bruns 1977).

Population status and trends—Based on BBS data summarized for the basin (Saab and Rich 1997), significant declines were reported for the period 1966-94 for western meadowlark (-0.8 percent per yr, $n \geq 14$, $P < 0.10$) and lark sparrow (-2.9 percent per yr, $n \geq 14$, $P < 0.05$). Saab and Rich (1997) identified western meadowlark and lark sparrow as two of 15 species that are of high concern to management under all future management themes for the basin. Vesper sparrow, burrowing owl, and ferruginous hawk had stable population trends within the basin for the same time period (Saab and Rich 1997). In physiographic region 89 (Columbia Plateau), which corresponds to much of the range of this group within the basin, trends over the period 1966-95 (Sauer and others 1996) were positive for the ferruginous hawk (+6.3 percent per yr, $n = 18$, $P < 0.05$).

Burrowing owl populations are increasing across the West (+6.3 percent per yr; $n = 116$, $P < 0.001$; Sauer and others 1996). No detectable trend was found for the short-eared owl in the basin (Saab and Rich 1997) or in physiographic region 89 (Columbia Plateau; Sauer and others 1996). Marti and Marks (1989) reported that short-eared owl numbers were stable, with fluctuating populations.

Burrowing owls, short-eared owls, and ferruginous hawks are not adequately monitored by the BBS technique so apparent population trends, or the lack thereof, for these species may not be reliable (Saab and Rich 1997).

An estimated 99 percent of the continental pronghorn population was killed by indiscriminate hunting between 1850 and 1900, but numbers have increased dramatically since then in Idaho and Oregon (Yoakum 1968, 1978, 1986a; Yoakum and O'Gara 1990). Populations reached peaks in 1989 of 21,800 in Idaho and 22,650 in Oregon (O'Gara 1996). The most recent estimates (1995) are 12,500 in Idaho and 17,122 in Oregon (O'Gara 1996).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 31 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—The condition of the habitat for group 31 can be summarized by the composite ecological integrity ratings (Quigley and others 1996, p. 122) that show most of the habitat to have a "low" rating. Fescues and bunchgrasses—critical habitat components for this group— ". . . were irreversibly modified by extensive grazing in the late 1800s and early 1900s" (USDA Forest Service 1996, p. 51). Most of the current habitat for this group was classified into Rangeland Clusters 5 (generally corresponding to much of the Owyhee Uplands ERU) and 6 (generally the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs) where the primary risk to ecological integrity is "continued declines in herbland and shrubland habitats" (Quigley and others 1996, p. 112, 114). Further, Rangeland Cluster 6 has the additional risk of being ". . . highly sensitive to overgrazing and exotic grass and forb invasion" (Quigley and others 1996, p. 114). These widespread and overriding issues provide a clear statement of the problems facing this group over the long term.

Primary issues:

1. Permanent and continued loss of large acreage of shrub-steppe and fescue-bunchgrass habitat because of agricultural conversion, brush control, and cheatgrass invasion.

2. Soil compaction and loss of the microbiotic crust.

3. Adverse effects of human disturbance. For the burrowing owl, a primary issue is the loss of nesting burrows through poisoning and recreational shooting of burrowing mammals. For ground-nesting birds, the issue is nest mortality in agricultural fields from farm machinery during spring weed control and early harvests. For pronghorn, a primary issue is disruption of movement patterns because of fence constructions that inhibit passage. For all species in group 31, the issue is general disruption of breeding activity and movements because of human intrusion.

Potential strategies—

1. (To address issue no. 1) Identify and conserve large remaining areas (contiguous habitat >1000 ha [2,470 acres]) of shrub-steppe vegetation where ecological integrity is still relatively high, and manage to promote their long-term sustainability. Large contiguous blocks of public land in the Northern Great Basin and Owyhee Uplands are the most obvious sites. These generally include the subbasins in Rangeland Cluster 5 (Quigley and others 1996). These areas will provide long-term habitat stability for populations and provide the anchor points for restoration, corridor construction, and other landscape-level management.

2. (To address issue no. 1) Restore the grass and forb components of the shrub-steppe cover types to approximate historical levels throughout the basin.

3. (To address issue no. 2) Restore the microbiotic crust in ERUs where potential for redevelopment is high; that is, in areas near propagule sources that have suitable soil, vegetation, and climatic characteristics [see Belnap 1993, Belnap 1995, Kaltenecker 1997, Kaltenecker and Wicklow-Howard 1994]). Ecological reporting units with highest potential for redevelopment include the Northern Great Basin, Owyhee Uplands, Upper Snake, and to a lesser extent, the Columbia Plateau (map 3.59 in Hann and others 1997).

4. (To address issue no. 3) Maintain burrows for nesting and roosting by burrowing owls. Reduce mortality of ground-nesting birds in agricultural areas. Construct fences in pronghorn range that allow pronghorn passage. Minimize the adverse effects of human intrusion.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Identify large areas of high ecological integrity to be managed for sustainability by analyzing current vegetation, precipitation patterns, elevation, temperature (Klemmedson and Smith 1964, Morrow and Stahlman 1984, Stewart and Hull 1949), and the presence of priority species in this group. These sites most likely will be successful on large areas of Federal land managed by BLM. Evaluation criteria for protection or enhancement include maintaining or increasing the size of smaller patches, preventing further habitat fragmentation, and protecting or increasing the size and integrity of corridors among patches, all in connection with the location of core areas.

2. (In support of strategy no. 1) Explore options under the CRP (Johnson and Igl 1995), or develop other incentive programs, to encourage restoration of agricultural areas to native cover types. Focus on areas that would increase patch size or links with existing source habitat patches.

3. (In support of strategy no. 2) Use fire prevention and suppression to retard the spread of cheatgrass in areas that are susceptible to cheatgrass invasion but currently are dominated by native grass species. Planting of fire-resistant vegetation through "green stripping" is being experimentally tested (Pellant 1994) and may be used to protect existing vegetation.

4. (In support of strategy no. 2) Restore selected areas of cheatgrass monocultures through seeding and other manipulations (Allen 1995, Daubenmire 1970, Evans and Young 1978, Hosten and West

1994, Kennedy 1994, Monsen and McArthur 1995, Ogg 1994, Whisenant 1995, Yoakum 1986b), where such restoration would increase the size of existing shrub-steppe patches or provide links between patches.

5. (In support of strategy no. 2) Restore native vegetation by appropriate treatments and seedings of native shrub, grass, and forb species.

6. (In support of strategy no. 2) Design livestock grazing systems to promote an abundance of forbs and grasses in the understory (Yoakum 1980).

7. (In support of strategy no. 3) Encourage the redevelopment of microbiotic crust by reducing or eliminating livestock grazing in areas where restoration of microbiotic crusts is encouraged (Mack and Thompson 1982, St. Clair and others 1993). Explore the use of ground-based and aerial soil inoculation to increase the speed and extent of dispersal of the organisms that create microbiotic crust (Belnap 1993).

8. (In support of strategy no. 4) Allow burrowing mammals such as ground squirrels and marmots to persist or expand to provide nesting burrows for burrowing owls (Coulombe 1971; Gleason and Johnson 1985; Rich 1984, 1986). Provide artificial burrows for burrowing owls where burrowing mammals must be controlled (Trulio 1995).

9. (In support of strategy no. 4) Modify agricultural practices to minimize direct mortality of nesting birds by delaying hay mowing until young birds are fledged (Clark 1975, Rodenhouse and others 1995, Vickery 1996). Avoid surface tillage for spring weed control. An alternative is to use the "undercutting" method, which is much less detrimental to meadowlarks (Rodgers 1983).

10. (In support of strategy no. 4) Control, reduce, or eliminate pesticide applications in and around agricultural areas, especially in the Columbia Plateau ERU where source habitats are small and virtually all surrounded by agricultural lands (USDAForest Service 1996). The Upper Snake ERU, and to a lesser extent the Owyhee Uplands, also have relatively many miles of interface with agricultural lands.

11. (In support of strategy no. 4) Avoid construction of net-wire and similar fences in pronghorn habitat or in pronghorn migration routes (Oakley and Ridle 1974). Modify existing fences and construct new fences in pronghorn range with the following specifications (these are standard policy on BLM lands occupied by pronghorns): bottom wire at least 41 cm (16 in) from the ground and smooth, not barbed; next wire up is 66 cm (26 in) from the ground; top wire is 91 cm (36 in) from the ground (Yoakum 1980).

12. (In support of strategy no. 4) Protect pronghorn winter ranges and fawning areas from intrusion by snowmobiles and all-terrain vehicles (Autenrieth 1978) through timed access control and area closures. Minimize access roads and, where possible, locate them on the periphery of the pronghorn use areas (Autenrieth 1978). Provide artificial nesting structures in areas away from human disturbance to attract ferruginous hawks to safer sites (Apple 1994, Niemuth 1992, Schmutz 1984). Protect burrowing owl nesting sites from disturbance by domestic dogs (Green and Anthony 1989, Martin 1983).

Group 32—Preble's Shrew, Uinta Ground Squirrel, White-Tailed Antelope Squirrel, Wyoming Ground Squirrel, Washington Ground Squirrel, Striped Whipsnake, Longnose Snake, Ground Snake, Mojave Black-Collard Lizard, and Longnose Leopard Lizard

Results

Species ranges, source habitats, and special habitat features—Group 32 consists of year-round habitat for the residents in this group: Preble's shrew, Uinta ground squirrel, white-tailed antelope squirrel, Wyoming ground squirrel, Washington ground squirrel, striped whipsnake, longnose snake, ground snake, Mojave black-collared lizard, and longnose leopard lizard.

***Mammals*—**Little is known about the Preble's shrew, but they may be widely distributed in the basin (fig. 96), based on records from the area's borders (Cornely and

Figure 96—Ranges of species in group 32 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 96—Ranges of species in group 32 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 96—Ranges of species in group 32 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

others 1992, Zeveloff and Collett 1988). Among the four species of ground squirrels, the Uinta is restricted to the upper end of the Snake River drainage in the Snake Headwaters, Upper Snake, and Central Idaho Mountains ERUs (fig. 96). The range of the white-tailed antelope squirrel occurs in the Northern Great Basin and Owyhee Uplands ERUs and is nearly distinct from that of the Uinta ground squirrel (fig. 96). Two subspecies of the Wyoming ground squirrel occur in the basin, *Spermophilus elegans nevadensis* that overlaps with the antelope squirrel in the Owyhee Uplands, and *Spermophilus elegans aureus* that overlaps with the Uinta ground squirrel in northeastern Idaho (fig. 96). Finally, both the current and historical (fig. 96) range of the Washington ground squirrel is allopatric with the other three species, being confined almost entirely to the northern part of the Columbia Plateau ERU. The current range of the Washington ground squirrel is reduced and disjunct compared to the historical period.

***Reptiles*—**The striped whipsnake is widely distributed at lower elevations in Washington, Oregon, and Idaho (fig. 96). Narrowly distributed and largely sympatric, the longnose snake and ground snake occur only in the Owyhee Uplands (fig. 96). The Mojave black-collared lizard has a distribution similar to the previous two species but has an additional portion of its range in the Northern Great Basin (fig. 96). Finally, the longnose leopard lizard is found largely in the Owyhee Uplands but has disjunct populations in the Northern Great Basin, Upper Snake, Columbia Plateau, and Southern Cascades ERUs.

Source habitats for group 32 include several shrub, grass, and herbaceous cover types (vol. 3, appendix 1, table 1). All 10 species have source habitats in big sagebrush, mountain big sagebrush, fescue-bunchgrass, and wheatgrass bunchgrass types. Ten species also have source habitats in low sage, whereas eight share juniper/sagebrush or mountain mahogany.

The striped whipsnake uses cliffs and talus where they occur in source habitats; these are special habitat features for this species (vol. 3, appendix 1, table 2). Preble's shrew requires a good understory of forbs and grasses and a dense overstory of sagebrush; it is associated with more mesic sites near ephemeral and perennial streams (Ports and George 1990). Down logs provide important foraging and hiding cover (vol. 3, appendix 1, table 2). Washington ground squirrels prefer deeper soils with less clay at 10 cm (4 in) and at 50 cm (20 in) compared to unoccupied sites (Betts 1990).

Talus slopes, canyon rims, and shadscale habitats are preferred over other types by ground snakes and collared lizards (Diller and Johnson 1982, Whitaker and Maser 1981). Collared lizards similarly prefer rock outcrops and sparse vegetation (Sanborn and Loomis 1979). Striped whipsnakes are much more apt to be encountered on canyon rims than on mid-slopes or in canyon bottoms (Gerber and others 1997).

Broad-scale changes in source habitats—Historically, source habitats for this group were projected to occur throughout the basin, with greatest concentrations in the Northern Great Basin, Columbia Plateau, Owyhee Uplands, and Upper Snake ERUs (fig. 97A). Substantial amounts of source habitats also occurred in the Blue Mountains, Northern Glaciated Mountains, Central Idaho Mountains, and Upper Klamath ERUs. Only the most mountainous and forested regions did not support members of this group.

The extent of decreasing and strongly decreasing trends in source habitats was dramatic (fig. 97C), particularly for the state of Washington, the northern half of Oregon, and the upper Snake River drainage. Nine ERUs had declining trends for most watersheds, whereas only two ERUs (Northern Great Basin and Owyhee Uplands) showed stable trends. The only noteworthy source habitat increases were in the Central Idaho Mountains (fig. 98).

Basin-wide, 56 percent of the watersheds showed a moderately or strongly declining trend in source habitats (fig. 98). The Columbia Plateau ERU historically provided the most watersheds with source habitats for this group (fig. 98). But over 83 percent of the watersheds in that ERU had moderately or strongly declining trends, and only about 5 percent were increasing. In the Blue Mountains, nearly 84 percent of the watersheds had moderately or strongly declining trends (fig. 98), and <4 percent were increasing. The Upper Snake ERU had no watersheds with increasing trends (fig. 98) and over 67 percent with moderately or strongly declining trends. In the Owyhee Uplands, over 81 percent of watersheds had stable trends, and 17 percent had moderately or strongly declining trends (fig. 98).

Figure 97—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 32 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

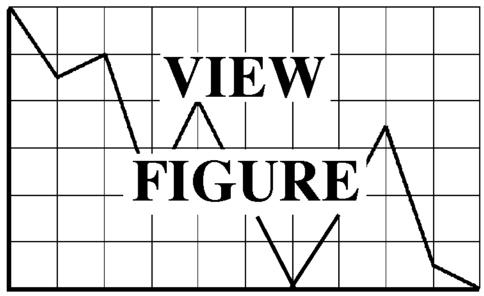

Figure 98—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 32, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Declines in source habitats were primarily due to reductions in the amount of big sagebrush, fescue-bunchgrass, wheatgrass bunchgrass, and interior ponderosa pine (Hann and others 1997). These losses were most striking in the Columbia Plateau and Upper Snake ERUs (fig. 97B; vol. 3, appendix 1, table 4). In the Columbia Plateau, big and mountain sagebrush types declined by nearly half and three-quarters, respectively, from historical conditions. Wheatgrass bunchgrass declined by three-fourths and fescue-bunchgrass was nearly eliminated (Hann and others 1997) in the Columbia Plateau.

Large-scale losses of sagebrush and native bunchgrass habitats were primarily due to conversion to agriculture. Basin-wide, the largest transitions among terrestrial communities from the historical to current periods were that of upland shrubland and upland herbland to agricultural (Hann and others 1997).

Another factor contributing to loss of sagebrush habitat is conversion of shrub-steppe vegetation to exotic forbs and annual grass. Substantial portions of the Owyhee Uplands and Upper Snake ERUs have undergone conversions from upland shrubland to exotic herbland (Hann and others 1997). Noteworthy increases in this cover type have occurred in all major shrub-steppe ERUs. Conversion of native vegetation to exotics is augmented by the increased frequency of wildfire and by improper grazing (Braun and others 1976, Daubenmire 1970, Evans and Young 1978, Quigley and others 1996, USDA Forest Service 1996).

Any increases in wheatgrass bunchgrass or native forb cover types (vol. 3, appendix 1, table 4) should be viewed with caution because these cover types can be dominated by exotic vegetation, which is not considered source habitat for species of this group. Additionally, in some cases the wheatgrass bunchgrass cover type was misclassified as an upland herbland group instead of an early-seral forest group that was created as a result of timber harvest or recent large-scale wildfires (see Hann and others 1997).

Relatively large increases have occurred in the source habitats of juniper woodlands (tripled), mountain mahogany (tripled), juniper/sagebrush (doubled), and low sage (one-third increase) in the Central Idaho Mountains (Hann and others 1997) (vol. 3, appendix 1, table 4).

Condition of special habitat features—The availability of mesic sites used by the Preble's shrew has declined as part of the general and widespread decline in riparian habitat conditions throughout the basin (Lee and others 1997, Quigley and others 1997). Cliffs and talus habitat for the striped whipsnake, although difficult to measure at the scale of this analysis, were estimated to be in much the same condition now as historically.

Other factors affecting the group—Poisoning and other eradication potentially affect populations of all four species of ground squirrels. Ground squirrels also are popular targets for recreational shooting. The Mojave black-collared lizard, longnose leopard lizards, and longnose snakes use small-mammal burrows for cover (Beck and Peterson 1995, Brown and others 1995, Nussbaum and others 1983, Pough 1973), and therefore could be indirectly affected by both poisoning and shooting. The effect of these factors on these species in the basin is unknown.

Accidental and deliberate mortality of snakes potentially increases with increased roading and traffic in the basin. Although the three species of snakes in this group may not be as frequently killed by vehicles as are some more common species (such as gopher snake and western rattlesnake), increasing human access to source habitats will predictably result in more deliberate killing of snakes. Currently, large areas of the Owyhee Uplands ERU support moderate to high road densities (see figs. 21 and 22 and "Species and Groups Affected by Factors Associated with Roads" in vol. 1).

The typical small size of Washington ground squirrel colonies makes them vulnerable to extirpation (Tomich 1982). Source habitats for this species were estimated to have undergone the fourth greatest decline among 91 broad-scale species of focus analyzed in this report (vol. 1, table 7). Washington ground squirrels may benefit from corridors of vegetation created by cultivation that allow exchange among colonies and general dispersal (Betts 1990).

Four of the reptilian species of this group (Mojave black-collared lizard, longnose leopard lizard, longnose snake, and ground snake), are located in isolated disjunct areas within the basin that make them vulnerable to extirpation.

Areas dominated by dense stands of cheatgrass or other exotic plants may preclude use by longnose leopard lizards (Stebbins 1985), longnose snakes (Beck and Peterson 1995), and collared lizards. In the Owyhee Uplands, areas with low vegetative cover and high amounts of bare ground or rock have the highest lizard densities (Whitaker and Maser 1981). In a study of off-road vehicle and grazing effects in the Mojave Desert in California, leopard lizards were found only in plots unused by off-road vehicles (compared with moderately and heavily used plots), and were absent from grazed plots (Busack and Bury 1974).

Because reptiles are increasingly popular as pets, all reptile species in this group, but particularly the lizards, are potentially affected by collecting (Lehmkuhl and others 1997). This impact will increase as the human population in the basin increases.

Soil compaction caused by livestock grazing could negatively affect both the longnose snake and ground snake. These burrowers benefit from loose, sandy, and friable soils (Beck and Peterson 1995, Nussbaum and others 1982).

Species in this group evolved in shrub-steppe habitats, where microbiotic crusts were broadly distributed (see Kaltenecker and Wicklow-Howard 1994). Microbiotic, or cryptogamic, crusts consist of lichens, bryophytes, algae, microfungi, cyanobacteria, and bacteria growing on or just below the soil surface in arid and semiarid environments (Kaltenecker and Wicklow-Howard 1994), and they developed without large herds of grazing ungulates (St. Clair and Johansen 1993). These crusts are projected to have been widely distributed throughout the source habitats for this group, particularly in the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs but also scattered in the Columbia Plateau ERU (Hann and others 1997, map 3.59). Increasing evidence indicates that microbiotic crusts improve soil stability, productivity, and moisture retention; moderate extreme temperatures at the soil surface; and enhance seedling establishment of vascular plants (Belnap and Gardner 1993, Harper and Pendleton 1993, Johansen and others 1993, St. Clair and others 1993), thus contributing to high ecological integrity of shrubsteppe habitats. The BLM in Idaho has recognized the potential importance of microbiotic crusts by proposing standards for rangeland health that include the maintenance of these crusts to ensure proper functioning and productivity of native plant communities (USDI BLM 1997). These crusts were widely destroyed by trampling during the excessive livestock grazing period of the late 1800s and early 1900s (Daubenmire 1970, MacCracken and others 1983, Mack and Thompson 1982, Poulton 1955). Currently, high-intensity grazing and altered fire regimes modify shrub-steppe plant communities and threaten the maintenance and recovery of microbiotic crusts (Belnap 1995, Kaltenecker 1997, St. Clair and Johansen 1993).

Population status and trends—Quantified population trends are not available for any of these species. The Washington ground squirrel has experienced range contraction (fig. 96), with 23 colonies in Washington and 12 in Oregon disappearing from 1980 to 1989. This area includes most of the colonies in the northern part of the basin (Betts 1990). This decline is wholly consistent with known habitat loss.

Lehmkuhl and others (1997) projected a decline from historical in populations of the Mojave black-collared lizard as a result of the cumulative effects of habitat loss because of agricultural conversion, exotic weed invasion, and reservoir development.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 32 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—The condition of the habitat for group 32 can be summed up by the composite ecological integrity ratings (Quigley and others 1996) that show most of the habitat to have a “low” rating. Most of the current habitat for this group is classified into Rangeland Clusters 5 (generally corresponding to much of the Owyhee Uplands ERU) and 6 (generally the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs), where the primary risk to ecological integrity is “continued declines in herbland and shrubland habitats” (Quigley and others 1996). Further, Rangeland Cluster 6 has the additional risk of being “. . . highly sensitive to overgrazing and exotic grass and forb invasion” (Quigley and others 1996, p. 123). These widespread and overriding issues provide a clear statement of the problems facing this group over the long term. The results of our habitat trend analysis, combined with other literature cited here, suggest the following issues are of high priority for group 32:

1. Permanent and continued loss of large areas of shrub-steppe and fescue-bunchgrass habitat to agricultural conversion, brush control, cheatgrass invasion, and expansion of juniper woodlands and mountain mahogany.

2. Increased soil compaction and loss of the microbiotic crust.

3. Reduction in burrow availability for lizards and snakes.

4. Human-caused mortality and capture of reptiles for pets.

5. Loss of downed logs.

6. Loss of surface water and riparian vegetation.

Potential strategies—The following strategies could be used to reverse broad-scale declines in source habitats. These strategies should be applied basin-wide:

1. (To address issue no. 1) Identify and conserve remaining large areas of shrub-steppe, fescue-bunchgrass, wheatgrass bunchgrass, and other source cover types where ecological integrity is still relatively high (Gray and Rickard 1989, Rickard and Poole 1989, Schuler and others 1993, Smith 1994, Yoakum 1980). Large contiguous blocks of Federal land in the Northern Great Basin and Owyhee Uplands are the most obvious sites to consider. These generally include the subbasins in Rangeland Cluster 5 (Quigley and others 1996). However, native shrublands that currently exist on military lands in the state of Washington (Rickard and Poole 1989, Schuler and others 1993, Smith 1994) also are important. These core areas will provide long-term habitat stability for populations and provide the anchor points for restoration, corridor construction, and other landscape-level management.

2. (To address issue no. 1) Minimize further spread of juniper woodlands, juniper/sagebrush, and mountain mahogany that have expanded because of fire suppression, particularly in the Central Idaho Mountains and the Columbia Plateau.

3. (To address issue no. 2) Reduce causes of soil compaction, particularly within source habitats of the longnose snake and ground snake. This factor may be important in the Owyhee Uplands ERU in particular. Restore microbiotic crusts in ERUs with potential for redevelopment (that is, areas near propagule sources, and with suitable soil, vegetation, and climatic characteristics [see Belnap 1993, 1995; Kaltenecker 1997; Kaltenecker and Wicklow-Howard 1994]): Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs and, to a lesser extent, the Columbia Plateau ERU (Hann and others, map 3.59).

4. (To address issue no. 3) Maintain and restore small-mammal populations to provide burrows for the collared lizard, longnose leopard lizard, longnose snake, and ground snake.

5. (To address issue no. 4) Determine the impact of the capture of reptiles, especially lizards, for pets. Take action as necessary to allow wild populations to persist.

6. (To address issue no. 4) Reduce the direct and indirect effects of human disturbance on populations of species within group 32.

7. (To address issue no. 5) Increase the number of downed logs in the basin.

8. (To address issue no. 6) Improve the condition of riparian systems throughout the basin.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Identify large areas of high ecological integrity to be managed for long-term protection by analyzing current vegetation,

precipitation patterns, elevation, temperature (Klemmedson and Smith 1964, Morrow and Stahlman 1984, Stewart and Hull 1949), and the presence of priority species in this group. These sites are most likely to be successful on large areas of Federal land managed by BLM. Apply special management designations as necessary to protect these sites for the long term.

2. (In support of strategy no. 1) Explore options under the CRP (Johnson and Igl 1995), or develop other incentive programs, to encourage restoration of agricultural areas to native cover types. Focus on areas that would increase patch size or links with existing source habitat patches.

3. (In support of strategy no. 1) Avoid further loss of sagebrush cover through burning, plowing, seeding, and other brush “control” methods where sagebrush cover types are below historical levels.

4. (In support of strategy no. 1) Avoid further conversion of sagebrush and native grasslands to agricultural lands through policy and land management allocations. If conversion cannot be avoided, then tracts slated for conversion will have less impact if located so as to (a) minimize further fragmentation of shrub-steppe throughout the basin; (b) avoid further reducing the size of smaller, isolated patches, particularly in the Columbia Plateau ERU; and (c) avoid conversion in areas that currently occur in large blocks of moderate Composite Ecological Integrity (Quigley and others 1996), primarily in the Owyhee Uplands and Northern Great Basin ERUs.

5. (In support of strategy no. 1) Use fire prevention and suppression to retard the spread of cheatgrass in areas that are susceptible to cheatgrass invasion but currently are dominated by native grass species. Planting of fire-resistant vegetation through “green stripping” (Pellant 1994) should be examined for its value to protect existing vegetation as well as allow degraded sites a chance to recover.

6. (In support of strategy no. 1) Restore selected areas of cheatgrass monocultures through seeding and other manipulations (Allen 1995, Daubenmire 1970, Evans and Young 1978, Hosten and West 1994, Kennedy 1994, Monsen and McArthur 1995, Ogg 1994, Whisenant 1995, Yoakum 1986b) where such restoration would increase the size of existing shrub-steppe patches or provide links among patches.

7. (In support of strategy no. 1) Restore native vegetation by appropriate mechanical treatments and seedings of native shrub, grass, and forb species.

8. (In support of strategy no. 2) Apply wildland fire and grazing practices that arrest the advances of juniper woodlands in areas that historically did not support this vegetation type.

9. (In support of strategy no. 3) Reduce or eliminate livestock grazing in critical habitat for the ground and longnose snakes if soil compaction is found to contribute to population declines. Encourage the redevelopment of microbiotic crust by reducing or eliminating livestock grazing (Mack and Thompson 1982, St. Clair and others 1993). Explore the use of ground-based and aerial soil inoculation to increase the speed and extent of dispersal of the organisms that create microbiotic crust (Belnap 1993).

10. (In support of strategy no. 4) Allow burrowing mammals such as ground squirrels and marmots to persist or expand to provide burrows for the lizards in this group and for the longnose snake.

11. (In support of strategies no. 5 and no. 6) Minimize accidental and deliberate killing of snakes by vehicles and by humans on foot. Road densities, which provide an index to the potential for disturbance, reveal that the Owyhee Uplands, Northern Great Basin, and northern part of the Columbia Plateau ERUs are least susceptible to disturbance (Quigley and others 1996). Determine the direct effect of recreational shooting of ground squirrels on populations in this group. Effects may be serious only in local situations where the demand for this recreation and access to squirrels coincide. Washington ground squirrels are especially vulnerable because of their limited distribution and known losses to date. Avoid poisoning or otherwise controlling ground squirrel populations. Encourage and enforce laws that protect reptiles from collection.

12. (In support of strategy no. 8) Maintain strips of trees and snags along riparian corridors. Restore and enhance riparian and shoreline vegetation around permanent and seasonal water sources.

Group 33—Brewer's Sparrow, Lark Bunting, Sage Sparrow, Sage Thrasher, Sage Grouse, Pygmy Rabbit, and Sagebrush Vole

Results

Species ranges, source habitats, and special habitat features—Group 33 includes breeding habitat for the migratory Brewer's sparrow, lark bunting, sage sparrow, and sage thrasher, summer and winter range for the sage grouse, and year-round habitat for the pygmy rabbit and sagebrush vole. The basin encompasses a substantial portion of the entire range of all species in this group, with the exception of the lark bunting, which is peripheral to the basin, occurring only in the southeastern part of the basin (fig. 99). Both the pygmy rabbit and sage grouse (current range) have notable gaps in their distribution, with significant disjunct populations primarily in the Columbia Plateau ERU. The current range of the sage grouse also has disjunct populations occurring in the Upper Klamath and Snake Headwaters ERUs. In comparison, the historical range of the sage grouse (fig. 99) was substantially more extensive and included portions of the Columbia Plateau, Blue Mountains, Northern Glaciated Mountains, Lower Clark Fork, and the Upper Clark Fork ERUs, where the species does not occur today.

The seven species in this group have source habitats in two structural stages of big sagebrush and mountain big sagebrush: open canopy, low-medium shrub, and closed canopy, low-medium shrub (vol. 3, appendix 1, table 1). Four of the species (pygmy rabbit, sagebrush vole, sage grouse, and sage sparrow) also have source habitats in both structural stages of low sagebrush. Other habitats of importance are juniper/sagebrush (Brewer's sparrow, sage sparrow, sage thrasher) and the closed herb structural stage of big sagebrush (Brewer's sparrow, lark bunting, sage sparrow, and sage thrasher). Habitats used by only a single species in the group include mountain mahogany (Brewer's sparrow), salt desert shrub (sage sparrow), and herbaceous wetlands (sage grouse).

A special habitat feature for sage grouse during the brood-rearing period is riparian vegetation, especially wet meadows with forbs (vol. 3, appendix 1, table 2). Native forbs provide spring and summer food for hens and broods (Autenrieth and others 1982, Call 1979, Oakleaf 1971, Peterson 1970, Roberson 1986, Savage 1969, Wallestad and others 1975). Herbaceous vegetation is also important to sagebrush voles (Hall 1928) and pygmy rabbits (Lyman 1991), which augment their sagebrush diet with forbs and grasses. An understory composed of native grasses is believed important for most species in group 33 (Bock and Bock 1987, Connelly and others 1991, Cooper 1868, Dobler and others 1996, Gregg 1991, Hall 1928, Mullican and Keller 1986).

Bare ground is an important foraging substrate for sage sparrows and sage thrashers (Rotenberry and Wiens 1980). Brewer's sparrows, however, forage mostly in sagebrush. The value of bare ground to the other bird species in this group and the sagebrush vole is unknown. Because pygmy rabbits choose tall, dense sage for their burrows and foraging sites, we assume that vegetative cover that provides protection from predators is important (Lyman 1991) and that areas of bare ground would be avoided.

Broad-scale changes in source habitats—Source habitats for group 33 were historically widespread and continuous over much of the planning area (fig. 100A), particularly in the Columbia Plateau, Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs.

Basin-wide, nearly 48 percent of the watersheds showed a moderately or strongly declining trend in habitat, and declines exceeded increases in every ERU (fig. 101). Extensive habitat reductions were estimated in the Columbia Plateau and Upper Snake ERUs, with moderate declines in the Owyhee Uplands (figs. 100 and 101). Strongly increasing trends in habitat, however, were apparent in about 20 percent of watersheds in the Central Idaho Mountains and Columbia Plateau ERUs (fig. 101). Only the Northern Great Basin ERU has changed little from historical conditions (figs. 100 and 101).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—The single largest loss in cover types within the basin was the decline in big sagebrush (Hann and others 1997). Large-scale

Figure 99—Ranges of species in group 33 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 99—Ranges of species in group 33 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 100—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 33 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

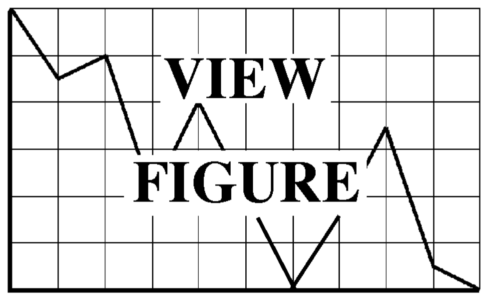

Figure 101—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 33, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

loss of sagebrush habitat was attributed to several factors. The first factor was conversion to agriculture. Agricultural lands have increased significantly in every ERU in the basin (Hann and others 1997). In fact, the largest transition of any terrestrial community was from upland shrubland to agriculture (Hann and others 1997). The ERUs with the biggest changes were the Columbia Plateau and Upper Snake. The former is now nearly half agricultural lands, whereas the latter is nearly one-third. These ERUs have had the greatest degree of conversion among all ERUs in the basin. Agriculture also now occupies over a tenth of the Owyhee Uplands ERU. Only the Northern Great Basin ERU has been relatively free of agricultural conversions.

A second factor contributing to loss of sagebrush habitat was conversion of shrub-steppe vegetation to exotic forbs and annual grass. Significant increases in this cover type occurred in all the major sagebrush ERUs. Exotic forbs and annual grass now occupy small portions of the Northern Great Basin, Columbia Plateau, and Owyhee Uplands ERUs, and over a tenth of the Upper Snake ERU (Hann and others 1997).

Increases in source habitats in the Central Idaho Mountains and Columbia Plateau ERUs were attributed to expansions of juniper/sagebrush and mountain mahogany cover types (Hann and others 1997).

Habitat condition for group 33 can be described by the composite ecological integrity ratings (Quigley and others 1996) that show most of the habitat to have a “low” rating. Most of the current habitat for this group was classified into Rangeland Clusters 5 (generally corresponding to much of the Owyhee Uplands ERU) and 6 (generally the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs), where the primary risk to ecological integrity is continued losses of herbland and shrubland habitats (Quigley and others 1996). Further, Rangeland Cluster 6 is vulnerable to overgrazing and to exotic grass and forb invasions (Quigley and others 1996).

Condition of special habitat features—Wet meadows and riparian vegetation, cover types used for brood-rearing by sage grouse, have declined substantially since historical times (Lee and others 1997, Quigley and others 1996).

Other factors affecting the group—Roading (Quigley and others 1996) has contributed to increased human disturbance in ERUs most important for sage grouse. Moderate road densities (0.4 to 1.0 km per km^2 [0.7 to 1.7 mi per mi^2]) are typical for the Northern Great Basin ERU, the Owyhee Uplands ERU, and the Upper Snake ERU. Roads and associated human disturbance can be especially harmful to sage grouse during the lekking and wintering periods. Habitat loss caused by roads is a direct effect.

The quality of soil may be important to the two burrowing species in this group (sagebrush vole and pygmy rabbit) because the soil must be capable of sustaining burrows. Weiss and Verts (1984) determined that burrow sites for pygmy rabbits are found in areas where soils are significantly deeper and looser than adjacent soils. Grazing, if not managed properly, can potentially damage pygmy rabbit habitat (Washington Department of Wildlife 1993b).

Voles seldom use compacted or rocky soil (Maser and others 1974) and may be absent from areas that have suffered soil erosion because of heavy livestock grazing (Maser and Strickland 1978).

Heavy livestock grazing could negatively impact other species in group 33 by altering the structure and composition of the soil and removing native herbaceous understory vegetation. Thus, areas that are currently judged to be source habitat because of the presence of sagebrush cover may not be currently suitable because of changes in soil or understory vegetation that cannot be mapped at the broad scale. Additionally, changes in natural wildfire regimes have contributed to invasions of exotic vegetation in native sagebrush habitats.

Species in this group evolved in shrub-steppe habitats, where microbiotic crusts were broadly distributed (see Kaltenecker and Wicklow-Howard 1994). Microbiotic, or cryptogamic, crusts consist of lichens, bryophytes, algae, microfungi, cyanobacteria, and bacteria growing on or just below the soil surface in arid and semiarid environments (Kaltenecker and Wicklow-Howard 1994); these crusts developed without large herds of grazing ungulates (St. Clair and Johansen 1993). In addition, these crusts are projected to have been widely distributed throughout the source habitats for this group, particularly in the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs but also scattered in the Columbia Plateau ERU (Hann and others 1997, map 3.59). Increasing evidence indicates that microbiotic crusts improve soil stability, productivity, and moisture retention; moderate extreme temperatures at the soil surface; and enhance seedling establishment of vascular plants (Belnap and Gardner 1993, Harper and Pendleton 1993, Johansen and others 1993, St. Clair and others 1993), thus contributing to high ecological integrity of shrub-steppe habitats. The BLM in Idaho has recognized the potential importance of microbiotic crusts by proposing standards for rangeland health that include the maintenance of these crusts to ensure proper functioning and productivity of native plant communities (USDI Bureau of Land Management 1997). These crusts were widely destroyed by trampling during the excessive livestock grazing of the late 1800s and early 1900s (Daubenmire 1970, MacCracken and others 1983, Mack and Thompson 1982, Poulton 1955). Currently, high-intensity grazing and altered fire regimes modify shrub-steppe plant communities and threaten the maintenance and recovery of microbiotic crusts (Belnap 1995, Kaltenecker 1997, St. Clair and Johansen 1993).

Little information is available on effects of landscape patterns on species in this group. Brewer's sparrows are known to have small territories, and individual pairs will occupy small patches of suitable habitat placed within a matrix of unsuitable vegetation. Sage thrashers also appear to use discontinuous, patchy habitats surrounded by other types but rarely occur as single pairs; the probability of habitat occupancy increases with shrub patch size (Knick and Rotenberry 1995). Sage sparrows seem to be both area sensitive and more social (Rich 1981) than the previous two species. Individual pairs essentially never occur alone. The species does not occupy small patches of habitat, and large patches of seemingly suitable habitat may be unoccupied. Thus, sage sparrows occur in large expanses of shrub-steppe where many pairs share adjacent territories (Knick and Rotenberry 1995) and apparently do not use slopes of greater than a few percent.

Disjunct patches of sagebrush that were previously connected to other patches may now be unsuitable source habitat for sage grouse because wintering flocks have large home ranges. Grouse select winter use sites based on snow depth and topography (Connelly 1982, Hupp 1987, Robertson 1991) where sagebrush is accessible. Sagebrush heights of 25 to 30 cm (10 to 12 in) and canopy cover of 10 to 25 percent, regardless of snow cover, are important for winter use by sage grouse. Because seasonal movements differ among regions and populations, this effect needs to be assessed case by case.

Populations of pygmy rabbits historically occurred in five counties in Washington, but current records indicate that populations occur in isolated fragments in only one county (Douglas) (Washington Department of Wildlife 1993b). These small, disjunct populations are susceptible to extirpation by habitat degradation and loss, as well as catastrophic events such as fire, disease, flooding, or intense predation.

The sage sparrow, Brewer's sparrow, and lark bunting are not frequently parasitized by brown-headed cowbirds (Ehrlich and others 1988). Both sparrows apparently accept the eggs (Rich 1978). The sage thrasher also is parasitized but rejects cowbird eggs (Rich and Rothstein 1985). Sage grouse using agricultural areas may be adversely affected by pesticide applications (Blus and others 1989, Post 1951, Ward and others 1942).

Population status and trends—Quantitative population trend data are available only for the bird species in group 33. No information is available for the pygmy rabbit, only anecdotal notes are available for the sagebrush vole and, because the lark bunting is peripheral to the basin, sample sizes for this species are inadequate.

Historical reports indicate that the sagebrush vole was abundant in grasslands around Walla Walla in 1868 (Cooper 1868), although it has not been found there since. Currently, other subspecies of this vole occur in higher elevation grasslands in Utah and California where sagebrush does not occur. This suggests that the species may occur today largely in shrub-steppe habitats because the large grasslands, which it may actually prefer, no longer exist. Thus, the species probably experienced substantial population declines.

Brewer's sparrow has the most clear population trend, decreasing 1.3 percent per yr ($n > 14$, $P < 0.01$) over the period 1968-94 and 4.3 percent per yr ($n > 14$, $P < 0.01$) over the period 1984-94 (Saab and Rich 1997) in the basin. This sparrow also is declining in Idaho (6.3 percent per yr, 1966-95; $n = 40$, $P < 0.01$) and in physiographic region 89 (Columbia Plateau; 5.2 percent decline over the same period, $n = 57$, $P < 0.01$) (Sauer and others 1996). Among 15 Neotropical migrants in the basin, Brewer's sparrow, sage sparrow, sage thrasher, and lark bunting were designated as species of high concern to management under all future management themes for the basin (Saab and Rich 1997).

Population trends for the sage sparrow and sage thrasher are not consistent with the population declines demonstrated by Brewer's sparrows and sage grouse. The sage sparrow shows no trend in the basin (Saab and Rich 1997) and a nonsignificant decline of -1.0 percent per yr (1966 to 1995, n = 38) in physiographic region 89 (Columbia Plateau; Sauer and others 1996). The sage thrasher also shows no trend in the basin (Saab and Rich 1997), a nonsignificant 1.1-percent decline per yr in Idaho (n = 28), a 2.1-percent per yr increase in Oregon (n = 27, P < 0.01), and a nonsignificant 0.8-percent increase in physiographic region 89 (Columbia Plateau; n = 51) over the period 1966-95 (Sauer and others 1996).

Sage grouse populations have shown significant, steep declines since the 1940s in Idaho,[13] Oregon (Crawford and Lutz 1985), and Washington (Tirhi 1995). The rates of decline in Idaho and Oregon are not significantly different.[14] Moreover, the rate of decline in Washington appears to be similar to that in Idaho and Oregon, thereby suggesting common, widespread factors affecting these populations. A complicating factor is that sage grouse in this geographic area may exhibit population cycles with a periodicity of around 10 years (Rich 1985, Willis and others 1993b). Thus, apparent trends over short periods should be regarded with caution. Populations in Washington were heavily impacted by habitat loss before surveys were established. Remaining populations now exist as isolated remnants (Tirhi 1995).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 33 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

[13] Personal communication. 1997. John Connelly, Upland Bird Research Coordinator, Idaho Department of Fish and Game, P.O. Box 25, Boise, ID 83707-0025.

[14] Personal communication. 1997. Terrell D. Rich, National Avian Ecologist, USDI Bureau of Land Management, 1387 S. Vinnell Way, Boise, ID 83709.

Issues—The results of our habitat trend analysis suggest the following issues are of high priority for group 33:

1. Permanent and continued loss of large areas of shrub-steppe habitat to agricultural conversion, brush control, and cheatgrass invasion.

2. Soil compaction, erosion, and loss of microbiotic crust.

3. Continued degradation of wet meadow and riparian vegetation adjacent to springs, seeps, and streams by improper grazing and, in some areas, spring development to provide livestock water supplies.

4. Adverse effects of human disturbance.

Potential strategies—The following strategies could be used to reverse broad-scale declines in source habitats:

1. (To address issue no. 1) Identify and conserve large remaining areas of shrub-steppe vegetation where ecological integrity is still relatively high (Gray and Rickard 1989, Rickard and Poole 1989, Schuler and others 1993, Smith 1994, Yoakum 1980). Basin-wide, maintain or restore 15 to 25 percent of sagebrush cover with heights of 36 to 79 cm (14 to 31 in) (Autenrieth 1981, Connelly and others 1991, Fischer 1994, Gregg 1991, Klebenow 1969, Patterson 1952, Peterson 1970, Wakkinen 1990, Wallestad 1975). In sage grouse winter range, maintain a mosaic of sagebrush height and cover classes to allow access to sagebrush with canopy cover of 10 to 25 percent and heights of 25 to 30 cm (10 in to 12 in) regardless of snow cover (Connelly 1982, Hupp 1987, Robertson 1991).

2. (To address issue no. 1) Restore native grass and forb understories to historical levels, where restoration potential exists, and retard the spread of nonnative vegetation.

3. (To address issue no. 2) Reduce and eliminate soil compaction and erosion to benefit both pygmy rabbits and sagebrush voles.

4. (To address issue no. 2) Restore microbiotic crusts in ERUs with potential for redevelopment (that is, areas near propagule sources, and with suitable soil, vegetation, and climatic characteristics [see Belnap 1993, Belnap 1995, Kaltenecker 1997, Kaltenecker and Wicklow-Howard 1994]): the Northern Great Basin, Owyhee Uplands, Upper Snake, and to a lesser extent, the Columbia Plateau (Hann and others, map 3.59).

5. (To address issue no. 3) Restore vegetation around springs, seeps, streams, meadows, and other riparian areas.

6. (To address issue no. 4) Minimize the adverse effects of human disturbance.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Identify sites of high ecological integrity to be managed for long-term protection by analyzing current vegetation, precipitation patterns, elevation, temperature (Klemmedson and Smith 1964, Morrow and Stahlman 1984, Stewart and Hull 1949), and the presence of priority species in this group. These practices are most likely to be successful on large areas of Federal land managed by the BLM.

2. (In support of strategy no. 1) Explore options under the CRP (Johnson and Igl 1995), or develop other incentive programs, to encourage restoration of agricultural areas to native cover types. Focus on areas that would increase patch size or links with existing source habitat patches.

3. (In support of strategy no. 1) Avoid further loss of sagebrush cover through burning, plowing, seeding, and other brush "control" methods where sagebrush cover types are below historical levels.

4. (In support of strategy no. 1) Avoid further conversion of source habitats to agricultural lands, or strive to minimize the impacts of further conversions through landscape design, to minimize further fragmentation of shrub-steppe.

5. (In support of strategy no. 2) Use fire prevention and suppression to retard the spread of cheatgrass in areas that are susceptible to cheatgrass invasion but currently are dominated by native grass species. Planting of fire-resistant vegetation through "green stripping" (Pellant 1994) could be explored to evaluate its effectiveness in protecting existing native vegetation.

6. (In support of strategy no. 2) Restore selected areas of cheatgrass monocultures through seeding and other manipulations (Allen 1995, Daubenmire 1970, Evans and Young 1978, Hosten and West 1994, Kennedy 1994, Monsen and McArthur 1995, Ogg 1994, Whisenant 1995, Yoakum 1986b), where such restoration would increase the size of existing shrub-steppe patches or provide links among patches.

7. (In support of strategy no. 2) Plant perennial bunchgrasses or native forbs where these components of the habitat have been lost or reduced (Braun and others 1976, Daubenmire 1970, Evans and Young 1978, Yoakum 1986b). Criteria for enhancement include maintaining or increasing the size of smaller patches, preventing further habitat disassociation, and protecting or increasing the size and integrity of corridors among patches, all in connection with the location of sites with high ecological integrity as identified above.

8. (In support of strategies nos. 2-4) Modify grazing systems or reduce grazing use where native perennial bunchgrasses have been depleted.

9. (In support of strategy no. 4) Encourage the redevelopment of microbiotic crust by reducing or eliminating livestock grazing (Mack and Thompson 1982, St. Clair and others 1993). Explore the use of ground-based and aerial soil inoculation to increase the speed and extent of dispersal of the organisms that create microbiotic crust (Belnap 1993, 1994).

10. (In support of strategy no. 5) Protect existing riparian, spring, and seep sites of high ecological integrity from degradation, restore degraded sites, restore historical water tables in nonfunctioning riparian systems, and eliminate or greatly reduce water diversions. Seeding of native forbs, in particular, may be desirable in certain mesic areas to improve sage grouse brood-rearing habitat.

11.(In support of strategy no. 6) Protect sage grouse leks from human disturbance by designating leks and winter concentration sites as special management areas closed to public access, avoiding the placement of new roads or the improvement of existing roads in important sage grouse areas, and closing existing roads in sensitive areas.

12.(In support of strategy no. 6) Control, reduce, or eliminate pesticide use around agricultural areas adjacent to sage grouse habitat (Blus and others 1989, Post 1951, Ward and others 1942). Avoid use of toxic organophosphorus and carbamate insecticides in sage grouse brood-rearing habitats.

13.(In support of strategy no. 6) Restrict organized recreational events in sage grouse nesting, brood-rearing, and wintering habitats at the appropriate times of year (Call 1979, Roberson 1986).

Group 34—Kit Fox and Black-Throated Sparrow

Results

Species ranges, source habitats, and special habitat features—Group 34 consists of two shrubland species, the kit fox and black-throated sparrow. Both species occur in the most southern shrublands of the basin, and the black-throated sparrow also is found in south-central Washington (fig. 102). The kit fox is a year-round resident of the basin, whereas the black-throated sparrow is a summer resident, migrating to southern portions of its range and Baja California for the winter. The basin represents the northern periphery of the continental distribution for these species, both of which are more commonly associated with desert shrublands of southwestern North America.

Source habitats for both species are big sagebrush and salt desert shrub, and the black-throated sparrow also uses mountain big sagebrush (vol. 3, appendix 1, table 1). Structural stages within these cover types are open- and closed-canopy stages of low-medium shrubs. In southeastern Oregon and northern Nevada, black-throated sparrows are found predominantly in sites with higher shrub cover, greater maximum shrub height, and greater shrub species diversity than used by another shrub-steppe species, the sage sparrow (Wiens and Rotenberry 1981).

Aspecial habitat feature identified for the kit fox is the presence of burrows for den sites (vol. 3, appendix 1, table 2). Kit foxes often use the abandoned dens of other species, and most home ranges include several dens (Egoscue 1962). In addition to reproductive purposes, dens provide resting habitat that modifies the extremes of desert weather and furnishes protection from predators (Golightly and Ohmart 1983). No special habitat features have been identified for the black-throated sparrow.

Broad-scale changes in source habitats—Source habitats have undergone localized declines since historical times. Historically, source habitats were concentrated along the southeastern border of Oregon and southern border of Idaho, extending also into the portions of Nevada and Utah that are included in the basin (fig. 103A). Source habitats for the black-throated sparrow also occurred in south-central Washington. The current distribution of source habitats is roughly the same, but declines in habitat availability have occurred primarily in south-central Washington and south-central Idaho (fig. 103B).

The amount of source habitats was estimated as roughly the same as the historical extent in 65 percent of the watersheds in which these species occur, but 33 percent of the watersheds have exhibited declining trends (fig. 104). The greatest declines occurred in the Upper Snake ERU, where 29 of 55 watersheds had strongly declining trends (fig. 104). The Blue Mountains and Snake Headwaters ERUs also had strongly declining trends, but only three watersheds in each ERU provided source habitats historically, so the magnitude of change may not be significant. Habitat trends were mostly static in the Owyhee Uplands ERU, although 82 of the 256 watersheds with source habitats have declining trends (fig. 104).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—The principal cause for observed declines in habitat availability is the alteration of sagebrush and salt desert shrub to other cover types, primarily agriculture, urban, juniper/sagebrush, and exotic forbs-annual grass. In the Columbia Plateau ERU, nearly one half of the big sagebrush cover type was converted to croplands (Hann and others 1997). Virtually all broad-scale patches of mountain big sagebrush in the Columbia

Figure 102—Ranges of species in group 34 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 103—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 34 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

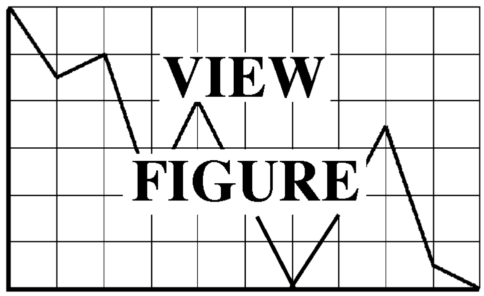

Figure 104—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 34, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n.*

Plateau within the range of the black-throated sparrow were eliminated (vol. 3, appendix 1, table 4). In the Owyhee Uplands, the dominant cover type transition was from the big sagebrush cover type to croplands and exotic forbs-annual grass (Hann and others 1997). In the Upper Snake ERU, an estimated 41 percent of the sagebrush cover type was converted to croplands (Hann and others 1997).

Condition of special habitat features—No information is available to determine whether changes in availability of burrows for kit fox dens, or in soil conditions needed for burrow excavation, have occurred in the basin. Lack of suitable loose-textured soil for burrow construction may be a natural, limiting factor for kit foxes in southeastern Oregon (Keister and Immell 1994). The soil surface there is predominantly desert pavement, whereas soils near Fallon, Nevada, where higher densities of kit foxes occur than in Oregon, are typically sandy (Keister and Immell 1994). Land uses that increase soil compaction or cause the destabilization of dunes may inhibit burrow establishment.

Other factors affecting the group—The black-throated sparrow seems to show a positive numerical response to moderate livestock grazing (Bock and others 1984, cited in Saab and others 1995).

Because the kit fox is a predator, population health is affected by the availability of small-mammal prey, which in turn is affected by vegetation composition and structure. Land uses that do not directly affect kit foxes may nevertheless affect prey availability. Livestock grazing can impact small-mammal abundance and diversity (Bock and others 1984; Hanley and Page 1982, as cited in Horning 1994).

Kit foxes are vulnerable to poisoned baits placed for destruction of coyotes (Orloff and others 1986). They are also susceptible to hunting and trapping, usually as a nontarget species (DeStefano 1990). Coyote predation is a major cause of kit fox mortality in the San Joaquin Valley of California (White and others 1994), and is a potential limiting factor of kit foxes in the basin.

Population status and trends—Population trend data are not available for the black-throated sparrow within the basin. The only statistically significant population trend for the black-throated sparrow is based on numbers recorded on all BBS routes in North America with black-throated sparrow occurrences between 1966 and 1995. This survey-wide trend indicated a 4-percent annual decline across the range of the species over the 28-yr period (n = 258, $P < 0.05$; Sauer and others 1996). Occurrences of the black-throated sparrow on BBS routes within the basin are insufficient to conduct a statistically robust trend analysis (Saab and Rich 1997). Saab and Rich (1997), however, included the black-throated sparrow as one of 15 Neotropical migrants in the basin that are of high concern to management under all future management themes for the basin primarily because of its association with just four cover type-structural stage combinations. We know of no estimates of kit fox numbers within the basin.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 34 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Primary conservation issues for group 34 are as follows:

1. Loss of desert shrub habitat to other land uses and to shrub-control programs.

2. Degradation of desert shrub habitat quality through exotic weed invasions.

3. Effect of adverse land uses on understory vegetation that supports kit fox prey base.

4. Lack of information on the location and status of kit fox dens.

Potential strategies—Strategies for addressing the issues listed above include the following:

1. (To address issue no. 1) Maintain remaining native desert shrublands, especially in the Upper Snake ERU and in all watersheds within the Owyhee Uplands where strong negative trends have occurred.

2. (To address issue no. 2) Restore desired vegetation composition and structural attributes of shrublands that no longer meet source habitat conditions.

3. (To address issue no. 3) Avoid land use practices that potentially affect kit fox prey by reducing the grass-forb component of shrub communities.

4. (To address issue no. 4) Locate and protect active dens of the kit fox.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (To address strategy no. 1) Identify areas of native shrubland vegetation with high ecological integrity, particularly within the Columbia Plateau and Upper Snake ERUs, and actively manage to promote their long-term sustainability.

2. (To address strategy no. 2) Use prescribed burns, shrub planting, and exotic weed control to restore degraded shrublands, but avoid burning areas susceptible to invasion by noxious weeds.

3. (To address strategy no. 3) Adjust or maintain grazing management plans to promote long-term persistence of the grass and forb components of shrub communities.

4. (To address strategy no. 4) Conduct surveys for kit fox burrows, and provide protective measures for active burrows in all relevant planning documents.

Group 35—Loggerhead Shrike

Results

Species ranges and source habitats—Group 35 consists of breeding habitat for the loggerhead shrike. Range of the loggerhead shrike (fig. 105) includes most of the basin except for the mountainous portions of Idaho and Montana and the eastern slope of the Cascade Range. Outside the planning area, the species is widespread as a breeder or year-round resident in the United States and Mexico (Yosef 1996).

This shrike uses various woodland and shrub cover types including juniper, sagebrush, mountain shrub types, salt desert shrubs, and bitterbrush/wheatgrass (vol. 3, appendix 1, table 1). The common structural feature is a good component of woody vegetation in a landscape dominated by more open structure. Nests are typically placed in the taller woody vegetation, whereas the bird forages in open areas.

Broad-scale changes in source habitats—High percentages of contiguous watersheds with source habitats for the loggerhead shrike historically occurred in the Columbia Plateau, Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs (fig. 106A).

Basin-wide, moderate and strong declines (44 percent of watersheds) in source habitats exceeded moderate and strong increases (24 percent), but over 30 percent of watersheds showed no estimated change from the historical condition (fig. 107). Although declining trends in the Columbia Plateau seem to balance against increasing trends (fig. 107), these upward trends were due to large relative increases in vegetation that actually covered <8 percent of the ERU. The biggest losses occurred in the Upper Snake ERU (fig. 107), with over 57 percent of the watersheds showing strong decreases. In contrast, the Upper Klamath ERU was estimated to have nearly 62 percent of its watersheds strongly increasing in source habitats (fig. 107).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Among source habitats basin-wide, big sagebrush types have declined by one-third, the most serious habitat change for shrikes because of the total acreage affected (vol. 3, appendix 1, table 4; Hann and others 1997). Salt desert shrub and mixed-conifer woodlands also have declined substantially, one-third and one-half, respectively. Together, the latter declines affected only a small part of the basin (vol. 3, appendix 1, table 4; Hann and others 1997). The only other significant basin-wide changes have been increases in juniper/sagebrush, juniper woodlands, and mountain mahogany (Hann and others 1997). The latter three types combined, however, cover only a small percentage of the basin.

Figure 105—Ranges of species in group 35 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

The largest changes have been in the Upper Snake and Columbia Plateau ERUs, where big sagebrush has declined by about 50 percent (vol. 3, appendix 1, table 4). In the Upper Clark Fork and Blue Mountains ERUs, mixed-conifer woodlands have declined by over four-fifths and one-half, respectively (Hann and others 1997). Declines in the Upper Clark Fork can be attributed to a near total loss of mixed-conifer woodlands, although this type historically only covered a small portion of the ERU. Increases in the southern Columbia Plateau are due to juniper/sagebrush, which more than doubled, and mountain mahogany, up nearly sixfold; these types together now are estimated to occupy nearly one-tenth of the ERU. Similarly, juniper/sagebrush in the Upper Klamath is estimated to have tripled, making the availability of source habitats there significantly greater (Hann and others 1997). Large increases in source habitats in the Northern Glaciated Mountains are most likely because of relatively large increases in mixed-conifer woodlands, though source habitat is limited in this ERU.

Large-scale loss of sagebrush habitats is due to several factors. The first factor is conversion to agriculture. Agricultural lands have increased significantly in every ERU in the basin (Hann and others 1997). In fact, the largest transition of any terrestrial community from historical to the current period was that of upland shrubland to agriculture (+9.0 percent), and the second largest was that from upland herbland to agriculture (+6.6 percent, Hann and others 1997). This transition, occurring in the fundamental source habitats for this group, explains much of the pattern evident in habitat trends for loggerhead shrike (fig. 106).

A second factor contributing to loss of sagebrush habitat is conversion of shrub-steppe vegetation to exotic forbs and annual grass. Increases in exotic cover types have occurred in all the major shrub-steppe ERUs. Substantial portions of the Owyhee Uplands and Upper Snake ERUs have undergone a conversion from upland shrubland to exotic herbland (Hann and others 1997).

Figure 106—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 35 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

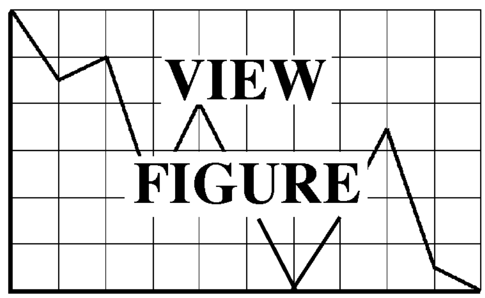

Figure 107—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 35, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

The condition of the habitat for group 35 can be described by the composite ecological integrity ratings (Quigley and others 1996) that show most of the habitat to have a “low” rating. Most of the current habitat for this group was classified into Rangeland Clusters 5 (generally corresponding to much of the Owyhee Uplands ERU) and 6 (generally the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs), where the primary risk to ecological integrity is continued losses of herbland and shrubland habitats (Quigley and others 1996). Further, Rangeland Cluster 6 also is vulnerable to overgrazing and to exotic grass and forb invasions (Quigley and others 1996).

Other factors affecting the group—Shrikes prefer tall plants for nest sites, often choosing particularly tall individual big sagebrush plants or, more generally, sites with tall average shrub heights (for example, >1 m [3 ft]) (Leu 1995, Sharp 1992, Yosef 1996). This type of sagebrush community is apt to be a big sagebrush site with deeper soils and a slightly more mesic moisture regime. These sites are precisely where agricultural conversion has most commonly occurred in the past and where future risks of conversion remain the greatest (Hann and others 1997).

Shrikes also prefer to hunt from elevated perches such as fence posts, utility lines, and woody vegetation (Bohall-Wood 1987, Gawlik and Bildstein 1993, Yosef and Grubb 1992), and to restrict their foraging to an area within 10 m of such perches (Chavez-Ramirez and others 1994). Their use of any area may correspond directly to the availability of such perches. Young shrikes prefer to forage on bare ground and sites with little vegetative cover (Leu 1995). Foraging opportunities for young shrikes may be severely reduced because shrub-steppe habitats with natural openings of bare ground have been altered by exotic grasses (for example, cheatgrass) and forbs, creating a continuous vegetative layer (see Leu 1995).

In a study area generally corresponding to the Northern Great Basin ERU, shrike densities were negatively correlated with the cover of grass and positively correlated with woody cover, bare ground, and vegetation height (Rotenberry and Wiens 1980). Shrike densities were negatively correlated with those of Brewer’s sparrow and positively correlated with those of rock wrens. Among habitat variables, shrikes were positively associated with the cover of rock and shrubs, and with shrub species diversity (Wiens and Rotenberry 1981).

Loggerhead shrikes evolved in shrub-steppe habitats, where microbiotic crusts were broadly distributed (see Kaltenecker and Wicklow-Howard 1994). Microbiotic, or cryptogamic, crusts consist of lichens, bryophytes, algae, microfungi, cyanobacteria, and bacteria growing on or just below the soil surface in arid and semiarid environments (Kaltenecker and Wicklow-Howard 1994); these crusts developed without large herds of grazing ungulates (St. Clair and Johansen 1993). In addition, these crusts were projected to have been widely distributed throughout the source habitats for this group, particularly in the Northern Great Basin, Owyhee Uplands and Upper Snake ERUs, but also scattered in the Columbia Plateau ERU (Hann and others 1997, map 3.59). Increasing evidence indicates that microbiotic crusts improve soil stability, productivity, and moisture retention; moderate extreme temperatures at the soil surface; and enhance seedling establishment of vascular plants (Belnap and Gardner 1993, Harper and Pendleton 1993, Johansen and others 1993, St. Clair and others 1993), thus contributing to high ecological integrity of shrub-steppe habitats. Idaho BLM has recognized the potential importance of microbiotic crusts by proposing standards for rangeland health that include maintaining these crusts to ensure proper functioning and productivity of native plant communities (USDI Bureau of Land Management 1997). These crusts were widely destroyed by trampling during the excessive livestock grazing of the late 1800s and early 1900s (Daubenmire 1970, MacCracken and others 1983, Mack and Thompson 1982, Poulton 1955). Currently, high-intensity grazing and altered fire regimes modify shrub-steppe plant communities and threaten the maintenance and recovery of microbiotic crusts (Belnap 1995, Kaltenecker 1997, St. Clair and Johansen 1993).

Conversion of native vegetation to exotics is augmented by the propensity of annuals, such as cheatgrass, to spread with wildfire and with improper grazing (Braun and others 1976; Daubenmire 1970; Evans and Young 1978; Quigley and others 1996, p. 123). Some losses of salt desert shrubs likely are due to selective grazing of palatable forbs in this cover type, combined with more xeric conditions that make vegetative resilience low.

Losses of pasture and old fields for wintering habitat in the Southeastern United States have affected shrike populations (Brooks and Temple 1990, Gawlik and Bildstein 1993). Loss of pasture and prairie habitats for breeding in Canada and the Eastern United States are widely cited as causes for population declines in those regions (Yosef 1996). These habitat losses have not been identified as limiting factors for shrike populations in the basin.

Because shrikes often forage and nest along roads (Blumton 1989, Craig 1978, Flickinger 1995, Yosef 1996), vehicular collisions may be an important source of mortality. Automobiles accounted for 29 percent of the observed fall and winter mortality of loggerhead shrikes in Virginia (Blumton 1989). Shrikes also may have been affected by DDT in the past and may suffer sublethal effects of certain insecticides, although the evidence is weak (Anderson and Duzan 1978, Grubb and Yosef 1994, Yosef 1996). Cowbird parasitism of nests does not appear to be a factor affecting productivity of loggerhead shrikes (Yosef 1996).

Population status and trends—Populations of loggerhead shrikes have been declining significantly in the basin, with a trend of -2.7 percent per yr ($n > 14$, $P < 0.05$) over the period 1968-94 (Saab and Rich 1997). The 1966-95 trend for BBS physiographic region 89 (Columbia Plateau) was -2.3 percent per yr ($n = 41$, $P < 0.05$; Sauer and others 1996). Saab and Rich (1997) included the loggerhead shrike as one of 15 Neotropical migrants in the basin that are of high concern to management under all future management themes for the basin.

Patterns of widespread declines throughout its range (Yosef 1996) suggest that either (1) habitat losses throughout its breeding range in various types of breeding habitat are similar, or (2) additional, more extensive factors are impacting the species, such as pesticides or wintering ground problems. These possibilities do not diminish the losses of source habitats in the basin but suggest that widespread population declines may be at least partly the result of a more pervasive cause.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 35 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—The results of our habitat trend analysis suggest the following issues are of high-priority for group 35:

1. Permanent and continued loss of large acreage of big sagebrush cover types to agricultural conversion, brush control, reduction of microbiotic crusts, and cheatgrass invasion.

2. Adverse effects of human disturbance.

Potential strategies—The following strategies could be used to reverse broad-scale declines in source habitats:

1. (To address issue no. 1) Identify and conserve large remaining areas (contiguous habitat >1000 ha [2,470 acres]) of shrub-steppe vegetation where ecological integrity is still relatively high (Gray and Rickard 1989, Rickard and Poole 1989, Schuler and others 1993, Smith 1994, Yoakum 1980). Sites resistant to cheatgrass domination because of their moisture regime (>30 cm [12 in]) in the Upper Snake, Owyhee Uplands, Northern Great Basin, and Columbia Plateau ERUs are of highest priority.

2. (To address issue no. 1) Restore microbiotic crusts in ERUs with potential for redevelopment (that is, areas near propagule sources, and with suitable soil, vegetation, and climatic characteristics [see Belnap 1993, Belnap 1995, Kaltenecker 1997, Kaltenecker and Wicklow-Howard 1994]): the Northern Great Basin, Owyhee Uplands, Upper Snake, and, to a lesser extent, the Columbia Plateau (Hann and others, map 3.59).

3. (To address issue no. 1) Retard the spread of cheatgrass in native shrub-steppe vegetation communities.

4. (To address issue no. 2) Minimize adverse effects of human disturbance.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Protect and restore corridors and habitat blocks in areas of shrub-steppe that support large, contiguous areas of high ecological integrity so as to optimize long-term

conservation of shrikes. These practices are most likely to be successful on large tracts of Federal land managed by BLM.

2. (In support of strategy no. 1) Restore existing agricultural lands to native vegetation when possible. Sites where this might be especially useful are areas that were historically shrub-steppe and areas that would augment corridors among existing shrub-steppe patches.

3. (In support of strategy no. 1) Avoid further loss of sagebrush cover through burning, plowing, seeding, and other brush “control” methods where sagebrush cover types are well below historical levels.

4. (In support of strategy no. 1) Minimize the impacts of further agricultural conversions through landscape design. If conversion cannot be avoided, then tracts slated for conversion should be located to minimize further disassociation of shrub-steppe, to avoid reducing the size of isolated patches, and to avoid areas that are currently in large blocks of moderate Composite Ecological Integrity (Quigley and others 1996).

5. (In support of strategy no. 1) Restore native vegetation by appropriate mechanical treatments and seedings of native shrub, grass, and forb species (Allen 1995, Monsen and McArthur 1995, Whisenant 1995, Yoakum 1986b).

6. (In support of strategy no. 2) Encourage the redevelopment of microbiotic crust by reducing or eliminating livestock grazing (Mack and Thompson 1982, St. Clair and others 1993). Explore the use of ground-based and aerial soil inoculation to increase the speed and extent of dispersal of the organisms that create microbiotic crust (Belnap 1993, 1994).

7. (In support of strategy no. 3) Use fire prevention and suppression to retard the spread of cheatgrass in areas that are susceptible to cheatgrass invasion but currently are dominated by native grass species. Explore the effectiveness of planting fire-resistant vegetation through “green stripping” (Pellant 1994) to protect existing vegetation as well as allow degraded sites a chance to recover.

8. (In support of strategy no. 3) Restore selected areas of cheatgrass monocultures through seeding and other manipulations (Allen 1995, Daubenmire 1970, Evans and Young 1978, Hosten and West 1994, Kennedy 1994, Monsen and McArthur 1995, Ogg 1994, Whisenant 1995, Yoakum 1986b), where such restoration would increase the size of existing shrub-steppe patches or provide links among patches.

9. (In support of strategy no. 4) Minimize access to roads and, where possible, locate them on the periphery of areas known to have good shrike populations. Avoid construction of new roads or improvement of old roads in shrike habitat. Plan habitat enhancement projects for sites away from heavily traveled roads.

10. (In support of strategy no. 4) Avoid insecticide spraying during shrike breeding season.

Group 36—Columbian Sharp-Tailed Grouse (Summer)

Results

Species ranges, source habitats, and special habitat features—Columbian sharp-tailed grouse is a year-round resident that is distributed patchily in mesic shrubland and grassland types of the Upper Snake, Snake Headwaters, Central Idaho Mountains, Northern Glaciated Mountains, and Columbia Plateau ERUs (fig. 108). Only trends in summer habitat are evaluated here, because winter cover types (primarily riparian and upland shrub) occur in naturally small patches that could not be analyzed at the broad scale. During the late 1980s, early 1990s, 1996, and 1997, populations were augmented in Montana within the Northern Glaciated Mountains ERU and reintroduced in Oregon within the Blue Mountains ERU.

Summer source habitats of Columbian sharp-tailed grouse include open-canopied big, mountain, and low sagebrush cover types, wheatgrass and fescue bunchgrasses, herbaceous wetlands, upland or mountain shrub cover types of chokecherry-serviceberry-rose, and shrub wetland cover types (vol. 3, appendix 1, table 1) (Marks and Saab Marks 1987a, Meints and others 1992, Saab and Marks 1992). Within these habitats, sharptails only use areas where the annual

Figure 108—Ranges of species in group 36 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

precipitation is at least 30 cm (12 in) (Meints and others 1992), and where the topography is flat to rolling (<30 percent slope) (Saab and Marks 1992). During spring and summer, sagebrush and grasslands provide nesting and brood-rearing habitat, whereas mountain (upland shrub) and riparian shrubs are used for escape cover. Fall and winter habitats are primarily mountain shrub and riparian vegetation. Following those seasonal changes in habitat use, herbaceous vegetation and associated arthropods provide food for sharptails during spring and summer, whereas fruits and buds of woody vegetation, insects, and agricultural crops are consumed by grouse during fall and winter (Giesen and Connelly 1993).

During spring and summer in western Idaho, nesting and brood-rearing microhabitats used by sharptails are characterized by moderate vegetative cover (>60 percent), high structural diversity, and a high diversity of native herbaceous vegetation (Marks and Saab Marks 1987a, Saab and Marks 1992). Native perennials arrowleaf balsamroot and bluebunch wheatgrass were especially important nesting and brood-rearing cover during a drought year when many exotic annuals dried up and provided no cover (Saab and Marks 1992). Additionally, selected microhabitats in western Idaho were least modified by livestock grazing and near escape cover of mountain shrubs and riparian vegetation. Grouse broods in eastern Idaho preferred CRP lands over native shrublands or agricultural fields during summer (Sirotnak and others 1991). Seedings on CRP lands provide nesting cover and are often good sources of food if the seedings include alfalfa, *Tragopogon* species, and *Lactuca* species. Height of nest-brood cover was identified as a critical microhabitat feature and averaged 25 $\pm$ 16 cm (10 $\pm$ 6.3 in) in eastern Idaho (Meints and others 1992).

When native shrubland is used for nesting in Idaho, most nests are placed beneath a shrub (Marks and Saab Marks 1987a, Meints 1991). Thus, shrubs are a special habitat feature for this species (vol. 3, appendix 1, table 2). Shrub density at nests in eastern Idaho averaged 11,000 shrubs per ha (2.5 acres) compared to 5,000 shrubs per ha (2.5 acres) at independent, randomly located sites (Meints 1991). In a native grassland of northwestern Montana, preliminary data indicated that nests were placed beneath wheatgrass and fescue bunchgrasses.[15]

Spring and summer movements are typically within 1.0 to 2.5 km (0.63 to 1.6 mi) of dancing grounds (lek sites) (Saab and Marks 1992). Summer home ranges averaged 187 $\pm$ 114 ha (462 $\pm$ 282 acres) in western Idaho and 90 percent of all locations were within 1.2 km (0.75 mi) of a dancing ground (Saab and Marks 1992). Nests have been located <100 m (328 ft) (Marks and Saab Marks 1987a) to >3 km (1.9 mi) (Meints 1991) from lek sites, with most females nesting <1.6 km (1.0 mi) from the lek where they were trapped (Marks and Saab Marks 1987a, Meints 1991, Oedekoven 1985).

Winter habitat requirements seem more restricted than in other seasons (Giesen and Connelly 1993). Columbian sharptails in western Idaho wintered almost exclusively in mountain shrub or riparian cover types, the only cover types that provided food and escape cover regardless of snow depth (Marks and Saab Marks 1988). Fruits of Douglas hawthorn and buds of serviceberry and chokecherry were the main winter foods. Winter grouse locations in eastern Idaho averaged 90 m (295 ft) to riparian cover (Meints 1991). Movements of sharptails between breeding and wintering areas varied from 2.6 km (1.6 mi) in western Idaho (Marks and Saab Marks 1987a) to 20 km (12.5 mi) in southeastern Idaho (Meints 1991). Columbian sharptails apparently move farther to wintering habitats in regions lacking a broad distribution of winter food resources (Giesen and Connelly 1993).

Broad-scale change in source habitats—Historically, source habitats for Columbian sharp-tailed grouse were broadly distributed in eastern Washington and eastern Oregon, except in the Northern and Southern Cascades ERUs (fig. 109A). Historical source habitats were also in western portions of the Central Idaho Mountains, in the southern Owyhee Uplands, southern Snake Headwaters, and eastern portions of the Upper Snake and Snake Headwaters ERUs (fig. 109A).

[15] Personal communication. 1997. Tim Thier, wildlife biologist, Montana Department of Fish, Wildlife, and Parks, P.O. Box 507, Trego, MT59934.

Figure 109—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 36 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

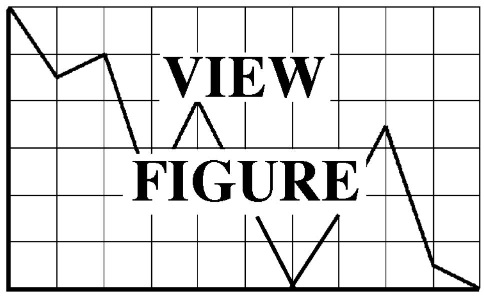

Figure 110—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 36, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

The current distribution of source habitats is limited and highly disjunct compared to historical patterns (fig. 109B). The western half of the Snake Headwaters and eastern Upper Snake ERUs currently provide the most contiguous habitat within the current range (figs. 108, 109B). In contrast, other remaining populations are restricted to small and isolated portions of the Central Idaho Mountains, Northern Glaciated Mountains, Columbia Plateau, Blue Mountains, and Lower Clark Fork ERUs (fig. 108). Breeding populations reintroduced to northeastern Oregon in the early 1990s occupy small areas near Enterprise in the Blue Mountains, and augmentations were conducted near Eureka, Montana, in the Northern Glaciated Mountains during the late 1980s and early 1990s (fig. 108).

Strong declines in source habitats were projected in over 60 percent of watersheds throughout the basin, whereas increases in habitat occurred in only 6 percent of watersheds (figs. 109C and 110). Eight of 11 ERUs with historical source habitats had strongly decreasing trends. The Northern Glaciated Mountains experienced the greatest declines, where 94 percent of the watersheds had strong decreases in source habitats (fig. 110).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—The open-canopy low-medium structural stage of mountain big sagebrush and big sagebrush experienced some of the greatest absolute declines on an ERU basis. The combined absolute decline for the open-canopy low-medium structural stage of these two sagebrush types declined in the Upper Snake (-40 percent), Owyhee Uplands (-20 percent), Columbia Plateau (-13 percent), Snake Headwaters (-7 percent), and Northern Great Basin (-2 percent) (vol. 3, appendix 1, table 4). In these open-canopied cover types, in the absence of fire, shrubs and trees eventually invade much of the area that was occupied by grasses and forbs.

In addition, large-scale losses of sagebrush habitats were attributed primarily to agricultural development. Agricultural lands have increased substantially in all ERUs within the basin (vol. 3, appendix 1, table 4). The largest conversions of terrestrial communities from historical to current levels were those of upland shrubland to agriculture and from upland herbland to agriculture (Hann and others 1997). These conversions were widespread within the historical range of sharptails and, in part, explained the broad-scale changes in their source habitats (fig. 109C).

Mountain shrub (chokecherry-serviceberry-rose) and shrub wetland terrestrial community groups are key components of sharp-tailed grouse habitat during late summer, fall, and winter. These cover types naturally occur in small patches and were difficult to map at the scale of this analysis. Therefore, accurate information was not available on habitat trends in mountain shrub and shrub wetlands.

Condition of special habitat features—Mesic sagebrush lands, mountain shrub (chokecherry-serviceberry-rose) communities, and riparian vegetation are special habitat features used by sharptails. Loss and degradation of these features, as a result of livestock grazing and agricultural conversions, were identified as factors contributing to the widespread population declines in Columbian sharp-tailed grouse within the basin (Marks and Saab Marks 1987a, 1988; Meints and others 1992; Saab and Marks 1992; Tirhi 1995). Additionally, losses of native perennial grasses and forb understories of the mesic sagebrush zones, because of livestock grazing and exotic grass invasions, are microhabitat features that could not be examined by the broad-scale analysis.

Other factors affecting the group—Livestock grazing is the dominant land use in occupied Columbian sharp-tailed grouse habitat. Habitat degradation by high-intensity livestock grazing (also by native ungulates) results in reductions or losses of native perennial grasses and forbs, necessary for grouse nesting and brood-rearing cover. Excessive grazing can alter the native vegetation by allowing invasions of exotic plants, including cheatgrass, medusahead, and mustards. Additionally, deciduous trees and shrubs, which are critical for sharptail escape cover and for winter food (Marks and Saab Marks 1987a, 1987b, 1988; Meints 1991; Tirhi 1995), may be reduced by intensive cattle browsing during late summer (Kovalchik and Elmore 1992).

Loss of lands managed under the CRP is potentially another factor influencing Columbian sharptails. In eastern Idaho, CRP lands provide important feeding, nesting, brood-rearing, and relatively mild winter habitat (Ulliman 1995). In Washington, however, CRP lands receive little use by sharptails (Schroeder 1994).

Although some females nest in CRP and other idle croplands, the most successful nests in Washington were built in native habitats of sagebrush or forbs mixed with grass (Schroeder 1994).

Herbicides and pesticides have been identified as potential threats to sharptails (Giesen and Connelly 1993). Herbicide spraying has negative effects on the species because of losses in herbaceous and woody vegetation that is used for nesting, brood-rearing, and wintering habitat. Pesticide spraying may have negative impacts by directly killing young or by reducing or eliminating insects used for food.

Fire can either enhance or degrade sharp-tail habitat, depending on the cover type, timing, frequency, intensity, size of burn (Giesen and Connelly 1993), soils, and precipitation. Many species of deciduous shrubs (for example chokecherry and rose) resprout after fire. In contrast, most sagebrush species do not resprout and may be eliminated by fires. Exotic vegetation can invade following fire, depending on the soils and precipitation.

Human disturbances related to the expansion of residential developments, increases in road densities, and associated recreational activities likely will exacerbate losses of suitable habitat within the historical range of Columbian sharp-tailed grouse (Giesen and Connelly 1993, Tirhi 1995).

Population status and trends—Sharptails currently occupy <5 percent of their historical range in the basin. The BBS data summarized for western North America indicate that population trends declined by an average of -7.7 percent annually between 1966 and 1995 (n = 39, P < 0.05; Sauer and others 1996).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 36 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—The following issues were identified by our analysis of source habitat trends and from the findings of other studies on Columbian sharp-tailed grouse:

1. Fragmentation and loss of mesic shrubsteppe and steppe habitats by conversion to agriculture.

2. Alteration of shrub-steppe and steppe habitats by invasions of exotic forbs and grasses.

3. Degradation and loss of cover types within the shrub-steppe, steppe, mountain shrub, herbaceous wetlands, and shrub wetland community groups by excessive livestock grazing.

4. Loss of sagebrush cover because of burning, herbicide spraying, and other brush control methods.

5. Human disturbance of leks and wintering populations because of increased roading and human presence.

6. Increased application of pesticides in and near agricultural areas.

7. Loss of CRP lands by conversion back to active croplands.

8. Isolated and disjunct populations vulnerable to extinction by stochastic events (that is, demographic, environmental, or genetic stochasticity).

Potential strategies—The issues identified above suggest the following broad-scale strategies for the long-term persistence of Columbian sharp-tailed grouse:

1. (To address issue no. 1) Basin-wide, identify areas of mesic shrub-steppe vegetation with high ecological integrity and manage to promote their long-term sustainability.

2. (To address issue no. 2) Restore shrub-steppe and steppe habitats that have been altered by medusahead grass, cheatgrass, and exotic mustards, and focus on areas that would increase patch size or links with existing source habitat patches.

3. (To address issue no. 2) Protect shrub-steppe habitats against wildfire in areas vulnerable to invasion by exotic vegetation.

4. (To address issue no. 3) Reduce habitat degradation by livestock grazing in cover types within shrub-steppe, mountain shrub, riparian, grassland, and herbaceous wetland terrestrial community

groups that are currently occupied by sharptails, with a high potential of being recolonized by sharptails, or that have been identified for reintroductions.

5. (To address issue no. 4) Maintain sagebrush and mountain shrub cover, and increase these shrublands in areas where substantial losses have occurred because of brush control, especially in locations currently occupied by sharptails, with a high potential of being recolonized by sharptails, or in locations that have been identified for reintroductions.

6. (To address issue no. 7) Maintain CRP lands that are currently occupied by sharptails, lands that have a potential of being used by sharptails, or are near locations that have been identified for reintroductions.

7. (To address issue no. 8) Expand the current range of Columbian sharptails within their historical habitats.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategies no. 1 and no. 4) Establish special management areas for maintaining high-integrity shrublands where livestock grazing would be eliminated or restricted. Manage areas of at least 200 ha (494 acres) for summer nesting and brood-rearing habitat; suitable wintering habitats should be within 2.6 to 20 km (1.6 to 12.5 miles) of summer areas.

2. (In support of strategy no. 2) Restore degraded shrub-steppe, mountain shrub, and shrub wetland habitats by plantings of native shrub and herbaceous vegetation, and by prescribed fire (in areas not vulnerable to invasion by exotic plants).

3. (In support of strategy no. 2) Develop methods through ongoing or new research to restore shrub-steppe habitats altered by medusahead, cheatgrass, and exotic mustards.

4. (In support of strategy no. 3) Plant native vegetation that is naturally resistant to wildfire, and actively suppress wildfires in areas that are susceptible to postfire invasions of exotic vegetation.

5. (In support of strategy no. 4) Remove or explicitly control the timing and intensity of grazing to improve the ecological condition of degraded rangelands in locations occupied by sharptails, with a high potential of being recolonized by sharptails, or that have been identified for reintroductions.

6. (In support of strategy no. 5) Eliminate brush control for sagebrush and mountain shrubs in those areas currently occupied or with a high potential of being recolonized by sharptails, including the Snake Headwaters, Upper Snake, Central Idaho Mountains, Blue Mountains, and Columbia Plateau ERUs.

7. (In support of strategy no. 6) Promote the continuation and development of the CRP program, whereby private landowners are encouraged to reduce soil erosion and establish perennial cover, especially in the Upper Snake and Snake Headwaters ERUs.

8. (In support of strategy no. 7) Acquire lands that are currently occupied by sharptails but are not specifically managed for the grouse.

9. (In support of strategy no. 7) Reintroduce and augment sharp-tailed grouse populations after habitat enhancement.

Group 37—Grasshopper Sparrow, Clay-Colored Sparrow, and Idaho Ground Squirrel

Results

Species ranges, source habitats, and special habitat features—Group 37 consists of breeding habitat for the grasshopper sparrow and clay-colored sparrow, and year-round habitat for the Idaho ground squirrel. The breeding range of the grasshopper sparrow (fig. 111) includes most of the basin except for the Northern Great Basin, Upper Klamath, Southern Cascades, and Northern Cascades ERUs. The breeding range of the clay-colored sparrow (fig. 111), on the other hand, is restricted to the Northern Glaciated Mountains, Upper Clark Fork, and Snake Headwaters ERUs. Within the basin, ranges of these two sparrow

Figure 111—Ranges of species in group 37 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

species overlap only in Montana and Wyoming. Two subspecies of the Idaho ground squirrel occur in the basin, the northern Idaho ground squirrel (*Spermophilus brunneus brunneus*) and the southern Idaho ground squrriel (*Spermophilus brunneus endemicus*). Both of these subspecies are found only in western Idaho (fig. 111), and of the two subspecies, the northern is the more rare (Yensen 1991). The ecology and management concerns of the northern subspieces are the basis for most of the subsequent discussion of northern Idaho ground squirrel in this document.

Fescue-bunchgrass is the one cover type shared by all three species (vol. 3, appendix 1, table 1). Open-canopied mountain big sagebrush is source habitat used by the grasshopper sparrow and Idaho ground squirrel. Additionally, the open-canopied big sagebrush is source habitat for the ground squirrel. The clay-colored sparrow also has source habitats in chokecherry-serviceberry-rose and native forb cover types.

Neither sparrow has a clear preference for any special habitat features, but the clay-colored may be attracted to sites that have dense shrubs in a matrix of more open grasslandlike vegetation (Janes 1983). Idaho ground squirrels inhabit meadows, usually with shallow soils and small intrusions of deeper soil for nest burrows (USDA Forest Service and USDI Fish and Wildlife Service 1996).

Broad-scale changes in source habitats—Historically, source habitats for the sparrows in this group were widespread, but generally occupied <25 percent of most watersheds (fig. 112A). High percentages of contiguous watersheds with source habitats occurred in the northeast end and along the eastern edge of the Columbia Plateau ERU, and in the northern end of the Blue Mountains ERU. In the rest of the basin, however, large, contiguous source habitats of high ecological integrity were small and scattered. Nonetheless, the sparrows likely occupied relatively small patches of suitable habitat throughout their historical ranges.

Habitat loss has been obvious as both contiguous areas of source habitats and watersheds with relatively less habitat have greatly diminished (fig. 112B). The Columbia Plateau and Blue Mountains ERUs had strongly declining trends in source habitats for grasshopper sparrows. Similarly, the small but important source areas for the clay-colored sparrow in the northeastern portion of the basin and for Idaho ground squirrel in the center of the basin have decreased. Although much of the basin never had a high percentage of watersheds with source habitats, large acreages have been converted to landscapes with no habitat (fig. 112B).

Over 60 percent of the watersheds had strongly declining trends in source habitats basin-wide (fig. 113). Within the two ERUs that constitute the heart of the habitat for grasshopper sparrow, the Columbia Plateau and Blue Mountains, changes were markedly negative (fig. 113). Similarly, where the two sparrows occur together in the Northern Glaciated Mountains and Upper Clark Fork ERUs, trends were clearly declining (fig. 113). Source habitats for the ground squirrel were projected to have undergone the second greatest decline among 91 species evaluated (vol. 1, table 7). All three species in this group were in the habitat trend category with the greatest decrease in source habitats (vol. 1, table 7).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—The principal vegetation change corresponding to the negative trend in source habitats was in the fescue-bunchgrass cover type, which declined two-thirds from historical levels basin-wide (Hann and others 1997). The largest declines within the species ranges occurred in the Columbia Plateau and Northern Glaciated Mountains (>80 percent); Blue Mountains (75 percent); and Upper Clark Fork and Central Idaho Mountains (60 percent; vol. 3, appendix 1, table 4). The decrease in fescue-bunchgrass amounted to over 5 percent of all changes in the basin, an amount exceeded only by the decrease in big sagebrush (Hann and others 1997).

The open-canopy low-medium structural stage of mountain big sagebrush and big sagebrush experienced some of the greatest absolute declines on an ERU basis. The combined absolute decline for the open-canopy low-medium structural stage of these two sagebrush types declined in the Upper Snake (-40 percent), Owyhee Uplands (-20 percent), Columbia Plateau (-13 percent), Snake Headwaters (-7 percent), and Northern Great Basin (-2 percent) (vol. 3, appendix 1, table 4). In these open-canopied cover types, in

Figure 112—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 37 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

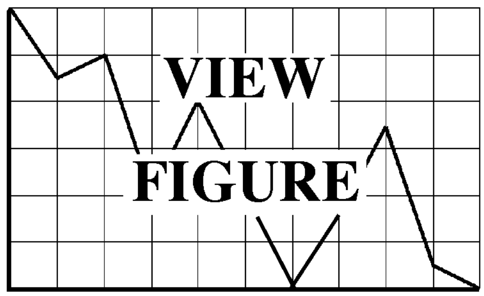

Figure 113—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 37, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

the absence of fire, shrubs and trees eventually invade much of the area that was occupied by grasses and forbs.

Basin-wide declines in mountain big sagebrush were substantial (Hann and others 1997) and resulted in critical losses of source habitats for the grasshopper sparrow and Idaho ground squirrel. Vegetation changes affecting Idaho ground squirrels may be difficult to discern for small meadows of sagebrush or native herbaceous cover types within ponderosa pine-dominated forests. This mosaic of habitats is not always detectable at the 1-km^2 (0.4-mi^2) pixel size that was used for evaluating habitat trends in this effort.

Increases in the Central Idaho Mountains were due to the large relative increase in native forbs, although this cover type occupies only a small fraction of the ERU (vol. 3, appendix 1, table 4).

Conversion of upland shrubland to agriculture affected 9 percent of the basin (Hann and others 1997). Major conversions in the Columbia Plateau, Owyhee Uplands, and Blue Mountains greatly affected this group. The basin-wide loss of fescue-bunchgrass and wheatgrass-bunchgrass cover types was largely because of conversion to agriculture. Transition of upland herbland to agriculture affected 7 percent of the basin, a conversion rate second only to that for upland shrubland (Hann and others 1997). Conversion in the Columbia Plateau and Blue Mountains was particularly high—up to 25 percent of upland shrublands. Basin-wide declines in mountain big sagebrush and native forbs also were attributed in part to agricultural conversion.

Habitat condition for group 37 can be described by the composite ecological integrity ratings (Quigley and others 1996) that show most of the habitat to have a “low” rating. Fescues and bunchgrasses, critical habitat components for this group, were irreversibly modified by high-intensity grazing in the late 1800s to early 1900s (USDA Forest Service 1996). Most of the current habitat for this group was classified into Rangeland Clusters 5 (generally corresponding to much of the Owyhee Uplands ERU) and 6 (generally the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs), where the primary risk to ecological integrity is continued losses of herbland and shrubland habitats (Quigley and others 1996). Further, Rangeland Cluster 6 is vulnerable to overgrazing and exotic grass and forb invasions (Quigley and others 1996).

Other factors affecting the group—Early season mowing of hayfields causes major nest failures in grassland-nesting species (Knapton 1994, Smith 1963). Where hayfields and similar agricultural lands have replaced native source habitats or are now located adjacent to such habitats, those sites likely serve as significant population sinks, particularly for grasshopper sparrows.

Grasshopper sparrow populations temporarily decline immediately after grassland fires (Bock and Bock 1992). Birds likely avoid recently burned areas because of the lack of grass cover, and they are expected to return to burned sites after grasses are restored. This sparrow also avoids areas where shrub cover exceeds 35 percent (Bock and Bock 1992, Smith 1963). Thus, fire plays a beneficial role in habitat management for this species.

Although clay-colored sparrows are sympatric with grasshopper sparrows in some regions, clay-coloreds prefer the other end of the grass-shrub gradient, becoming more common with increases in shrub cover and patches of shrubs (Knapton 1979, 1994; Owens and Myers 1973). Thus, clay-colored sparrows also will respond negatively, in the short term, to burning and may require more time to return to prefire population densities while shrubs become reestablished after fire (Pylypec 1991).

Species in this group evolved in shrub-steppe habitats, where microbiotic crusts were broadly distributed (see Kaltenecker and Wicklow-Howard 1994). Microbiotic, or cryptogamic, crusts consist of lichens, bryophytes, algae, microfungi, cyanobacteria, and bacteria growing on or just below the soil surface in arid and semiarid environments (Kaltenecker and Wicklow-Howard 1994); these crusts developed in the absence of large herds of grazing ungulates (St. Clair and Johansen 1993). In addition, these crusts are projected to have been widely distributed throughout the source habitats for this group, particularly in the Northern Great Basin, Owyhee Uplands, and Upper Snake ERUs but also scattered in the Columbia Plateau ERU (Hann and others 1997, map 3.59). Increasing evidence indicates that microbiotic crusts improve soil stability, productivity, and moisture retention; moderate extreme temperatures at the soil surface; and enhance seedling establishment of vascular plants (Belnap and Gardner 1993, Harper and Pendleton 1993, Johansen and others 1993, St. Clair and others 1993), thereby contributing to high ecological integrity of shrub-steppe habitats. Idaho BLM has recognized the potential importance of microbiotic crusts by proposing standards for rangeland health that include the maintenance of these crusts to ensure proper functioning and productivity of native plant communities (USDI Bureau of Land Management 1997). These crusts were widely destroyed by trampling during the excessive livestock grazing of the late 1800s and early 1900s (Daubenmire 1970, MacCracken and others 1983, Mack and Thompson 1982, Poulton 1955). Currently, high-intensity grazing and altered fire regimes modify shrub-steppe plant communities and threaten the maintenance and recovery of microbiotic crusts (Belnap 1995, Kaltenecker 1997, St. Clair and Johansen 1993).

Grazing may reduce or completely exclude grasshopper sparrow populations (Bock and Webb 1984, Saab and others 1995) because livestock remove grass, the main feature of a given site that attracts this species (Janes 1983).

The grasshopper sparrow may be area sensitive and more likely to occupy large tracts of habitat than small fragments (Samson 1980). Minimum area requirements in Maine are about 100 ha (247 acres) (Vickery and others 1994) and in Illinois are about 30 ha (74 acres) (Herkert 1994).

Although brown-headed cowbirds parasitize nests of grasshopper sparrows, the impact is believed to be generally low because of the cryptic nature of the nests of sparrows (Vickery 1996). Cowbirds also parasitize nests of clay-colored sparrows, which may accept or reject the eggs. The overall impact on this species is not known but may be lower than in many species, as cowbird parasitism accounts for only 22 percent of egg loss (Knapton 1994).

Idaho ground squirrels are threatened by sport shooting or “plinking” (Moroz 1995). Several sites occupied by the ground squirrels are regularly visited by shooters for this purpose. When populations are small, this activity could have a critical, detrimental impact. Increases in human occupation in the basin likely have caused an increase in human disturbance.

Idaho ground squirrels may experience competition with Columbian ground squirrels (Moroz 1995, USDAForest Service and USDI Fish and Wildlife Service 1996). Both species use similar habitats, but the Idaho ground squirrel tends to inhabit more xeric areas that cannot support Columbian ground squirrels. Columbian ground squirrels are larger and require larger areas with deeper soils. Although the Idaho ground squirrel can use the same habitats for hibernation, it may be competitively forced into the drier areas with more shallow soils. The shallow soil areas are more prone to fluctuating water tables and freezing during harsh winters, causing overwinter mortality in Idaho ground squirrels (Moroz 1995).

Low population numbers of the Idaho ground squirrel, probably no more than 600 to 800 individuals, make the species vulnerable to (1) genetic drift, inbreeding, and attendant loss of viability; (2) catastrophic invasions of predators, parasites, or diseases; and (3) extirpation because of natural population fluctuations (Moroz 1995). Populations are small and often isolated by several kilometers (Yensen 1991).

Poisoning through the use of rodenticides may negatively affect populations. Predation by domestic cats also is a concern (USDA Forest Service and USDI Fish and Wildlife Service 1996).

Forest encroachment into meadows due to fire suppression and natural succession may be a threat to Idaho ground squirrels (Moroz 1995). Encroachment on meadows, replacement of open forest stands with dense stands of trees, and human developments may have eliminated or reduced dispersal corridors (USDA Forest Service and USDI Fish and Wildlife Service 1996).

Population status and trends—Sample sizes for the clay-colored sparrow in the basin were insufficient to determine population trend (Saab and Rich 1997). The 1966-95 trend for BBS physiographic region 64 (Central Rocky Mountains) is +11.4 percent per yr (n = 17, $P < 0.05$), but the sample size is small (Sauer and others 1996).

Saab and Rich (1997) reported a stable population trend for the grasshopper sparrow in the basin but also stated that the species is not well monitored by the BBS technique and advised specialized monitoring. The trend for Washington is +7.5 percent per yr (n = 18, $P < 0.1$) and for physiographic region 89 (Columbia Plateau) is stable (n = 24, $P > 0.1$; Sauer and others 1996). Again, sample sizes are too small to provide definitive results.

There are 36 known historical and current population sites of northern Idaho ground squirrels (U.S. Government 2000b). Twenty-seven of these sites are currently occupied by northern Idaho ground squirrels, and the total population is estimated at less than 1,000 individuals. The northern subspecies was listed as threatened by the U.S. Fish and Wildlife Service in April, 2000 (U.S. Government 2000b).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 37 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—The results of our habitat trend analysis suggest the following issues are of high priority for group 37:

1. Continued loss of large acreage of fescue-bunchgrass and mountain big sagebrush cover types.

2. Loss of microbiotic crusts.

3. Undesired changes in shrub:grass ratios because of changes in historical fire regimes.

4. Direct mortality of ground nesting birds because of agricultural practices.

5. The disjunct nature of remaining habitat for grasshopper sparrow populations.

6. Loss of meadow habitat because of forest encroachment and human developments.

7. Loss of dispersal corridors for Idaho ground squirrel from replacement of open forest stands with dense stands and human developments.

8. Vulnerability to extinction of small, isolated populations of ground squirrels because of poisoning, shooting, predation, disease, or natural fluctuations.

9. Displacement from habitat because of interspecific competition.

Potential strategies—The following strategies could be used to reverse broad-scale declines in source habitats:

1. (To address issues no. 1 and no. 5) Identify and conserve remaining large areas of mountain big sagebrush and fescue-bunchgrass vegetation where ecological integrity is still relatively high (Bock and others 1993, Gray and Rickard 1989, Rickard and Poole 1989, Schuler and others 1993, Smith 1994, Yoakum 1980). The remaining blocks of habitat in the eastern Blue Mountains and southern Central Idaho Mountains ERUs (fig. 112) may serve as focal points for protection. For the clay-colored sparrow, only the small watersheds in the Upper Clark Fork and Northern Glaciated Mountains ERUs (fig. 112) can be expected to contribute to source habitats.

2 (To address issue no. 1) Restore native perennial bunchgrasses and avoid further depletion because of improper grazing (Braun and others 1976, Daubenmire 1970, Evans and Young 1978). Priority areas for the grasshopper sparrow are the eastern Blue Mountains and southern Central Idaho Mountains ERUs (fig. 113). For the clay-colored sparrow, priority areas are the Upper Clark Fork and Northern Glaciated Mountains ERUs.

3. (To address issue no. 2) Restore microbiotic crusts in ERUs with potential for redevelopment (that is, areas near propagule sources, and with suitable soil, vegetation, and climatic characteristics [see Belnap 1993, 1995; Kaltenecker 1997; Kaltenecker and Wicklow-Howard 1994]): the Northern Great basin, Owyhee Uplands, and Upper Snake ERUs and, to a lesser extent, the Columbia Plateau ERU (Hann and others 1997, map 3.59).

4. (To address issue no. 3) Use fire to obtain desired shrub:grass ratios. Enhance development of shrub communities, particularly mountain sagebrush and chokecherry-serviceberry-rose, in the Upper Clark Fork and Northern Glaciated Mountains ERUs. Maintain dense grassland cover in the eastern Blue Mountains and southern Central Idaho Mountains ERUs.

5. (To address issue no. 4) Minimize direct mortality of ground nesting birds in agricultural areas.

6. (To address issue no. 5) Maintain and restore the largest areas of native grassland habitats.

7. (To address issues no. 6 and no. 7) Maintain meadows and corridors currently used by Idaho ground squirrels. Restore potentially suitable meadows within the range of the species. Stop or reverse forest encroachment into meadows.

8. (To address issue no. 8) Prevent direct human-caused mortality of Idaho ground squirrels.

9. (To address issue no. 8) Restore populations of the Idaho ground squirrel.

10. (To address issue no. 9) Explore the removal of Columbian ground squirrels from adjacent habitats.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Use landscape planning to avoid further reductions in the size of large blocks of mountain big sagebrush and fescue-bunchgrass within each watershed, particularly in the Blue Mountains and Central Idaho Mountains ERUs, where sizable blocks of source habitats are available.

2. (In support of strategy no. 1) Explore options under the CRP (Johnson and Igl 1995), or develop other incentive programs, to encourage restoration of agricultural areas to native cover types. Focus on areas that would increase patch size or links with existing source habitat patches.

3. (In support of strategies no. 2 and no. 3) Modify grazing systems or reduce grazing use where native perennial bunchgrasses have been depleted. The elimination of grazing may encourage the redevelopment of microbiotic crust (Mack and Thompson 1982, St. Clair and others 1993).

4. (In support of strategy no. 3) Explore the use of ground-based and aerial soil inoculation to increase the speed and extent of dispersal of the organisms that create microbiotic crust (Belnap 1993, 1994).

5. (In support of strategies no. 1, 3, and 4) Develop a prescribed burning program designed to increase native grass cover and reduce shrub cover (Vickery 1996) on limited acreages and in concert with strategy no. 1. For example, summer burns, which correspond to the period of increased natural lightning strikes, may be more beneficial for maintaining source habitats than burns at other times of the year (Shriver and others 1996); extensive, hot burns in shrub-steppe habitats are probably less beneficial than cooler, more controlled burns that leave some shrub cover (Bock and Bock 1987). In clay-colored sparrow habitats, fire control will allow development of the shrub component that this species prefers (Knapton 1994).

6. (In support of strategy no. 5) Where possible, avoid early season mowing of hayfields and other agricultural lands (Rodenhouse and others 1995, Vickery 1996). Defer mowing on publicly owned lands and develop incentives for private land owners (Vickery 1996). Avoid creating hayfields and similar crop fields adjacent to, or in the general area of, natural nesting habitats.

7. (To address strategy no. 6) A breeding site of 100 to 200 pairs in an area of source habitats 800 to 1400 ha (1,330 to 2,330 acres) is recommended to sustain a population of grasshopper sparrows (Delany and others 1995). Avoid fragmenting existing source habitats below this size and work to protect and restore other sites to at least this standard.

8. (In support of strategy no. 7) Maintain meadow and meadow-corridor habitats within ponderosa pine cover types for Idaho ground squirrels. Retard conifer invasion of meadows by thinning young trees from stands, prescribed burning, and controlled grazing (Moroz 1995). Replant with native grasses.

9. (In support of strategy no. 7) Develop livestock grazing practices that retain grass seed-heads available to ground squirrels (Moroz 1995).

10. (In support of strategy no. 7) Create new meadow habitats at suitable locations with various deep and shallow soils. Expand existing meadow habitats through practices in issue no. 6, with attention to corridors that could provide dispersal habitats for existing populations of Idaho ground squirrels.

11. (In support of strategy no. 8) Avoid use of rodenticides in occupied habitats of Idaho ground squirrels.

12. (In support of strategy no. 8) Control recreational uses such as off-road vehicles, roadside turnouts, and camping within meadow complexes occupied by Idaho ground squirrels. Encourage the public to avoid shooting, poisoning, or trapping the squirrel. Close important ground squirrel areas to discharge of firearms. Inform the public about this endemic Idaho species.

13. (In support of strategy no. 9) Reintroduce Idaho ground squirrels into suitable habitats.

14. (In support of strategy no. 10) Determine if removal or reduction of Columbian ground squirrel populations will provide more habitat for the Idaho ground squirrel.

Group 38—Black Rosy Finch and Gray-Crowned Rosy Finch

Results

Species ranges, source habitats, and special habitat features—Group 38 consists of the black rosy finch and the gray-crowned rosy finch, summer residents of alpine communities. The gray-crowned rosy finch occurs throughout the basin, whereas the black rosy finch is restricted to the eastern part of the basin (fig. 114). This analysis is focused on summer habitat only. Both finches winter in open habitats at lower elevations and occasionally are observed in towns.

Source habitats for group 38 are alpine tundra, barren rocky areas, and cliffs (vol. 3, appendix 1, table 1). Rosy finches nest primarily on cliffs in rocky crevices (French 1959), which are a special habitat feature used by these species. Both finches feed on seeds and insects (French 1959).

Broad-scale changes in source habitats—Source habitats coincide with the distribution of alpine tundra, both historically and currently (figs. 115A, and 115B). The greatest amount of source habitat occurs in the Rocky Mountains in Montana (fig. 115B). No change in amount of source habitats was projected for this group (figs. 115C and 116).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Neutral trends in source habitats were attributed to insignificant changes in the amount of alpine tundra since historical times (Hann and others 1997). These projections were limited by the coarse resolution of the data. Hann and others (1997) suspected that finer resolution data would indicate long-term degradation of soils and changes in the composition of vegetation resulting from excessive domestic sheep grazing within alpine environments. Thus, the projected neutral trend should be interpreted as describing habitat extent but not habitat quality.

Condition of special habitat features—Changes in the abundance of rocks and cliffs have not been documented but likely are insignificant.

Other factors affecting species within the group—Potential overgrazing by sheep and human recreational activities in alpine tundra could have a negative effect on habitat suitability for these species (ICBEMP 1996g, Lehmkuhl and others 1997). Rock climbing could cause local disturbances of nest sites.

Population status and trends—Trend data for populations of the black rosy finch or the gray-crowned rosy finch are not available. Low population numbers and limited habitat contribute to conservation concerns for both species (ICBEMP 1996g, Marshall and others 1996).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 38 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—Results of our habitat trend analysis do not lead to any management issues at the broad-scale. Expert opinions (ICBEMP 1996g, Lehmkuhl and others 1997), however, suggest the following issues may be important for the long-term viability of rosy finches:

Figure 114—Ranges of species in group 38 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Figure 115—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 38 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

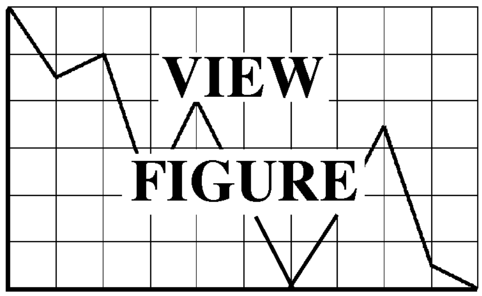

Figure 116—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 38, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

Figure 117—Ranges of species in group 39 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

1. Declines in quality of alpine vegetation in the basin because of past and current sheep grazing and recreational activities.

2. Disturbance to cliff and rock nest sites.

Potential strategies—The primary strategy for addressing issue no. 1 is to minimize negative effects of grazing and recreational activities in alpine tundra habitat. Because of lack of information on the degree of impacts to rock and cliff nest sites, no strategies are proposed for issue no. 2.

Practices that support the strategy—The following practices would be effective in implementing the strategy listed above:

1. Restrict human access and livestock use in heavily degraded areas of alpine tundra.

2. Modify grazing allotment plans and trail use regulations to prevent declines in good quality habitat.

3. Restore alpine areas that are in a degraded condition.

Group 39—Lewis' Woodpecker (Resident Population)

Results

Species ranges, source habitats, and special habitat features—Resident Lewis'woodpeckers are distributed in a small area of open woodlands in the northern end of the Southern Cascades and in southern portions of the Northern Cascades ERUs (fig. 117), along the eastern foothills of the Cascade Range. Birds use this area year-round, unlike migratory Lewis'woodpeckers described in group 2 that use the basin only during the breeding season. Source habitats of the resident Lewis'woodpecker include oak woodlands (vol. 3, appendix 1, table 1), parklike pine-oak, burned pine-fir forests, and cottonwood groves (Galen 1989). These vegetation types apparently were most abundant, historically and currently, in a small area within the northern portion of the Southern Cascades ERU (fig. 118).

Unlike most woodpecker species, Lewis'woodpecker is an aerial insectivore and requires openings for its foraging maneuvers. This woodpecker breeds in habitats that provide abundant insects (see group 2 for a broader discussion on migratory Lewis' woodpeckers) and winters in areas where temperatures are warm enough to support flying insects and where acorns are abundant. Acorns are harvested in fall and stored for winter use. Birds overwinter within the basin where a reliable acorn supply is available (Galen 1989).

Because this species has weak excavator morphology (Spring 1965), Lewis'woodpeckers typically require large snags in an advanced state of decay or trees with soft sapwood for ease of cavity excavation (Bock 1970, Raphael and White 1984, Saab and Dudley 1995, Tobalske 1997). Additionally, Lewis' woodpeckers usurp occupied cavities (Saab and Dudley 1995) or reuse old cavities created by strong excavators (that is, hairy woodpecker, black-backed woodpecker, and Northern flicker) or nest in natural cavities of trees (Bock 1970, Galen 1989, Saab and Dudley 1995, Tashiro-Vierling 1994, Vierling 1997).

Nest tree species of resident birds in the basin were primarily Oregon white oak and ponderosa pine, and less commonly Douglas-fir and cottonwood (Galen 1989). Snags and trees used for nesting are generally larger and more heavily decayed than expected based on availability of such snags (see group 2 for description of source habitats). In north-central Oregon, tree diameters at 23 nests in Oregon white oak ranged from 31.8 to 99 cm (12.5 to 39 in) and averaged 55. 9 cm (22 in); tree height ranged from 3.0 to 15.2 m (10 to 50 ft) and averaged 9.7 m (32 ft) (Galen 1989). Most of these nest trees, however, were living or had light decay. Heavily decayed trees, typical of nest trees elsewhere (see group 2 for source habitat description), were probably not necessary in north-central Oregon because nesting only occurred in pre-existing cavities, and there was no evidence of Lewis' woodpeckers excavating new cavities (Galen 1989).

Nesting habitat in north-central Oregon was usually open pine-oak woodlands and burned coniferous forests (Galen 1989). Nests also were located in cottonwood groves and narrow oak groves adjacent to open areas. No nests were found in scrub-oak thickets along south-facing slopes, unburned coniferous forests, or clearcuts. Proximity to openness was considered a critical microhabitat feature for breeding habitat (Galen 1989). Open woodlands provide sufficient visibility and space for effective flycatching. Most nests (36 of 53) were located in areas with >75 percent open canopy. Snags were also an important component of nesting habitat. Snags were used for perching during the breeding season and for acorn storage during winter.

Nesting densities of resident woodpeckers in Oregon differed from one breeding pair per 8 ha (20 acres) of woodland to one breeding pair per 16 ha (40 acres), depending on suitable snags, trees, and cavities available for nesting (Galen 1989). Nesting habitat required for one pair of Lewis'woodpeckers was estimated at 10 ha (25 acres) of open pine-oak, oak, or cottonwood when these woodlands are adjacent to open areas of equal or greater size (Galen 1989).

Wintering habitat of resident Lewis' woodpeckers in the basin was associated with nest trees used during the breeding season (Galen 1989). Nearly 90 percent of 46 nests showed signs of wintering woodpeckers. Acorns were stored in nest trees or in adjacent snags, and oaks were nearby.

In foothills habitat of southeastern Colorado, acorns were the primary winter food source (Vierling 1997). Acorn crops were higher at occupied winter sites than at random sites. Availability of storage sites for mast was a critical feature of winter habitat (Vierling 1997). Storage trees were significantly taller ($\bar{x}$ = 17.5 m versus 10.9 m [57.8 ft vs. 36 ft]) and of larger diameter ($\bar{x}$ = 104.8 cm versus 61.7 cm [41.3 in versus 24.3 in]) than random trees (Vierling 1997). Crevices in dead and decaying trees, and the deep furrowed bark of cottonwoods, were important characteristics of acorn storage sites.

Broad-scale changes in source habitats—No apparent broad-scale changes occurred in breeding and wintering source habitats of resident Lewis'woodpeckers (figs. 118A, 118B, and 119).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Areal extent of oak woodlands, the only source habitats used for this group, was not estimated to have changed using the large pixel size of this analysis (vol. 3, appendix 1,

Figure 118—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 39 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

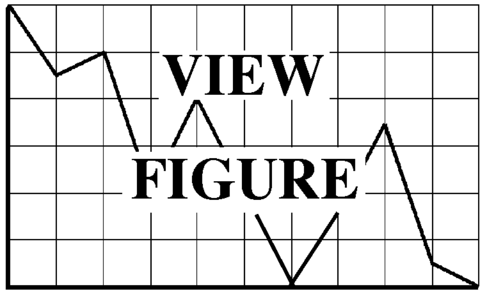

Figure 119—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 39, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of $\geq$60 percent; 1 = an increase of $\geq$20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of $\geq$20 percent but <60 percent; and -2 = a decrease of $\geq$60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

table 4; figs. 118A, and 118B). This cover type is limited within the basin and has had few threats of logging activities but greater threats by development and firewood cutting. Changes in oak woodlands may not be discernable where oaks occur in small stands or where they occur within conifer stands. Nearby pine-oak, burned pine forests, and cottonwood woodlands used by this resident population were not evaluated in the broad-scale analysis. Thus, a broad-scale analysis for this group has limited application.

Condition of special habitat features—Abundance of large, heavily decayed snags for nesting and acorn storage may have declined in the range of resident Lewis'woodpeckers within the basin. Densities of large-diameter snags ($\geq$53 cm [21 in] d.b.h.) have declined basin-wide from historical to current levels (Hann and others 1997, Hessburg and others 1999, Quigley and others 1996).

Oak mast-producing trees are critical for overwinter survival of Lewis'woodpeckers in the basin. A 500-yr-old Oregon white oak attains large diameters (58 to 89 cm d.b.h. [23 to 35 in]) on generally dry slopes that offer slower growing conditions (Galen 1989). Destruction of these old and mature trees by clearing for pastures and firewood cutting could jeopardize resident Lewis'woodpeckers.

Open woodlands that allow foraging maneuvers have probably decreased as a result of fire control practices. Historically, oak woodlands in Washington were maintained by frequent wildfires, and through controlled burning by early inhabitants (Ryan and Carey 1995). Oak woodlands currently are threatened by encroachment of ponderosa pine and Douglas-fir. Fire control also likely has reduced understory shrubs and associated arthropods that provide food during the breeding season. Additionally, understory shrubs may have been altered by disturbances of grazing practices and recreational activities.

Other factors affecting the group—Road densities have significantly increased throughout the basin (Hann and others 1997, Quigley and others 1996), allowing greater human access into forested regions and subsequent increases in snag removal for firewood. Salvage logging is another threat to snags that provide potential nest sites (Marshall and others 1996). Prolonged human presence at or near nest sites may cause abandonment (Bock 1970); however, stable populations coexist with park development and heavy tourist use during the breeding season in British Columbia (Siddle and Davidson 1991).

Chlorinated hydrocarbons, particularly DDT, which were formerly used as pesticides in fruit orchards and gardens, could have potentially negative effects on

Lewis'woodpeckers (Tobalske 1997) because these woodpeckers sometimes nest in agricultural settings (Sorensen 1986, Tashiro-Vierling 1994). Elevated energetic costs and stress may be associated with high rates of territorial encounters with European starlings, which could reduce reproductive success even if Lewis'woodpecker dominates the interaction (Siddle and Davidson 1991). Altered fire regimes and subsequent changes in the structure and composition of lower montane forests (Hann and others 1997) could reduce suitable oak woodlands for breeding and wintering Lewis'woodpeckers. Large cottonwoods, used for nesting and acorn storage, are threatened by altered hydrologic regimes, grazing practices, and urban development (Marshall and others 1996).

Population status and trends—No population trends are available for the resident Lewis'woodpeckers that occupy the eastern foothills of Mount Hood. Breeding Bird Surveys for the entire basin indicate that population trends have been stable during 1968-94 (Saab and Rich 1997), but any relation to the resident population is not known. Trend data generated by the BBS may be more adequate for monitoring populations of resident Lewis'woodpeckers than migratory populations (see group 2, "Population Status and Trends"). Dramatic cycles of population abundance related to local changes in habitat (Bock 1970) may not apply to resident birds that will use acorns as a year-round food source, supplemented by insects during the breeding season.

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 39 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Issues—

1. Exclusion of fire in parklike oak and pine-oak woodlands and subsequent decreases in natural forest openings and shrubby understories because of invasions by conifers (Marshall and others 1996).

2. Losses of large oak trees for mast production because of firewood cutting, fire control, and pasture development.

3. Decline in availability of large, heavily decayed ponderosa pine for nesting and acorn storage sites.

4. Losses of large cottonwoods used for nesting and acorn storage (Marshall and others 1996).

5. Increase in application of agricultural insecticides.

Potential strategies—The issues identified above suggest the following broad-scale strategies for the long-term persistence of resident Lewis'woodpeckers in the northern portion of the Southern Cascades ERU.

1. (To address issue no. 1) Return natural fire regimes to oak and pine-oak woodlands.

2. (To address issues nos. 2–4) Retain large (>30 cm d.b.h. [12 in]), old snags and trees of Oregon white oak, ponderosa pine, and cottonwoods (Galen 1989).

3. (To address issues no. 3 and no. 4) Protect acorn storage sites in wintering areas (Galen 1989, Marshall and others 1996).

4. (To address issue no. 4) Maintain existing old-growth cottonwood forests and manage young forests for the long-term sustainability of cottonwood/riverine systems.

5. (To address issue no. 5) Avoid use of toxic chlorinated hydrocarbons and organophosphorus insecticides near Lewis'woodpecker nesting and wintering sites.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Maintain parklike oak and pine-oak woodlands by using silvicultural treatments of prescribed fire and thinning of small-diameter ponderosa pine (<30 cm [12 in]).

2. (In support of strategy no. 2) Retain all Oregon white oak and ponderosa pine trees or snags over 3 m (10 feet) tall and >30 cm (12 in) d.b.h. (Galen 1989). Management of 10-ha (25-acre) units having about 25 percent canopy cover will likely provide nesting habitat for one pair of Lewis' woodpeckers (see Galen 1989).

3. (In support of strategy no. 3) Control fuel wood permits for removal of oaks, pines, or cottonwood used for winter storage sites. Minimize the density of roads open to motorized vehicles. Close roads after timber harvest activities, and maintain short periods during which such roads are open to reduce removal of snags along roads. In addition or as an alternative to road management, actively enforce fuel wood regulations to minimize removal of snags.

4. (In support of strategy no. 4) Survey and map existing old forests of cottonwoods and reference their locations in land management planning documents. Monitor conditions of cottonwood stands to ensure that sufficient seedling or vegetative regeneration, or both, is occurring. Identify factors limiting regeneration so that appropriate corrective measures can be taken. For example, return natural hydrologic regimes to portions of large river systems that support cottonwood riparian woodlands (for example, the Columbia River).

5. (In support of strategy no. 5) Establish zones with no use of toxic agricultural insecticides near Lewis'woodpecker breeding and wintering habitats.

Group 40—Brown-Headed Cowbird

Results

Species ranges, source habitats, and special habitat features—Group 40 consists of the brown-headed cowbird, a migrant summer breeder found throughout the basin (fig. 120). The cowbird is considered a contrast species (vol. 3, appendix 1, table 2) because it requires a juxtaposition of contrasting vegetative structure to meet all aspects of its ecology. Foraging areas are in disturbed sites near livestock, and breeding areas generally are in forests and riparian areas where passerine densities are high (Robinson and others 1995). Source habitats for the brown-headed cowbird are the agricultural community type (vol. 3, appendix 1, table 1), and the presence of livestock is a special habitat feature. Additionally, the cowbird is dependent on the presence of active bird nests for parental care of their offspring. Nest parasitism by cowbirds has been documented for over 220 bird species, primarily passerine species, and at least 144 species have fledged cowbird young (Friedmann and Kiff 1985).

Although not mappable at the broad-scale of our analysis, horse corrals and pack stations in lower montane and montane community groups also provide source habitats. Associated breeding sites are located as far as 7 km (4.3 mi) (Rothstein and others 1987) from livestock areas, where cowbirds congregate to forage. Because of the presence of livestock areas, the distribution of source habitats is much greater than estimated by our broad-scale analysis.

Broad-scale changes in source habitats—Source habitats for the cowbird were probably not present in the basin historically (fig. 121A). Source habitats are now present in all ERUs and are particularly widespread in the Columbia Plateau and Upper Snake (fig. 121B). The trend in habitat availability has been strongly increasing basin-wide (figs. 121C and 122).

Interpreting Results

Composition and structure of vegetation associated with changes in source habitats—Increases in source habitats were primarily attributed to the conversion of native vegetation to agriculture. The establishment of the cropland-hay-pasture cover type occurred on sites previously dominated by the fescue-bunchgrass, big sagebrush, and native forb cover types (Hann and others 1997). Agriculture now covers >10 percent of the land area in five ERUs: Columbia Plateau (estimated 44 percent), Blue Mountains (estimated 17 percent), Northern Glaciated Mountains (estimated 12 percent), Owyhee Uplands (estimated 12 percent), and Upper Snake (estimated 33 percent; vol. 3, appendix 1, table 4).

Condition of special habitat features—The presence of livestock is strongly associated with agricultural land uses throughout the basin. Livestock areas suitable for cowbird foraging, therefore, have probably increased in proportion to the estimated increase in area used for agriculture. Moreover, livestock areas in the lower montane and montane community groups likely have increased from historical conditions because of the location of pack stations adjacent to wilderness areas and parks, and rural expansion into forested areas.

Figure 120—Ranges of species in group 40 within the basin (from Marcot and others, in prep.). For species whose ranges shifted significantly from historical conditions, separate maps are shown for historical and current ranges; otherwise, the current range map also denotes the historical range.

Other factors affecting the group—Because cowbirds rely on other bird species to raise their young, they are affected by the same factors that govern breeding success of their selected hosts. About 50 percent of cowbird eggs are lost to normal nest-related mortality such as weather and predation (Nice 1957). Additional losses depend on the behavioral responses of the host, including egg rejection, egg burial, and nest desertion (Friedmann 1929).

Microsite conditions affect cowbird densities and parasitism rates. Cowbird numbers and parasitism rates are higher near internal forest openings, powerline corridors, and streams and in small versus large woodlots (Robinson and others 1995). Forest fragmentation and high edge density are conducive to successful breeding by cowbirds (Robinson and others 1995).

Population status and trends—Cowbirds have undergone a dramatic range expansion across North America, both eastward and westward. Expansion into eastern forests occurred in the late 1700s; this expansion was brought about by forest clearing and increases in agriculture and livestock uses. Colonization westward into Washington and Oregon began a century later (Rothstein 1994); this range expansion was likely associated with the clearing of lands for agricultural and livestock uses. Population trends were stable basin-wide from 1966 to 1994 (Saab and Rich 1997). Within Oregon, BBS data suggested that populations have been decreasing by 4 percent annually from 1966 to 1995 (n = 88; $P < 0.05$; Sauer and others 1996).

Management Implications

The following issues, strategies, and practices may be useful to managers as a starting point for integrating potential resource objectives for group 40 with broader, ecosystem-based objectives for all other resources on FS- and BLM-administered lands in the basin.

Figure 121—Percentage of area identified as source habitats, historically (A) and currently (B), and the relative change in percentage of area of source habitats from historical to current periods (C), for group 40 within each of 2,562 watersheds in the basin. Relative change for each watershed is shown as one of five trend categories, where -2 = a decrease of ≥60 percent; -1 = a decrease of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; 1 = an increase of ≥20 percent but <60 percent; and 2 = an increase of ≥60 percent.

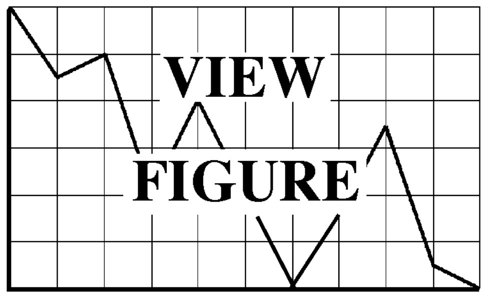

Figure 122—Percentage of watersheds within five trend categories of relative change in source habitats from historical to current periods for group 40, basin-wide and by ecological reporting units. Trend categories correspond to the following relative changes from historical to current periods: 2 = an increase of ≥60 percent; 1 = an increase of ≥20 percent but <60 percent; 0 = an increase or decrease of <20 percent; -1 = a decrease of ≥20 percent but <60 percent; and -2 = a decrease of ≥60 percent. Number of watersheds from which estimates were derived is denoted by *n*.

Issues—Issues primarily relate to the effect of nest parasitism by cowbirds on host species.

1. Reductions in nest success of host species, particularly state species of concern with known high parasitism rates.

2. Continued invasion of cowbirds into lower montane and montane community groups through the aid of small, remote livestock areas.

Potential strategies—

1. (To address issue no. 1) Minimize livestock concentrations in proximity to known source habitats for state and federally listed sensitive avian species.

2. (To address issue no. 1) Reduce parasitism rates on state species of concern.

3. (To address issue no. 2) Reduce opportunities for cowbird establishment in lower montane and montane community groups.

Practices that support strategies—The following practices would be effective in implementing the strategies listed above:

1. (In support of strategy no. 1) Consider the proximity of state species of concern before locating livestock-handling facilities on Federal land. Consider relocation of livestock facilities if such facilities exist in areas deemed important for recovery of an avian species of concern.

2. (In support of strategy no. 2) Intensively trap and remove cowbirds near nests of selected species of concern with high parasitism rates (Robinson and others 1995).

3. (In support of strategy no. 3) Delay annual establishment of livestock corrals within the lower montane and montane community groups during the early breeding season when cowbirds are actively seeking host nests (Kie 1991, Sanders and Flett 1989).

4. (In support of strategy no. 4) Consolidate remote livestock areas into fewer sites.

Abbreviations

Centimeter	(cm)
Hectare	(ha)
Inch	(in)
Kilometer	(km)
Meter	(m)
Mile	(mi)
Year	(yr)

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