APPENDIX J
BLM NEVADA MIGRATORY BIRD BEST MANAGEMENT PRACTICES FOR THE SAGEBRUSH BIOME

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Quid pro quo – There is no land management scheme or treatment that is going to be good for all birds. Every management action, whether it be simply protection or conversion to another seral vegetation condition, will be good for some bird species at the expense of other bird species. It all depends on the species for which you are managing. For example, the conversion of a juniper habitat type to a sagebrush habitat type will adversely affect gray flycatchers, juniper titmice, Bewick's wrens, blue-gray gnatcatchers, and black- throated gray warblers, but it will favor greater sage-grouse, Brewer's sparrows, sage sparrows, sage thrashers, vesper sparrows, burrowing owls, and loggerhead shrikes. There is no panacea management practice that will benefit all birds. Not all of the Best Management Practices in this document will be appropriate in all places, depending on local conditions and management needs.

Sagebrush landscapes are complex and variable. From shrublands to grasslands, wet meadows, and woodland edges, a mosaic of habitats supports an abundance of birds, animals, and native plants, some specially adapted to these semi-deserts. Far from pristine, however, sagebrush habitats across the West have been greatly altered by a century of settlement, livestock grazing, agriculture, weed invasion, and changes in wildfire frequency.

The birds in these shrublands not only add to the West's diversity of wildlife, they are important to the sagebrush ecosystem itself, providing crucial services such as dispersing seeds and preying on insects and rodents. Other wildlife species, including pronghorn, sagebrush lizard, sagebrush vole, and pygmy rabbit, also depend on healthy sagebrush habitat.

These Best Management Practices present land management recommendations to help bird communities in sagebrush habitats. These recommendations are a synthesis of other work prepared in *Birds in a Sagebrush Sea: Managing Sagebrush Habitats for Bird Communities* (Page and Ritter 1999), *Nevada Partners in Flight Plan* that was prepared by the Nevada Chapter of Partners in Flight, a partnership of private citizens, industry groups, government agencies, universities, non-government organizations, and others interested in bird conservation and Determinants of *Songbird Abundance and Distribution in Sagebrush Habitats of Eastern Oregon and Washington* (Holmes and Barton 2003).

These recommendations have not included the Western Association of Fish and Wildlife Agencies' *Guidelines to manage sage grouse populations and their habitats* (Connelly et al. 2000). Sage grouse are considered herein, but not to the detail of the Western Association of Fish and Wildlife Agencies' guidelines.

The recommendations presented herein are not regulations or policies. These Best Management Practices have only one purpose: to assist Field Offices who manage sagebrush shrublands and help support a thriving community of wild birds. These recommendations are entirely voluntary. Not all of the Best Management Practices in this document will be appropriate in all places, depending on local conditions and management needs, but even if you adopt only a few of the suggestions, you can give a boost to birds. In addition, we believe these recommendations will result in a healthy, diverse sagebrush ecosystem.

General Sagebrush Habitat Management

An obvious goal for sagebrush ecosystems in Nevada is a no net loss of sagebrush habitat in a landscape. No net loss does not preclude management activities. Sagebrush habitats are dynamic communities influenced by patterns in rainfall, fire, and the movements and population fluctuations of grazing animals. A fire, for instance, may kill a large area of sagebrush shrubs, yet as long as the land has the potential to return to sagebrush, it is not lost—the area has just become part of the natural mosaic of habitats within the landscape. However, if nonnative plants, like cheatgrass or medusahead, invade and become dominant or if sagebrush habitat is plowed under or paved over, then that area may be lost forever to the sagebrush wildlife community. Where habitat conversion fragments the landscape into isolated strips and islands of habitat, that conversion also reduces the remaining native habitat's capacity to support wildlife populations.

When we recommend "no net loss" of sagebrush, we accept that natural forces and land management activities will alter the landscape. What we hope is that human-induced habitat conversion will be accompanied by habitat restoration and conservation elsewhere. Future habitat conversions should be mitigated by restoration elsewhere, and range managers should plan for a dynamic pattern of different aged stands across a landscape. A loss of sagebrush habitats, both in amount and quality has been responsible for declines in sage grouse and Brewer's sparrow (Saab and Rich 1997).

- Identify and protect those habitats that still have a thriving community of native understory and sagebrush plants. Those areas that have remained untouched by livestock grazing or habitat conversion, have not been grazed for many years, or otherwise have high biological integrity, might be managed as conservation easements (which do not necessarily exclude economic land uses), refuges, protected areas, sanctuaries, or research areas. Management should focus on restoring natural disturbance processes, such as fire, and removing invasive nonnative plants. Where major habitat conversion has occurred, even small parcels have value to wildlife and should be protected.

- Where possible, restore or rehabilitate degraded and disturbed sites to native plant communities. On severely damaged or degraded sites, the restoration of an entirely native plant community may be expensive, long-term, or nearly impossible, but it may be possible to restore the vegetative structure (e.g., variation in shrub heights, mosaic pattern) to benefit some bird species.

- To benefit area-sensitive species such as sage grouse, and sage sparrows, maintain sagebrush in large, continuous areas composed of a mosaic of open to moderate shrub densities (5 to 20 percent) and multiple age and height classes. An area-sensitive species is one that requires a large block of unfragmented habitat to successfully breed and survive. For sage sparrows, continuous areas should be greater than 130 ha (about a half section). Sage grouse and sharp-tailed grouse need several thousand hectares of adequately connected habitat to maintain self-sustaining populations.

- Within extensive areas of sagebrush habitat, manage for a patchwork or mosaic of native plant communities across the local landscape. These patchworks or mosaics may include stands of young and old sagebrush, openings (ranging from bare ground to short vegetation to high grass density), wet

meadows, seeps, healthy streamside (riparian) vegetation, and other interspersed shrub and woodland habitats. Mosaics support many bird species with different needs. Young sparse stands support vesper sparrows and lark sparrows. Older, denser stands benefit sage grouse, Brewer's sparrows, sage sparrows, black-throated sparrows, gray flycatchers, and sage thrashers. Shrubsteppe with small, grassy openings supports sage grouse, long-billed curlews, and burrowing owls. Broad-leaved shrub thickets and riparian areas provide winter habitat for sharp-tailed grouse. Forested streamsides provide nest sites for Swainson's hawks, and interspersed juniper woodlands supply nesting areas for loggerhead shrikes, gray flycatchers, ferruginous hawks, and green-tailed towhees.

- Openings of short vegetation surrounded by sagebrush are particularly important for sage grouse leks (especially openings, knolls, and exposed ridges) and for ground foraging by sage thrashers, loggerhead shrikes, Brewer's sparrows, and sage sparrows. Openings of short vegetation (5 to 20 centimeters; 2 to 8 inches) with wide visibility provide long-billed curlew and burrowing owl breeding habitat.

- Maintain remaining biological soil crust communities by minimizing sources of soil disturbance, such as off-road vehicle use or heavy grazing.

- Maintain seeps, springs, wet meadows, and riparian vegetation in a healthy state for young sage grouse and other species that depend on the forbs and insects available in moist places. Wetlands and riparian zones also provide habitat for prey species and foraging opportunities for other sagebrush birds. Use buffers of 30 meters (100 feet) or greater around these areas (Braun et al. 1977; Blaisdell et al. 1982).

- Maintain ground squirrel colonies to provide nesting burrows for burrowing owls, and maintain small mammal populations as prey for many bird and mammal predators.

Sagebrush

Sagebrush plants provide nest sites and cover from wind and predators, harbor insects for insect-eating wildlife, and are the main food for sage grouse and pronghorn in the winter. Bird species of concern that nest in sagebrush shrubs include the sage thrasher, Brewer's sparrow, sage sparrow, green-tailed towhee, loggerhead shrike, gray flycatcher, and occasionally the Swainson's hawk. In addition, many of the ground nesters nest beneath sagebrush.

- Avoid practices that permanently convert sagebrush shrubland to nonnative grassland or farm land.

- Manage existing stands of sagebrush steppe for a balance between shrub and perennial grass cover, and for open to moderate shrub cover (5 to 25 percent) and multiple height classes.

- Extensive, overly dense and crowded sagebrush stands that have lost much of the native herbaceous understory and plant diversity may require selective removal of shrubs (rather than broad-scale eradication) to re-establish a balance between shrub cover and perennial grass and forb cover. For example, it may be possible to thin sagebrush cover by clearing patches that can be reseeded naturally

at lower densities, by using prescribed fires that produce a patchy burn pattern, or by applying reduced rates of herbicide (see Carrithers and Halstvedt 1996 for an example using tebuthiuron on big sagebrush). Only use prescribed fire in areas not threatened by cheatgrass or medusahead invasion.

- In large disturbed areas, sagebrush and perennial grasses may need to be reseeded to shorten the recovery time and prevent dominance by nonnative grasses and forbs.

- Wyoming and basin big sagebrush sites with shrub cover in the 20 to 30 percent live cover range provide valuable habitat for several sagebrush obligate bird species (sage thrasher, sage sparrow, Brewer's sparrow, gray flycatcher) even when they do not support much herbaceous vegetation in the understory. Although these sites are traditionally candidates for shrub control treatments, we recommend preserving large tracts of habitat with sagebrush with cover >20 percent to benefit the aforementioned species.

- Within site potential, maintain sagebrush canopy in mid to late seral condition with varying degrees of cover on >80 percent of the management unit.

Understory Grasses and Forbs

Perennial bunchgrasses and native forbs provide food and cover for many sagebrush birds. Several species (e.g., sage grouse, sharp-tailed grouse, and sage sparrow) are more common and more productive where perennial grasses in sagebrush steppe are tall, dense, and healthy, and many species that nest on the ground or low in woody shrubs rely on grasses for nesting cover. Also, there is experimental evidence that shrubsteppe birds prefer to eat native grass seeds rather than cheatgrass or medusahead (Goebel and Berry 1976; Kelrick et al. 1986).

- Wherever perennial bunchgrasses and native forbs persist, choose practices that stabilize or increase native grass and forb cover in balance with open to moderate (5 to 25 percent) sagebrush cover.

- To maintain bluebunch wheatgrass vigor (its capacity for growth and reproduction) avoid grazing during the growing season until plants begin to cure. Bluebunch wheatgrass, one of the most widespread of native bunchgrasses, is particularly sensitive to heavy grazing during the growing season. In a recent review of defoliation effects on bluebunch wheatgrass, Anderson (1991) asserts that recovery from a single heavy spring grazing season (50 percent or more defoliation) can require over 8 years under the best management, and depends on the number of growing tips remaining, soil moisture, and degree of competition.

- Rehabilitating sites depleted of native grasses and forbs may require seeding native species, temporarily eliminating or reducing livestock grazing, conducting appropriate fall-winter grazing, thinning sagebrush stands, creating small clearings, or other strategies.

- Where reseeding disturbed and degraded sites, try to use local, native genotypes that are competitive with nonnative weeds, and use seed priming and enhancement techniques that increase germination

rates. Where native plant community restoration is the goal, land managers may need to use contractors to collect and propagate local seed to produce enough seed for a project site or may need to transplant from adjacent sites. The availability and cost of native seeds remain the greatest obstacles to revegetation with native species, and using native generalist species or nonnative perennials may be the only commercially available alternatives. On severely degraded sites, nonnative forbs and perennial grasses may be preferable to monocultures of nonnative annuals.

- Within site potential manage for increases in herbaceous perennial components (grasses and forbs) while maintaining at least 10 percent shrub cover. This should result in an increase in grassland-associated species such as vesper sparrow, horned lark, and western meadowlark while retaining populations of shrub-nesting birds.

- Maintain native forb diversity. Although forb species may make up only a small portion of plant composition and cover in sagebrush habitats, they are extremely important to the diets of sage grouse broods, pronghorn, and other wildlife. Use practices that allow forb growth to continue through spring and summer, particularly in sage grouse breeding habitat. Some forbs that are especially valuable to sage- grouse are common dandelion, yellow salsify, hawksbeard, prickly lettuce, mountain-dandelion, sweet-clover and other clover species (*Melilota* spp. and *Trifolium* spp.), buckwheat, and common yarrow (Connelly 1997).

- Allow herbaceous cover to conceal nests through the first incubation period for birds that nest on the ground or low in shrubs. Maintain the current season's growth through mid-July, and manage for 50 percent or more of the annual vegetative growth to remain through the following nesting season (Saab et al. 1995).

Juniper

In habitats with increasing levels of western juniper manage for pre-settlement (>120 years before present) plant community structure. Brewer's sparrow appear sensitive to even low densities of juniper trees, while other sagebrush associated species may not be affected until shrub cover diminishes as a function of tree canopy cover. In general, however, sagebrush associated species will benefit from the control of expansion of western juniper into habitats dominated by sagebrush. Larger diameter juniper trees provide habitat for numerous woodland species, including several species that are juniper obligates or near-obligates within eastern Oregon. Sites that contain western juniper with old-growth characteristics, as defined by Miller et al. (2001) should be managed to maintain those characteristics.

Biological Soil Crusts

Although not used directly by birds, biological soil crusts are thought by some biologists to promote soil development and productivity in sagebrush habitats, and therefore benefit the native plant community.

- To maintain biological soil crusts, minimize soil disturbances. Crusts are sensitive to trampling by hikers, livestock, and vehicles. There is considerable debate over recovery times for biological soil crusts, from

a few years for visual recovery of the crust structure to several decades for full community recovery; recovery times depend on the site and degree of disturbance (Cole 1990; Belnap 1993; Johansen et al. 1993).

- Where restoring biological soil crusts is the goal, use exclosures or non-fence methods to eliminate trampling. Inoculating disturbed soils with material from surrounding biological crusts can hasten recovery times (Belnap 1993).

Grazing

There are many possibilities for harmonizing grazing practices with habitat management for birds. No single grazing strategy is appropriate for all sagebrush habitats, and grazing management should be tailored to the condition and potential of each grazing unit. In general, sagebrush birds will benefit if grazing plans promote a mosaic of different amounts of shrub cover, perennial grass and forb cover, and openings of bare ground, short grass, or high grass density. Proper seasonal grazing management also can ensure nesting cover and provide protection from trampling of nests or broods during the nesting season. Management plans also need to consider other grazers, such as elk and deer, and their influence on vegetation.

- Use stocking levels that stabilize or increase native perennial grass cover, reduce disturbance to biological soil crusts, and prevent sagebrush overdominance or nonnative grass and forb invasion.

- Grazing plans will depend on the current condition and plant composition of the range. Use grazing practices (seasons, stocking, kinds of stock, and distribution) that promote the growth of native grasses and forbs needed by birds for food and concealment. Options could include increasing rest cycles in rest-rotation, two-crop short rotation (early spring before boot stage and fall after seed-set), or deferred grazing. To maintain native bunchgrasses on a given unit, defer grazing until after crucial growth periods, waiting until grasses have begun to cure. Moderate to heavy spring grazing reduces or eliminates native bunchgrasses by preventing seedset (but note that deferred grazing can favor cheatgrass unless perennial grasses are a significant component of the vegetation). In stands where cheatgrass and native perennial grasses are mixed, grazing during the dormant period may favor perennial species (Young 1992; Vallentine and Stevens 1994).

- Where your goal is to protect or recover biological soil crusts, limit grazing to wet periods and winter months. Crusts are more sensitive to damage in dry months and can better tolerate the impact of hooves when wet or frozen.

- Reduce stock, time grazing, or rotate pastures to reduce or eliminate trampling of ground nests and nestlings (from May through mid-July).

- Maintain herbaceous cover for nest concealment by protecting the current season's growth through the nesting season and by managing for at least 50 percent of annual vegetative growth to remain through the following nesting season (Saab et al. 1995). For sage grouse, average grass height of at least

18 centimeters (7 inches), measured in May and early June, provides adequate herbaceous cover for successful nesting.

- Consider temporarily removing livestock from an area that is damaged or otherwise needing protection. Livestock exclusion can be considered as a short- or long-term option for locally or regionally rare vegetation types, sites undergoing restoration, recently burned areas, wet sites (springs, seeps, wet meadows, streams), and other areas that are easily degraded. By itself, removing livestock may not reverse the condition of severely damaged habitats and often must be combined with reseeding and other rehabilitation methods to restore site condition.

- Situations that concentrate livestock during the songbird breeding season (April through June) increase the influence of brown-headed cowbird brood parasitism on songbird breeding success. Corrals, feedlots, and watering sites provide feeding sites for cowbirds. Where possible, consider rotating livestock use in order to rest units from cowbird concentrations in alternate years and to give local songbird populations (within a radius of 6.5 kilometers or 4 miles) breeding opportunity without high parasitism pressure.

Water Developments

We cannot overstate the importance of healthy plant communities around streams, ponds, springs, seeps, wet meadows, and wetlands to birds and other wildlife, especially in arid country. These areas provide water, abundant insects and forbs for eating, and grasses and forbs for cover. Water developments for livestock or wildlife can use water that is already available (such as springs and seeps) or harvest water that is otherwise unavailable (such as wells and catchments). Be sure to evaluate the benefit of water developments against their effect on aquatic and riparian vegetation, the water table, and potential for attracting undesirable animals or plants.

- After evaluating the distribution and condition of natural water sources, avoid practices that degrade or destroy natural water flow or the vegetation in and around wetland habitats. Restore and enhance natural riparian and aquatic habitats wherever possible.

- Sage grouse are attracted to wet areas more for the availability of succulent forbs and associated insects than for the free water. Protect and enhance the growth of native forbs around natural and constructed water developments. Enhance water developments for grouse by placing them in known summer ranges and migration routes (Connelly and Doughty 1990).

- Exclosures or non-fencing methods of controlling livestock around riparian habitats, seeps, springs, ponds, and catchments will protect shoreline and wetland vegetation and benefit birds. However, fences can be hazardous to birds and mammals. If they are necessary, use smooth wires on top and bottom, and don’t string fences across the water. Limiting grazing to the plants’ dormant season (November to March) can help prevent damage to these areas.

- Livestock water developments can decrease stock concentrations and distribute grazing more evenly across the range to prevent degradation (Candelaria and Wood 1981). However, the tradeoff is that establishing new water developments can result in degradation of sites not previously grazed or only lightly grazed.

- Small birds sometimes drown in stock tanks and troughs. Provide escape ramps or floats to prevent drowning (Candelaria and Wood 1981).

Insecticides

Although withdrawal in the U.S. of many organochlorine insecticides, including dichlorodiphenyl-trichloroethane, eliminated the massive bird die-offs caused by these chemicals, many migratory birds are still exposed to these insecticides on their wintering grounds in other countries. Incorrect applications of legal insecticides in birds' breeding ranges also continue to cause direct mortality, sickness, behavioral changes, and reduced survival in many species. The full impact of insecticides on bird behavior and survival is still largely unknown. In sagebrush shrublands, grasshoppers are traditionally viewed as a major pest, and poor range condition, drought, and certain weather patterns can lead to grasshopper outbreaks. Intensive insecticidal control programs that eliminate beneficial insects as well as grasshoppers can trigger a rapid resurgence in pest species and actually increase the probability and duration of economically damaging grasshopper outbreaks (Lockwood et al. 1988). However, at low, endemic levels grasshoppers play a major role in rangeland ecosystems. Grasshoppers stimulate plant growth by feeding on them and contribute to nutrient cycling by producing leaf litter, and grasshoppers themselves are a major protein-rich food source for many shrubsteppe and grassland birds in summer and early fall. Although birds cannot control large pest outbreaks once they have erupted, as predators they play an important role in preventing pest buildups (McEwen 1982). Bird densities will likely decline as insect food sources decline (George et al. 1995). In the long term, insecticide applications that adversely affect insectivorous birds are counterproductive to pest control.

- Land managers concerned with maintaining productive bird populations should reduce insecticide use wherever possible.

- Include birds in integrated pest management plans for grasshopper and other insect control, along with natural pathogens, suitable crop and grazing practices, pest-resistant crop strains, minimal use of insecticides (George et al. 1995), and using less toxic forms of insecticides.

- Reduce or avoid the direct toxic effects of insecticides on birds by using insecticide baits and natural pathogens (such as Nosema locustae for grasshoppers) instead of broad-spectrum insecticides. Ulliman et al. (1998) recommend using chemicals that are least damaging to sharp-tailed grouse such as Sevin bran bait. Target pest control toward key problem areas, and time applications to be effective in minimum doses. Avoid broadcast spraying. Use ground applications rather than aerial spraying to prevent drift into nontarget areas.

- Avoid applying pesticides to sharp-tailed and sage grouse breeding habitat during the brood-rearing season (mid-May through mid-July) to reduce the loss of food supply to chicks and avoid the chance of secondary poisoning (Ulliman et al. 1998).

- Restrict use of insecticides to the minimum application rates on croplands that border sagebrush habitat. Organophosphate insecticides (dimethoate and methamidophos at maximum rates) have been shown to cause die-offs and sickness in sage grouse when aerially sprayed on croplands bordered by sagebrush habitat (Blus et al. 1989) and may affect many other species. Burrowing owls and other species attracted to agricultural areas by high densities of small mammals also are at risk from agricultural chemicals (King 1996).

Recreation

Recreation activities, such as camping, hiking, biking, and off-road driving, can also degrade sagebrush habitats. Recreationists may trample plants and biological soil crusts, and increase the incidence of fire, weed invasion, and roadkills. Humans may also disrupt bird breeding activities, causing nest failures or decreased production of young.

- Design recreation sites so they reduce impact on native vegetation and do not contribute to erosion or contaminate water. Protect springs and wetlands. Encourage use of established sites and minimum impact recreation ethics. Avoid placing recreation sites near and sage grouse leks and breeding habitat, or near raptor nest areas, such as outcrops, cliffs, and forested riparian zones.

- Driving vehicles off-road across sagebrush habitats destroys vegetation and biological soil crusts, contributes to soil erosion, and can destroy nests and nestlings. Keep all vehicles on established roads and trails or confined within areas established specifically for off-road recreation.

- In sensitive areas, hikers, mountain bikers, and horseback riders can damage vegetation and biological soil crusts and contribute to soil erosion. Reduce impacts by keeping these users to established trails.

- Limit the number of roads, and reclaim unused roadbeds with sagebrush and native grasses and forbs. This will reduce weed invasion, roadkills, and fragmentation. On remaining roads, use annual weed and fire control to protect adjacent sagebrush habitat.

Prescribed Fire and Wildfire

Burning over large areas to eradicate sagebrush is detrimental to birds in sagebrush habitats because it removes shrub cover. More alarmingly, it promotes the vegetation communities' conversion to nonnative annuals such as cheatgrass. Historically, small, patchy fires at frequencies of 25 to 100 years appear to have been the norm in some sagebrush shrublands, while larger fires at lower frequencies occurred in other areas, depending on the climate, topography, plant composition, and aridity of the site. Wildfire suppression is the best management prescription in areas prone to cheatgrass invasion and to subsequent increase in fire frequency and loss of sagebrush. Prescribed fire can be used to fulfill fire's natural role where needed.

- Burns to create openings in continuous or dense sagebrush should be on a small scale and designed to allow gradual re-establishment of sagebrush from upwind stands or soil-banked seeds. This will provide multiple ages of sagebrush over area and time.

- Burns should be timed to consider the development and susceptibility of desired plants. Mid-summer burns can devastate native perennial grasses and forbs because they destroy plants before they have reached maturity. Midsummer fires also favor cheatgrass, which matures earlier than native grasses, and can increase erosion when the soil is exposed to severe rain storms. Early spring and late fall burns when the soil is moist and grasses are dormant (before growth begins or after maturity) have less impact on native bunchgrasses and forbs (Blaisdell et al. 1982; West 1983, 1988; Young 1983; Rotenberry 1998). See Young (1983) for a summary of fire impacts on various grass and forb species and Blaisdell et al. (1982) for burning guidelines to minimize impacts on native species in sagebrush rangeland.

- Burns may require reseeding with native bunchgrass and forb species in order to stem the invasion of nonnative annuals. Avoid reseeding with crested wheatgrass or other nonnative species that create a continuous herbaceous cover and outcompete native species. However, crested wheatgrass may be appropriate in seed mixtures on severely degraded sites (Kaltenecker 1997) and may provide some structure valuable to birds. It is preferable to the more aggressive cheatgrass and medusahead. Keep cattle off recovering sites for one to two growing seasons; grazing after a burn can seriously damage soil and native perennials, delaying recovery (Blaisdell et al. 1982).

- In cheatgrass-dominated landscapes, “greenstripping” offers an option for slowing the spread of wildfire and reducing the size of range fires (Pellant 1994). Greenstrips are fuelbreaks of fire-resistant vegetation placed at strategic locations on the landscape. Greenstrips replace cheatgrass and other mat-like annual grasses with bunchgrasses or other plants that remain green, cure later than cheatgrass, or have a tufted (caespitose) growth-form so they don’t carry fire as easily. However, because greenstrips fragment sagebrush habitat and can bring in more nonnative weeds if the seeding is unsuccessful (Rotenberry 1997), only use greenstripping in areas where there is a high threat of invasion of annual grasses and where there is a real threat to high-value sagebrush sites. For example, sage grouse wintering and nesting habitats should be designated as high priority for wildfire suppression.

Habitat Fragmentation

Habitat fragmentation can result from land conversion to annual grassland or tilled cropland, mining, and development. These activities break sagebrush communities into small and sometimes isolated stands. Habitat fragmentation threatens sagebrush obligate species that evolved in a vast, continuous landscape of sagebrush habitat. Sage grouse and long-billed curlews are not as productive in small stands of habitat as in large stands. Sagebrush-obligate songbirds (sage thrasher, sage sparrow, and Brewer’s sparrow) are also sensitive to fragmentation. These species prefer larger stands with high shrub cover and decline with increasing disturbance (Knick and Rotenberry 1995; Knick 1996). Nest predation and cowbird brood

parasitism may also play a role in reducing bird productivity in fragmented sagebrush habitat, but have not been studied much (Rich 1997).

But how big is big enough? Unfortunately, the minimum or optimum sizes of habitat patches required to sustain populations of birds and other wildlife species are still largely unknown (Rotenberry 1997). M. Vander Haegan (1998), in a study in Washington, did not find sage sparrows on patches smaller than about 130 ha (about a half section). Rotenberry (1997) suggests that patches should be that size or larger.

- The safest approach to the habitat fragmentation issue is to manage for no net loss of sagebrush habitat and to maintain native vegetation communities in large and continuous stands wherever possible.

- Maintain existing larger stands of sagebrush and continuity between stands wherever possible. Avoid designs and practices that create or increase the amount of edge between sagebrush habitat and converted or highly altered land. These edges support cowbirds, nest predators, and invasive grasses and forbs, and they expose wildlife to insecticides, shooting, collisions with vehicles, and other hazards.

- To benefit sage grouse, maintain large expanses of sagebrush habitat. Summer sage grouse home ranges vary from 3 to 7 square kilometers (1 to 2.5 square miles) and may be larger in fragmented habitats. However, this area may be insufficient for year-long habitat use, and surveying the seasonal movements and winter habits of local sage grouse populations will better define a population's area requirements. Sage grouse winter home ranges may exceed 140 square kilometers (53 square miles). Large expanses of sagebrush across a landscape with stands of 10 percent to >20 percent canopy cover and tall shrubs (25 to 30 centimeters; 10 to 12 inches) provide winter habitat.

- To benefit sagebrush-obligate songbirds, maintain large continuous areas of sagebrush with multiple height classes and variable shrub cover. Prevent sagebrush conversion to annual grasslands or croplands. Suppress range fires that threaten to eradicate large areas of sagebrush.

- Some landscapes may require restoration of sagebrush and perennial bunchgrass communities to augment remaining sagebrush habitat and to avoid further fragmentation by wildfire carried by annual grasses.

- Roads also fragment sagebrush communities and play a role in the spread of noxious weeds. Limit the number of roads and consider closing and rehabilitating old roads.

Invasion of Nonnative Grasses and Forbs

The invasion of nonnative grasses and forbs is a major threat to remaining sagebrush habitats and in some areas overshadows all other concerns. Controlling these invaders is perhaps the most difficult and perplexing problem facing range managers. Once established, cheatgrass, medusahead, and other nonnatives change the vegetation ecology of sagebrush habitats. There are no simple prescriptions for

eliminating these noxious weeds, and it is far beyond the scope of this document to provide a complete review of weed management.

- Sites that are at risk for cheatgrass invasion, but not yet infested, should be managed proactively to prevent cheatgrass establishment. Management options that may minimize establishment of cheatgrass and other exotic plant species include reducing or eliminating activities that cause soil disturbance and reducing or eliminating vehicle traffic. Results from Holmes and Barton (2003) indicate that increases in cheatgrass (at the expense of bare ground or cryptobiotic crust) will result in reduced numbers of Sage Sparrow. Shrub loss due to recurrent, cheatgrass fueled wildfires will eventually render habitat unsuitable for shrub nesting species including sage sparrow, Brewer's sparrow, sage thrasher, gray flycatcher, and loggerhead shrike.

- Where stands contain a community of native grasses and forbs, reduce the likelihood of weed invasion by maintaining the vigor of native species, controlling livestock stocking levels, avoiding large-scale soil disturbances, and minimizing habitat fragmentation.

- Weed control with herbicides, biological agents, and mechanical techniques should be followed by reseeding and restoration of native plant species to prevent the reinvasion of weeds (Larson et al. 1994). Controlling fall-germinating annuals can enhance survival of seeded fall-dormant perennials, which will better re-establish if annuals are not already rooted and competing for moisture when the perennials germinate in spring (Hill 1997).

- In cheatgrass-dominated units, managers may have only two options—manage the unit as an annual grassland, or intensively control cheatgrass and reseed. Deferred grazing plans may favor cheatgrass if perennial grasses are not a significant component of the unit. Where cheatgrass dominates, heavy spring grazing before seed production may reduce cheatgrass and prepare a unit for reseeding with desirable perennial grasses (Vallentine and Stevens 1994). The BLM in Idaho is using the herbicide sulfometuron-methyl (tradename Oust) to control cheatgrass after fires. It is applied in late fall/early winter or in the early spring prior to seeding and rehabilitation efforts (Pellant 1998).

- Medusahead control appears particularly difficult. Mechanical means of control often do not work on the soils or topography where medusahead invades; herbicidal sprays may be more effective. There is some indication that a few perennial grass species can eventually establish themselves on medusahead infested sites (Young 1992).

Farming

Tillage fragments and completely alters sagebrush habitat to the detriment of sagebrush birds. However, even remnant sagebrush patches have value to some species. Certain practices can be adopted to reduce farming’s impacts on birds.

- Minimum till and no-till systems maintain vegetative cover through the non-breeding season and provide habitat for small mammals and wintering songbirds. This in turn benefits raptors. The burrowing owl and

short-eared owl, and to a lesser extent the ferruginous hawk and prairie falcon, all use agricultural areas during winter for foraging (Young 1987).

- Maintain riparian woodlands, unplowed borders and edges, and vegetated waterways to provide nest and roost sites for raptors and shrikes and foraging habitat for many songbirds. Provide an unplowed buffer of at least 30 meters (100 feet) around springs, seeps, wetlands, and riparian habitats. Even small-scale habitat protection can provide important habitat features for many birds during breeding, wintering, and migration.

- Haying often destroys nests of short-eared owls, vesper sparrows, sharp-tailed grouse, and other ground-nesting birds and decreases cover for mammalian prey. If possible, delay haying until ground-nesting birds have fledged. Most will have fledged by late July (Ivey 1995), depending on the area.

- Reduce or eliminate insecticide use to prevent poisoning birds, reducing insect prey, or eliminating beneficial insects.

- To avoid harm to other wildlife, check that fences meet specifications designed to protect deer and pronghorn. Avoid fencing small, scattered sagebrush patches in agricultural areas as this may encourage, rather than discourage, trespass grazing.

- Sites with unsuitable soils or slopes too steep for farming should be kept in native vegetation as "habitat stepping stones."

Mining and Oil/Gas Development

Mining and oil/gas development should only be a short-term habitat conversion. Land reclamation, initiated concurrently with mining operations, can restore sagebrush habitat for birds.

- Avoid placing mines, oil and gas drill sites, sand or gravel pits, geothermal sites, and roads in or next to sensitive habitats such as grouse lek, breeding, or wintering habitat; raptor nest sites on cliffs and outcrops; or riparian areas, springs, and other wetland habitats.

- The impact of construction and operations on raptor nest sites can be effectively reduced through buffers and timing restrictions. These will vary based on time of year, type and duration of activities, intervening topography, and other factors. Contact state or federal wildlife agencies for local advice on appropriate buffers and timing.

- Protection of grouse leks from disturbance during the mating season is important for successful reproduction. Ulliman et al. (1998) recommend no developments within 365 meters (400 yards) of a lek and avoiding physical, mechanical, and loud noise disturbances within 800 meters (0.5 mile) of a lek during the breeding season (March through May for sage grouse from one hour before sunrise to three hours after sunrise.

- Prepare fire and weed control plans to protect both reclamation and adjacent sagebrush habitat.

- Ponds containing mining wastes should be netted, fenced, or otherwise closed off to exclude birds, bats, and other wildlife attracted to the water.

- Reclaim areas as soon as possible after completion of activities. This reduces the amount of habitat converted at any one time and speeds up the recovery to sagebrush habitat.

- Avoid planting monocultures. Carefully plan for a complex of vegetation that reflects the diversity of plant species and habitats in the surrounding area (Karr 1980). Reseed with local genetic seed stock if available, and avoid using nonnative plant species that compete with native species. Big sagebrush will grow from soil-banked seeds, so saving topsoil is an excellent way to reestablish this species. Providing topography similar to the surrounding area will provide microsites that promote a mosaic pattern.

- Grasses and forbs compete with young shrubs, but a mixture of shrubs and herbaceous species can be established at lower seeding rates if they are seeded in separate strips (Richardson et al. 1986.)

- Fencing may be necessary to protect a site from both livestock and wild grazers, such as jackrabbits, until vegetation is well established (Richardson et al. 1986; Romney et al. 1990). However, because of hazards posed by fences, determine their necessity on a case-by-case basis.

BIRDS OF CONCERN IN SAGEBRUSH SHRUBLANDS

Seventeen bird species that breed in sagebrush shrublands score high on the Partners in Flight priority rankings for one or more of eight western states. We are concerned about the future for these species for several reasons. They are vulnerable to changes in sagebrush shrublands caused by human activities, and information from the continent-wide Breeding Bird Survey (Sauer et al. 1996) indicates that their populations are in decline or their population status is unknown. In order to view and/or download selected assessment scores for a particular species, please connect with the following link: http://www.rmbo.org/pif/scores/scores.html.

This section presents brief life history accounts for each of these "species of concern." We placed these species into several groups. Not all of the species are sagebrush obligates (i.e., using only sagebrush habitat). They all use sagebrush, but to varying extents. The groups are:

SAGEBRUSH OBLIGATE SPECIES—greater sage-grouse, sage thrasher, sage sparrow, and Brewer's sparrow.

Greater Sage-grouse (*Centrocercus urophasianus urophasianus*)

Sage grouse benefit from restoration of native forb and perennial bunchgrass communities and from maintenance of patches of tall and dense big sagebrush within sagebrush shrublands. Prevent sagebrush over-dominance by managing for a mosaic of patchy sagebrush with openings of native grasses and forbs across the landscape. Sagebrush stands should have multiple cover and size classes. During the breeding

season, nests and broods may be vulnerable to trampling by livestock. Springs, seeps, and wet meadows within and adjacent to sagebrush stands should be protected from livestock over-grazing to support the native forb and insect diet of young broods. Sage grouse respond positively to light or moderate grazing strategies that maintain grass and forb cover (Klebenow 1982). Avoid land uses that allow invasion of nonnative plants, reduce the diversity and abundance of native forbs, eliminate sagebrush, reduce cover within breeding habitats, or reduce soil moisture (Connelly 1997). Water developments, such as wildlife guzzlers, may be useful for sage grouse, but should be located in known summer habitats (Connelly and Doughty 1990). Sage grouse can be adversely affected by organophosphate and carbamate pesticides (Blus et al. 1989). Use of these pesticides should be avoided near breeding and brood-rearing.

Sage Thrasher (*Oreoscoptes montanus*)

A summary of several studies shows varying responses to grazing in sagebrush; the sage thrasher responded positively to grazing in big sage in two studies and negatively in one study (Saab et al. 1995). Long-term responses to grazing are unknown. Maintaining tall sagebrush in dense clumps with significant amounts of other shrubs, grasses, and forbs to minimize bare ground beneath shrub canopies is important for nest habitat. Some bare ground between shrubs may be important for foraging. The sage thrasher reportedly can help control Mormon crickets and other grasshoppers (Knowlton and Harmston 1943).

Sage Sparrow (*Amphispiza belli*)

Males show strong site fidelity to breeding territories and may persist where sagebrush is partially removed within a territory or for a short term where sagebrush is completely removed (Wiens and Rotenberry 1985; Wiens et al. 1986). With complete removal of sagebrush on a broader scale, sage sparrows steadily decline within two years (Wiens and Rotenberry 1985). In fragmented sagebrush shrubsteppe, they may be vulnerable to cowbird parasitism where habitat alteration brings cowbirds into contact with sagebrush breeders (Rich 1978). The sage sparrow will benefit from maintenance of large, continuous stands of sagebrush habitat. Because it is a ground forager, continuous cheatgrass cover is probably detrimental to its foraging success.

Brewer's Sparrow (*Spizella breweri*)

Many details of the species' biology and ecology are unknown. Brewer's sparrows are sensitive to sagebrush control, declining with the loss of shrubs and shifting their diet from insects to seeds with changes in food availability. Because they return to the same breeding territories each year, there can be a time-lag in their response to major habitat changes (Wiens and Rotenberry 1985). In the first year following sagebrush control by herbicides, Brewer's sparrow numbers declined by more than 50 percent (Best 1972; Schroeder and Sturges 1975; Kerley and Anderson 1995), and in the years following, they abandoned the habitat completely as the sagebrush died out (Schroeder and Sturges 1975). Castrale (1982) found similar reductions in Brewer's sparrow numbers on burned plots. In a Wyoming study, 22 years after spraying and 9 years after burning, numbers were less than 50 percent of the species' abundance in untreated continuous sagebrush (Kerley and Anderson 1995). Where sagebrush is not completely eliminated, Brewer's sparrows may persist (Best 1972; Castrale 1982), but the long-term effects of partial shrub reduction need further study. In short, Brewer's sparrows will thrive best where sagebrush is maintained in tall, clumped, and vigorous stands. Cowbird parasitism is also a concern in areas with fragmentation and cattle.

SHRUBLAND SPECIES—green-tailed towhee, black-throated sparrow, and lark sparrow.

Green-tailed Towhee (*Pipilo chlorurus*)
No quantitative information is available on the green-tailed towhee's biology, ecology, or sensitivity to management activities. The species should benefit from maintenance of dense shrub stands on mountain slopes and in ravines. It may be harmed by sagebrush control or heavy grazing that removes the grass and forb groundcover that provides a food base. Cowbird parasitism is also a concern in areas with fragmentation and cattle.

Black-throated Sparrow (*Amphispiza bilineata*)
The details of the black-throated sparrow's biology and ecology are largely unknown. The species responded positively to moderate grazing in a semi-desert habitat in Arizona (Bock et al. 1984), and a Utah study in shadscale showed a mixed response to heavy grazing (Medin 1986). Elsewhere, quantitative studies of the species' response to management activities are lacking. Their ground nests may be vulnerable to trampling. The black-throated sparrow would benefit from good perennial grass cover to conceal its nest. Cowbird parasitism is also a concern where there are cattle.

Lark Sparrow (*Chondestes grammacus*)
In semidesert habitats of Arizona, Bock et al. (1984) found that moderate grazing can have a positive effect on populations depending on the overall habitat condition. Elsewhere, quantitative information on the lark sparrow's sensitivity to management activities is lacking. The lark sparrow would benefit from good perennial grass cover to conceal its nest. Reducing or eliminating pesticide spraying and grasshopper control may increase its prey base.

SHRUBLAND AND GRASSLAND SPECIES—Swainson's hawk, ferruginous hawk, prairie falcon, and loggerhead shrike.

Swainson's Hawk (*Buteo swainsoni*)
This hawk is tolerant of agricultural lands interspersed with grasslands and sagebrush shrublands. Foraging habitat may be limiting, and the hawk should benefit from maintenance of native grass and forb habitats for rodent and insect prey. In sagebrush shrublands, provide foraging habitat by managing for native, perennial bunchgrasses in openings or intermixed with open sagebrush and preventing dominance by sagebrush or nonnative annual grasses (Harlow and Bloom 1989). Maintain scattered trees and woodlands for nesting.

Ferruginous Hawk (*Buteo regalis*)
Breeding productivity apparently varies with prey availability, and especially with jackrabbit abundance in the Great Basin. Maintaining habitats for prey base, especially rodents (e.g., prairie dogs) and lagomorphs, and protection of elevated nest sites (trees and rock outcrops) should benefit the ferruginous hawk. Nest abandonment has been linked to mining developments (Bechard and Schmutz 1995). For recommendations on protecting ferruginous hawk nest sites from disturbance, see White and Thurow (1985) and Olendorff (1993). Recreational facilities such as trails should be routed away from and screened from view of known nest sites.

Prairie Falcon (*Falco mexicanus*)
Leedy (1972) found that eggshell thinning from organochloride pesticide poisoning was associated with expanding alfalfa production in Montana. In Idaho, the species showed a negative response to moderate grazing in big sagebrush/bluebunch wheatgrass (Reynolds and Trost 1981). Prairie falcons should benefit from protection of cliff nest sites and maintaining habitat for grassland and sagebrush shrubland birds and small mammals. Activities on the cliff tops above eyries are much more disturbing to nesting falcons than below the eyries at cliff bottoms (Lambeth 1998). For drilling and construction activities, a buffer zone of 1 kilometer (0.6 mile) around active nest sites is recommended to avoid nest abandonment (Suter and Jones 1981).

Loggerhead Shrike (*Lanius ludovicianus*)
Agricultural conversion of sagebrush shrublands and prairies, urbanization, stripmining, and hedgerow destruction have reduced suitable habitat. Steep declines in shrike numbers in the Canadian prairies coincided with grasshopper control using dieldrin, and declines may be connected more to reduction in prey base than to direct effects of chemicals on reproduction, but the full effects of pesticide contamination are not known (Yosef 1996). In a Nevada study, loggerhead shrikes responded positively to grazing in shadscale and low sage habitats (Page et al. 1978). They showed no response to grazing in big sage/bluebunch wheatgrass in Idaho (Reynolds and Trost 1980) or in shadscale in Utah (Medin 1986). The shrike would benefit from elimination of pesticides and maintenance of a diverse vegetative structure. Long-term heavy grazing may ultimately reduce prey habitat and degrade the vegetation structure for nesting and roosting. Light to moderate grazing may provide open foraging habitat

GRASSLAND SPECIES—long-billed curlew, burrowing owl, short-eared owl, and vesper sparrow.

Long-billed Curlew (*Numenius americanus*)
Long-billed curlews generally respond positively to grazing prior to the onset of nesting to create short-grass habitat (Ryder 1980; Bicak et al. 1982; Medin and Clary 1990). A study in the northern plains, however, showed no response to heavy or moderate grazing in mixed-grass habitats (Kantrud and Kologiski 1982), and Reynolds and Trost (1981) found a negative response to moderate grazing in big sage/bluebunch wheatgrass. During the breeding season, nests and nestlings are vulnerable to livestock trampling. Curlews may respond positively to burning that creates openings of short grass (Bammann 1997). The species should benefit from wetland protection, protection from trampling during nesting, and maintenance of open areas of short to mixed-grass uplands.

Burrowing Owl (*Athene cunicularia*)
Protection of burrowing mammal populations is of primary importance to maintaining the burrowing owl's nest habitat. Agricultural conversion of grasslands and pastures and the control of small mammal populations eliminate the owl's breeding habitat. Predators, pesticides, shooting, and vehicle collisions also take a heavy toll on the birds. A summary of grazing studies shows mixed responses to grazing in sagebrush and grassland habitats (Saab et al. 1995). Owls will use well-grazed, early successional grasslands that emulate prairie dog towns (MacCracken et al. 1985). Burrowing owls will benefit from management that maintains zones free of herbicides and pesticides within a 600-meter (655-yard) radius of

burrows and that provides uncultivated plots of dense grasses and forbs within owl home ranges to support rodent and insect prey (Rich 1986; Haug and Oliphant 1990).

Short-eared Owl (*Asio flammeus*)
Highly dependent on vole populations, the short-eared owl irrupts locally when vole densities are high. In general, it responds negatively to moderate and heavy grazing in mixed grass and big sagebrush habitats (Saab et al. 1995). Maintaining large, continuous grasslands and wetlands with dense vegetation to support a prey base, and grasses 0.5 meter (1.6 feet) high or less, provides breeding and foraging habitat. Short-eared owls benefit from habitat management for waterfowl, particularly nest cover protection, and the burning and management of grasslands for nesting and prey habitat (Holt and Leasure 1993).

Vesper Sparrow (*Pooecetes gramineus*)
In an overview of several studies, the vesper sparrow shows inconsistent responses to grazing in several grassland types; a negative response to heavy grazing in sagebrush/grasslands; and a positive response to heavy grazing in greasewood/wild rye and shadscale/Indian ricegrass habitats (Saab et al. 1995). In the sagebrush shrublands, it benefits from maintenance of open habitats with scattered shrubs and good bunchgrass cover for nest concealment. Widespread use of pesticides and grasshopper control may be detrimental to the vesper sparrow's prey base.

PRIMARILY DRY WOODLAND SPECIES—gray flycatcher

Gray Flycatcher (*Empidonax wrightii*)
A summary of grazing studies indicates mixed responses to grazing in sagebrush habitats—a positive response in shadscale/Indian ricegrass and Nevada bluegrass/sedge, but a negative response in big sagebrush/bluebunch wheatgrass (Saab et al. 1995). The gray flycatcher will probably benefit from maintenance of tall, mature big sagebrush/bunchgrass communities and of mature juniper and pinyon-juniper stands as primary nesting and feeding habitats. Reducing or eliminating pesticides may increase its prey base.

BIRDS OF CONCERN IN RIPARIAN HABITATS

MacGillivray's Warbler (*Oporornis tolmei*)
The MacGillivray's Warbler ranges across the western U.S. and Canada including the Great Basin. It is a summer resident in most mountain ranges (Alcorn 1988). The MacGillivray's Warbler nests one to five feet from the ground in dense riparian willow and alder at the edges of meadow, coniferous or mixed woods (Dobkin 1992). It is found in canyons near streams, in thickets on north-facing slopes, in thick secondary growth following a fire, or in dense undergrowth of an aspen grove (Ryser 1985). Dense understory is required. Nests are located on or near ground.

Riparian habitats are inherently narrow, necessitating a lowered sensitivity to "edge" on the part of the species that use it. Nevertheless, below some threshold width, riparian habitats will begin to lose species (Stauffer and Best 1980). While MacGillivray's Warblers spend much of their foraging effort in the edge between riparian and brush habitats, breeding success requires concealment of the nest in thick vegetation.

MacGillivray's Warblers were found to be insensitive to campgrounds in dense riparian areas (Blakesley and Reese 1988). The Breeding Bird Survey trend data (1966-1996) indicate declines in breeding bird populations in northwestern Nevada.

The best strategy for MacGillivray's warbler is to manage for a dense willow component in suitable riparian stands through protection, enhancement, and restoration. Managing for Proper Functioning Condition in riparian systems is an admirable start toward long-term maintenance of healthy bird habitats. It must be recognized that Proper Functioning Condition only addresses the physical characteristics of the stream stratigraphy and not biological function. In the case of MacGillivray's Warbler, the challenge will be to maintain dense willow stands with a thriving understory of grasses and forbs suitable to conceal nests.

Willow Flycatcher (*Empidonax traillii*)
Riparian deciduous shrubs or trees such as willows and alder are essential components on willow flycatcher territories (Sanders and Flett 1989; Harris et al. 1987). In mountain meadows within the Sierra Nevada, willow thickets interspersed with open spaces are typically utilized, and large, contiguous willow thickets are avoided. Within mountain meadow situations, the nests of this species are typically placed at the edges of vegetation clumps situated near streams (Valentine et al. 1988; Sanders and Flett 1989). Nests are placed within riparian deciduous shrubs which are at least 6.6 feet high, with vertical foliar density of approximately 50 to 70 percent, and with 3.3 feet of cover above the nest (Harris et al. 1987). With respect to subspecies *E. t. adastus*, a trend has been noted that meadow systems are at a minimum 8.0 hectares in extent and are characteristically broad and flat (Verner 1995).

All known breeding territories have water present in the form of running water, standing pools, or saturated soils during the early stages of pair formation and breeding, mostly found between 4,500 and 8,000 feet elevation, although a few pairs may reside above 8,000 feet.

Loss of suitable habitat primarily from livestock grazing is probably the major factor resulting in the species' decline (Verner 1995). Excessive cattle grazing and trampling in willow stands can cause "highlining" of individual plants. This occurs when there are few or no green leaves or stems left on the lower portion of the plant. Willow thickets so modified become characterized by an umbrella-shaped structure. Willows with less than 40 percent foliage cover are unsuitable for willow flycatcher nesting (Fowler et al. 1991). Excessive grazing pressure on woody vegetation prohibits the establishment of seedlings and creates an even-aged, non-reproducing community (Kauffman et al. 1983; Carothers 1977; Crouch 1979).

Where present, maintain a clumpy, disjunct mature willow distribution interspersed with open areas on meadows where soil saturation lasts well into the willow flycatcher breeding period.

Orange-crowned Warbler (*Vermivora celata*) and **Yellow-breasted Chat (*Icteria virens*)**
The Nevada Working Group of PIF determined that objectives and strategies for MacGillivray's warbler were sufficient to also meet the needs for these species.

Where opportunities exist, the main thrust for riparian habitat management should be toward multi-storied, richly diverse vegetative corridors. An ideal stretch of healthy riparian bird habitat would typically include a mature overstory of tree willow or aspen capable of supporting accipiter nesting and cavity-nesting, a dense midstory of shrubby willow species, alder, or birch capable of supporting a diverse community of nesting passerines, and a vigorous understory comprised of a diverse array of grass and forb species, including wildflowers. While the ideal riparian stretch would include all these layers through the same floodplain segment (truly multi-layered), it is recognized that microsite conditions sometimes preclude true multi-layering in a riparian corridor; therefore, a healthy, properly functioning stream that provides healthy segments of each component, whether layered or closely contiguous will sufficiently provide most riparian bird habitat needs. These opportunities will exist most often where riparian habitats are already intact and can be preserved and managed at a high level of productivity through existing or slightly modified management practices. A high priority will be placed on identifying and preserving intact riparian systems.

BIRDS OF CONCERN IN JUNIPER HABITATS

Of the pinyon-juniper priority birds most have negative or unknown population trends, with only the ferruginous hawk showing a stable trend. Again with the exception of the ferruginous hawk priority birds generally need mature pinyon-juniper stands. Large, conebearing pinyon trees (only trees 75 years and older bear nuts) that are found in mature stands are necessary for pinyon jays as well as a host of other birds and wildlife. These trees should be protected from cutting and fire. Gray vireos need pinyon-juniper that is open and has a shrubby understory; this situation is often found on rocky slopes and canyon heads. The juniper titmouse needs mature pinyon-juniper in a more closed canopy situation than gray vireos and is often found near riparian areas. Often tree density conforms naturally to the scenario needed for gray vireos and the juniper titmouse. Because of available moisture, trees are frequently more dense in canyon bottoms and less so on rocky slopes. Black-throated gray warblers also need mature pinyon-juniper but also seem to prosper where a healthy understory of grass and forbs is found. ferruginous hawks are a slightly different case in that they are a pinyon-juniper sagebrush ecotone bird. It is important to protect isolated mature Utah junipers in this ecotone as nest trees. The area around known nest trees should be protected from human disturbance during the nesting period and from conversion at other times of the year.

In a habitat that is both spreading and being impacted (witness the declining population trends), it is important to identify the conditions that are needed by the priority species as closely as possible so managers understand that not all pinyon-juniper is of concern. Being able to identify mature pinyon-juniper stands that meet the conditions above would be of tremendous benefit to managers trying to conserve these priority species. A project to test the ability of remote sensing to detect mature pinyon-juniper is recommended. Basic monitoring data is needed to determine population trends for most priority species, and additional habitat use information is needed to guide management actions in pinyon-juniper habitats.

Pinyon jay (*Gymnorhinu cyanocephalus*)
In Nevada, pinyon jays are sporadically distributed throughout the pinyon-juniper belt extending from the Humboldt River south into the mountain ranges of the Mojave Desert, and ranging from the Sierra Nevada to the Utah border.

No bird species in Nevada is more strongly tied to a single habitat type than is the pinyon jay. Ligon (1978) described a mutualistic relationship between pinyon jays and pinyon pine in which pinyon jays served as the primary seed disseminators for the pine while the pine provided the jay's primary food item, pinyon nuts. Abundant cone crops stimulate pinyon jay breeding. Spotty distribution of the species across seemingly endless expanses of suitable habitat is dictated by local cone production. Flocks will wander widely in search of abundant food sources.

Limited Breeding Bird Survey data indicate that pinyon jays have experienced a population decline in the Basin and Range province since 1966 (-5.9 percent, p = 0.12; Sauer et al. 1998). Sauer (1998) estimated that as much as 31 percent of the world's population of pinyon jays was found in the Basin and Range province. Because Nevada comprises the majority of that province, because populations seem to be on the decline, and because pinyon jays better than any other species represents the needs of the pinyon-juniper bird community.

Consideration of pinyon jay habitat requirements in the public lands planning processes is the best way to build a body of knowledge about what is planned in the way of pinyon-juniper conversion over any planning period. Although pinyon jay populations appear to have recovered from the wholesale liquidation of their habitat 100 years ago, the overall effects of that event will never be known. Responsible landscape planning should ensure survival of the species while providing commodity outputs on our public lands.

Gray Vireo (*Vireo vicinior*)

The gray vireo's preferred habitat in southern Nevada is open pinyon-juniper forest, particularly occurring along desert washes with an understory of shrubs such as bitterbrush (*Purshia* sp.) or cliff rose (*Cowania* sp.). Preferred vegetative structure is sparse to open canopy closure of mature pinyon-juniper forest, although optimal density is not well understood. Shrub understory and herbaceous layer are both usually sparse under ideal conditions.

Gray vireo habitat is typically naturally fragmented with patchy to continuous stretches of suitable vegetation within fragments. Minimum patch size may be 0.8 to 1.2 hectares when habitat occurs at the head of a canyon. Often one pair of gray vireos occupies a canyon head. In larger patches, 1.5 pairs per square kilometer may occur. There are no natural disturbance regimes. Successional stage should be late to mature. Proximity to foraging areas is irrelevant.

No Breeding Bird Survey data exist for this species in Nevada. The species is subject to national concern, exhibiting a range contraction on its western front and making the newly delineated Audubon Watch List (1998).

Juniper Titmouse (*Baeolophus ridgwayi*)

In Nevada, the juniper titmouse is found in pinyon-juniper woodlands from Interstate 80 south to the Colorado River. The juniper titmouse is strongly associated with pinyon-juniper woodlands. Snags and heart rot are assumed to be important in providing nesting cavities. Dense foliage and closed canopies are preferred, while thin understory and ground cover are preferred for some feeding activities. These are all characteristics of late successional pinyon-juniper habitats. The juniper titmouse often nests in cavities in

riparian vegetation, so juxtaposition of pinyon-juniper to riparian is assumed to be beneficial. Its distribution throughout the pinyon-juniper type seems to be quite patchy and remains poorly understood.

Detailed understanding of the juniper titmouse's habitat preferences are lacking. It uses pinyon-juniper stands with canopy closure in the higher end of the scale. The juniper titmouse seems to frequent the interface between pinyon-juniper and riparian habitats. Pair density of 16 pairs per 40 hectares was reported in a pinyon-juniper/ponderosa pine ecotone in California (Laudenslayer and Balda 1976). The male defends a territory varying between 1.2 to 4.8 hectares (averaging around 2.4 hectares) year round.

Limited Breeding Bird Survey data indicate a slight, non-significant downward trend for the juniper titmouse in the Basin and Range province. Since the recent split of the plain titmouse from the old species which included what is currently known as the oak titmouse, the Basin and Range province has likely taken on a much greater percentage of responsibility for the maintenance of the (new) Juniper Titmouse, although to date there has been no analysis to that effect.

Black-throated Gray Warbler (*Dendroica nigrescens*)
In Nevada, the black-throated gray warbler breeds throughout the state from the Spring Mountains in Clark County north to the Carson Range in southern Washoe County, east to Great Basin National Park in White Pine County and north again to the Idaho border in Elko County.

In most of Nevada, black-throated gray warblers appear to be closely tied to the more arid pinyon-juniper habitats. Along the east side of the Sierra Nevada, habitat preferences include a mix of conifers, montane shrubs, and junipers. Black-throated gray warblers tend to be found in riparian habitats during migration.

In the Sheep Range of Clark County, black-throated gray warblers are found in close association with mature pinyon featuring canopy heights up to 15.2 meters. The mix of juniper can vary from small (less than three meters) pointed-top trees to large, old roundedtop trees that often reach 9.1 meters in height. Understory vegetation can be sparse, particularly in southern Nevada ranges. Sagebrush, squawbush (*Rhus trilobata*), curlleaf mountain mahogany (*Cercocarpus ledifolius*), and cliff rose (*Cowania mexicana*) in varying densities can be present. On the Sierra Nevada, the vegetation structure can include Jeffrey pine with manzanita (*Arctostaphylos* spp.) in the understory. In the Carson Range in northern Nevada, snowbush (*Ceanothus cordulatus*) may enter the understory mix.

The black-throated gray warbler breeds in the pinyon-juniper belt across the state ranging from 5,000 feet elevation in northern regions to as high as 8,000 feet in the southern ranges of Nevada. The species does not seem to be sensitive to slope or aspect. During post-breeding dispersal, black-throated gray warblers may be found in just about any habitat from coniferous forests to riparian zones, mountains to flatlands. Water is not required.

Limited Breeding Bird Survey data indicate decreasing trends for black-throated gray warbler in the Basin and Range physiographic region since 1966 (Sauer et al.1998), with downward trend continuing during the 1980-1996 period (-6.9 percent; $p = 0.44$, not statistically significant). Black-throated gray warblers have exhibited a consistent downward trend through the last three decades.

Ferruginous Hawk (*Buteo regalis*)

In Nevada, the ferruginous hawk prefers to nest in scattered juniper trees found at the ecotone of singleleaf pinyon (*Pinus monophylla*) – Utah juniper (*Juniperus osteosperma*) woodlands and desert shrub communities. In valleys that are known to support the highest nesting densities, the majority of active nests are located in isolated living junipers (Canopy Closure <1 percent) with an understory dominated by big sagebrush (*Artemisia tridentata*) or black sagebrush (*A. nova*) (Midstory Cover 40 to 80 percent) and within 3.2 kilometers of whitesage (*Ceratoides lanata*) or low sagebrush (*A. arbuscula*) communities (Midstory Cover 25 to 50 percent, Understory Cover 25 to 50 percent). Structure values are approximations. Other nest structures include living singleleaf pinyon, dead Utah juniper and desert peach (*Prunus fesciculata*). Whitesage and low sagebrush communities with associated native grasses and forbs generally support greater densities of preferred prey populations (rodents, e.g., Townsend's ground squirrels and lagomorphs e.g., black-tailed jackrabbits) than do adjacent monotypic big sagebrush communities.

Late successional to climax plant communities are preferred for nesting and foraging habitat. Nesting densities increase near pinyon-juniper/desert shrub ecotones. More open midstory vegetation with dense understory appears to be preferred to dense midstory vegetation types. Distance between nesting territories is dependent on topographic features and prey availability. In preferred habitat, nesting densities may approach 0.5 birds per square kilometer.

Conversion of whitesage and lowsage complexes to stands of exotic forbs (*Halogeton* spp.) and grasses (*Bromus tectorum* and *Agropyron desertorum*), through the agents of excessive livestock grazing, mechanical seeding, and fire disturbance has reduced the productivity of many ferruginous hawk nesting territories.

The ferruginous hawk has been a species of concern throughout much of its range since precipitous population declines were documented in the Northern Plains in the 1980s. Populations seem to be relatively stable in Nevada (Sauer et al. 1998) at the present time; however, the Basin and Range province has a high responsibility for the maintenance of the U.S. breeding population (Carter et al. 1998). There is high national concern for the status of the species as well as a high regional responsibility for population maintenance.

Land planning processes implemented by BLM are the best forum in which to incorporate management strategies for the ferruginous hawk in pinyon-juniper habitats. Landscape analysis of proposed habitat conversion should adequately address ferruginous hawk needs and avoid cumulative impacts to the Nevada population.

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