The Jewels of Juniper Woodlands

best management practices for juniper woodlands to benefit birds in wyoming

Every autumn, more than 350 species of birds leave the United States and Canada on their migratory journey for Mexico, the Caribbean, Central America, and South America. Some travel thousands of miles to their winter homes. These are the Neotropical (New World tropics) migratory birds. The list includes hawks like the Swainson's Hawk, owls like the Burrowing Owl, shorebirds like the Killdeer, and a long list of songbirds including warblers, sparrows, hummingbirds, swallows, thrushes, flycatchers, vireos, tanagers, and orioles. Ducks, geese, and resident species such as grouse are not included in the list of Neotropical migratory species (also referred to as "landbirds").

About 155 Neotropical migrant species spend part of their lives in Wyoming, and many of these nest in the State. Most of the Wyoming Neotropical migrants are songbirds that we see in our yards, on our public lands, and on our farms and ranches from spring to fall. All of us eagerly await their melodious announcement of spring each year.

Data collected for more than 30 years by scientists and amateur bird watchers clearly show that many migrant bird populations are being devastated by certain human influences. The primary cause for population loss is the

Photo by Nevada Natural Heritage Program, http://heritage.nv.gov/images/2005/crwshd78.jpg

Photo by Lee Karney, U.S. Fish and Wildlife Service

Juniper woodland habitat interspersed with sagebrush and other shrub species benefit Western Scrub-Jays, Juniper titmice, Bushtits, and others.

destruction of natural habitats on breeding and wintering grounds and along migration routes. By studying years of long-term Breeding Bird Survey data, this alarming decline has been tracked by the U.S. Fish and Wildlife Service and the U.S. Geological Survey, Biological Services Division.

Approximately 40 of Wyoming's avian species have been identified as using juniper woodland habitats. Some of these, such as the Ash-throated Flycatcher, are among the imperiled bird species in Wyoming and the western United States.

Partners In Flight—an international, volunteer organization of federal and state agencies, the forest products industry, academia, and non-governmental organizations from Canada to Argentina—is working to help these migratory bird species. Wyoming Partners In Flight has developed a set of recommended Best Management Practices (BMPs) for juniper habitats that can be used to protect and enhance populations of both Neotropical migratory birds and resident birds that call Wyoming home year-round.

juniper woodland ecology

Today the pinyon-juniper woodland occupies somewhere between 43 and 100 million acres of land in the West, and is possibly as much as three times as common as it was 150 years ago. Extending over large areas of Arizona, Colorado, Nevada, New Mexico, and Utah, it could be labeled the characteristic habitat type of the Southwest. Moving north from Colorado and Utah into Wyoming, the pinyon-juniper woodland breaks up into small discontinuous patches of juniper woodland. The two major species of juniper in Wyoming are Utah juniper and Rocky Mountain juniper. In eastern Wyoming, Rocky Mountain juniper occurs in ravines or where summer precipitation is higher. Utah juniper occurs in escarpments in the more arid basins of western Wyoming. Pure juniper stands dominate in the state, with the two species forming mixed stands where their ranges overlap. Mature pinyon pine is very uncommon in the juniper woodlands of Wyoming, but seedlings and saplings are present in the understory in the extreme south. Common understory shrubs include big sagebrush, mountain mahogany, rabbitbrush, and antelope bitterbrush. The elevation range of juniper in Wyoming is 4,000 to 10,000 feet, but it generally occurs below 6,000 feet on very dry, sandy, or rocky soils. Usually in association with mountain foothills, juniper woodlands are commonly found on moderate to steep surfaces of dipping sedimentary strata, often on rock outcrops and shallow breaks. Juniper woodland in Wyoming is configured in a naturally patchy distribution, not always a result of human-caused woodland fragmentation. It exists as a mosaic of woodland patches within a sagebrush-grassland matrix but stands with large, old trees are rare. Juniper communities today range from open savannah to closed canopies. Since juniper woodlands make up a mere 2.2% of land area in Wyoming (709,000 acres), this community is unique and has significant conservation value. Because this habitat is poorly represented in the state, several juniper specialist bird species have limited distributions in Wyoming. In addition, these woodlands mark the northernmost range for several juniper obligate bird species.

how to help

- Identify and protect those habitats that still have a thriving community of native understory plants and juniper trees. Conserve unique representatives and large,

ecologically functioning examples of juniper woodland. Conserve local breeding sites, migratory stopover sites, and wintering sites in juniper woodlands that are important for the conservation of priority species. These areas may 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.

- Take a conservative approach to management activities in juniper woodlands. Because junipers take over 100 years to mature, any miscalculations could have longlasting consequences. Consider both long- and short-term impacts and/or benefits of any activities within or adjacent to juniper woodlands. Recreation, development, fire suppression, and improper grazing in juniper woodlands can reduce the multi-aged, multi-layered structure, including snags (standing dead trees) and diseased trees, most beneficial to birds.

- Maintain old growth stands where they exist, and ensure the presence of multiple stages of mature woodland on the landscape. Habitat alterations should be designed to promote habitat interspersion but not to the detriment of old growth stands. Old growth juniper woodlands provide snags for cavity nesting species and late successional conditions favored by many woodland-dwelling species. Single tree harvests may be conducted in old growth stands in order to increase interspersion and slow stand decadence.

- Within extensive areas of juniper woodland habitat, manage for a patchwork or mosaic of native plant communities and successional stages across the landscape. This may include stands of young and old juniper, openings (ranging from bare ground to short vegetation to high grass density to sagebrush), seeps and riparian areas, and other interspersed shrub and woodland habitats. Mosaics support many bird species with different needs. Open, sparse stands support species like Scott's Orioles and Western Bluebirds; mature and old growth stands provide nesting areas for Juniper Titmice, Ash-throated Flycatchers, Black-throated Gray Warblers, Bewick's Wrens, and many others; and interspersed sagebrush and other shrub areas benefit Juniper Titmice, Western Scrub-Jays, Bushtits, and others.

- Maintain existing larger stands of juniper. The removal of large patches or reductions in patch size to below 1.2 mile^2 may negatively impact source populations of juniper specialists, and result in ecological traps for woodland-dwelling species in small, simple patches. Because very few large woodland patches greater than 7.3 mile^2 are present on the landscape, woodlands of this size have high conservation value.

Photo by Scott Swanson, U.S. Fish and Wildlife Service

Take a conservative approach to management activities in juniper woodlands. Because junipers take over 100 years to mature, any miscalculations could have longlasting consequences.

- Maintain continuity between stands wherever possible. Habitat fragmentation can result from land conversion to annual grassland, mining, and development. These activities break juniper communities into small, and sometimes isolated, stands. An increase in the number of juniper woodland patches with an average isolation of greater than 1,000 feet may have negative impacts on woodland-dwelling species. Nest predation and cowbird nest parasitism can reduce bird productivity in fragmented habitat, and most woodland patches more than 14 miles from contiguous woodland exhibit high densities of

cowbirds. The best way to avoid habitat fragmentation is to manage for no net loss of juniper woodland habitat and to maintain native vegetation communities in large and continuous stands wherever possible. Priority should be given to woodland communities less than 4.3 miles from contiguous pinyon-juniper woodland. Woodland habitat less than 4.3 miles from what is considered the mainland species pool appear to be relatively free from the negative impacts of open and edge habitats.

Photo by Lee Karney, U.S. Fish and Wildlife Service

Manage for a patchwork or mosaic of native plant communities and successional stages across the landscape. Mosaics can support many bird species with different needs.

- Avoid designs and practices that create or increase the amount of edge between juniper woodland 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.

- Maintain woodlands that contain a pinyon pine component. Mature pinyon pine is very uncommon in Wyoming, but seedlings and saplings are present in the understory in the extreme south. A positive correlation may exist between the proportion of permanent avian residents in the community and the proportion of trees in the woodland that are pinyon pines. The distribution of birds such as Gray Flycatchers, Juniper Titmice, Bewick's Wrens, and Black-throated Gray Warblers may be somewhat limited to areas where pinyon pine occurs in juniper woodlands.

- Extensive, overly dense, and crowded juniper stands that have lost much of the native herbaceous understory and plant diversity may require selective removal of trees to reestablish a balance between tree and shrub cover and perennial grass and forb cover. Woodlands with over 70% canopy cover will support little to no understory vegetation and the insects of the understory layer will no longer be available as food for birds.

- Provide small-scale openings in the habitat. A landscape mosaic that intersperses cover patches with small openings that provide foraging and browsing opportunities may be the best way to meet an array of management objectives. Openings create a diverse landscape that favors many wildlife species. For example, small mammal populations increase within cleared areas, which could attract predatory birds. Birds that feed on insects associated with openings should also benefit from this landscape. However, openings should not be too large and the woodlands should not become fragmented. Clearing widths should be limited to 650 feet to maximize use by species that nest in adjacent woodlands, yet can include cleared areas in their territories. These openings would still provide adequate space for species restricted to cleared areas. Openings should follow natural contours, have irregular edges, be interrupted by areas with various ages of junipers, and be in close proximity to mature juniper stands.

- Provide multiple layers of plants, or "vertical vegetation structure", in juniper woodland habitats. Many bird species nest and forage within 10 feet of the ground, so it is critical to have sufficient amounts of vegetation at that level. Healthy juniper woodlands have

young trees, shrubs, and herbaceous grasses/ forbs that provide these layers.

- Increase the quantity and quality of shrub cover near to or interspersed among mature juniper stands. Select sites for shrub enhancement that have good potential for shrub growth, leave lots of woody slash, and use varying levels of treatment so that more trees are left standing toward the edges of units. All of these measures will add structural complexity to the treated unit, thus compensating, in part, for the loss of the juniper overstory. Such treatment units will be more versatile as wildlife habitat than units stripped clean of wood and seeded with grasses. Also, shelterwood cuts (whereby several large trees are left temporarily as a source of shade for a new crop of seedlings) can result in increased shrub production, while providing a seed source for future junipers. Shrub enhancement should not be conducted to the detriment of old growth stands of juniper.

- Manage for a variety of locally native plants. Different plant species host different insect populations, which provide food for a variety of bird species.

- Manage existing stands of juniper for a balance between tree, shrub, and grass/forb cover and for open to moderate tree cover and multiple height classes.

- Regardless of the motivation for altering juniper habitat, snags should not be removed. The multi-stemmed juniper growth form produces a large number of natural cavities where the stems meet. The more tree-like, single-stemmed growth form is a common substrate for woodpeckers to excavate cavities. Both tree forms should be maintained in the same proportions post disturbance as pre-disturbance.

- Regularly monitor birds to see how the management plan is working, and redirect efforts if necessary (with special emphasis for species that seem to be declining). Implement juniper woodland habitat monitoring programs to establish baseline data and identify changes in habitat quality (both positive and negative) through time. Use standardized methods to monitor the habitats and sensitive species in an area, before and at several-year intervals after treatments are applied, to aid in making proper land management decisions in the future.

fire

Prior to human settlement and livestock grazing, fire was the most important natural disturbance in juniper woodland ecosystems. Grass fires often killed juniper trees less than 3 feet tall, and maintained juniper stands in a savannah-like condition with grassland inclusions. The absence of fire since European settlement has resulted in increased density and canopy cover in juniper woodlands, and in many cases a loss of diversity and density in the understory. Prescribed and natural fires may be used in juniper habitats to decrease density and canopy cover, increase herbaceous cover, and increase shrub productivity. Although fires can be detrimental to birds during the summer when eggs and nestlings might be destroyed, the understory growth in a recently burned area creates nesting habitat for birds that nest on or near the ground, and attracts insects, which leads to a better food supply for insectivorous birds.

- Use prescribed fire with great care or not at all in areas threatened by cheatgrass or medusahead invasion. Cheatgrass, an alien annual grass, has invaded many juniper woodlands, and when the tree and shrub overstory is removed by fire, this aggressive

Photo by Robert A. Hamilton, courtesy of The National Audubon Society

Old growth juniper woodlands provide snags for cavity nesting species and late-successional conditions favored by many woodland dwelling species.

grass may dominate the site. If the native understory vegetation is depleted by competition from a dense tree overstory or by overgrazing, its ability to compete with cheatgrass and other noxious weeds is further hindered. In severe cases, fire suppression may be the only way to avoid continued cheatgrass invasion. In other cases, prescribed fire may be combined with artificial reseeding of native bunchgrass and forb species to curb the invasion of non-native annuals. A hot fire may destroy enough of the seed reserve of cheatgrass, which is mostly located in the litter or on the soil surface, to provide a brief time window for successful seeding of native species.

- Burns should be relatively small so a portion of the area contains nesting cover and mature stands at all times. Historically, small, patchy fires were probably the norm in most juniper woodlands. Burns to create openings in continuous or dense juniper should be on a small scale and designed to allow gradual reestablishment of juniper from adjacent stands. This will provide multiple ages of juniper cover across the landscape and over time.

- In areas known to support nesting birds, prescribed burns should not be conducted until fall to avoid loss of nesting cover. Burns should also 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. Mid-summer fires also favor cheatgrass, and can increase erosion when the soil is exposed to severe rainstorms.

- Juniper stands are often difficult to ignite, and a reduced herbaceous ground cover may cause the fire to carry poorly. Burning has been most successful when the trees themselves were lit and managers did not depend on the understory to carry the fire into the canopy. Often the conditions necessary to get a fire to burn in juniper—hot, dry, windy weather—are too dangerous to allow burning. Temperatures above 70° F, relative humidity of less than about 25%, and winds of 10 to 30 mph provide the most favorable conditions for burning. A Haines index of 5 or 6, which indicates the lower atmosphere is dry and unstable, is helpful for large fire growth and successful burning. Cloud-free days are necessary for sustained

Photo by Arthur Allen, U.S. Fish and Wildlife Service

In areas known to support nesting birds, prescribed burns should not be conducted until fall to avoid loss of nesting cover. Burns should also be timed to consider the development and susceptibility of desired plants.

fire spread, and ignition in drainage bottoms can help achieve crown fires.

- Natural fires less than 1,000 acres should not be suppressed except when significant stands are threatened or when fragmentation of old growth stands will become too severe. If a large increase in fire frequency and areas burned occurs then the policy should be reviewed by considering the amount of old growth left and its distribution over the landscape.

- Keep cattle off recovering sites for one to two growing seasons. Grazing after a burn can seriously damage soil and native perennials, delaying recovery.

PHOTO BY U.S. FISH AND WILDLIFE SERVICE

A positive correlation may exist between the proportion of permanent avian residents in the community and the proportion of trees in the woodland that are pinyon pine.

- Develop a fire use plan before burning. It should include the following:
  - Burn Area – Clearly define the boundaries of the burn area.
  - Burn Objectives – Define the purpose of the prescribed burn, when it should be conducted, and the desired results.
  - Burn Prescription – Define the components of the burn that will accomplish your objectives. Time of year is a major burn prescription component for obtaining desired results.
  - Burn Plan – Clearly define how the prescribed burn will be carried out on the ground. Include components such as fuel treatments and fire lines to ensure the fire will carry into all areas to be burned, will not burn too hot or flare up, and will be contained within natural or constructed boundaries.

grazing

Livestock production has long been the primary use for juniper woodlands, although livestock grazing in Wyoming, especially sheep operations, was more extensive during the early 1900s than it is currently. Even today, the juniper community is a low value, but nevertheless important, component of the range complex, as it provides forage and shelter for both domestic livestock and wildlife. In many areas, a year-round grazing scheme has traditionally been used to maximize profits. In areas where this occurs, overgrazing can influence woodland succession by decreasing native grass species and increasing shrubs, forbs, exotic grasses, and the density of juniper cover. In addition, big game wintering areas that exceed carrying capacity can greatly alter the structure of the community. Juniper woodlands require careful grazing management because of their susceptibility to changes in understory vegetation, invasion by exotic grasses, and erosion.

- There are many possibilities for harmonizing grazing practices with habitat management for birds. No single grazing strategy is appropriate for all juniper habitats, and grazing management should be tailored to the condition and potential of each grazing unit. In general, juniper birds will benefit if grazing plans promote a mosaic of different amounts of tree and shrub cover, perennial grass and forb cover, and openings of bare ground and rock, short grass, or high grass/forb density. Proper seasonal grazing management can also ensure nesting cover and provide protection from trampling of nests or broods during the nesting season.

- Grazing management plans should be developed and evaluated on a case-by-case

Photo by U.S. Fish and Wildlife Service

Combine core preserves and buffer areas to maximize habitat size across the landscape. When possible, manage core preserves strictly for biological diversity.

basis by the managing agency or landowner because no single grazing strategy will fit all situations. Include juniper woodland management as an integral part of each grazing management plan. Determine site-specific objectives and tailor the grazing management plan to help meet the objectives. Consider the site's specific factors of concern, such as erosion or loss of old growth juniper; the site's potential and capability; its suitability for grazing livestock and the type of stock best suited to the area; and the ideal grazing strategy, including the time, place, amount, duration, and intensity of grazing. Monitor the effects of each grazing strategy on the juniper woodland to check progress toward the objectives. Record how various size classes of juniper, the overall juniper ecosystem, and the understory plant species respond to grazing management (annual photographs taken from the same point are helpful).

- 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 cover. To maintain native bunchgrasses on a given unit, defer grazing until after crucial growth periods, waiting until grasses have begun to cure so seed-set can occur. However, 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.

- Maintain proper stocking rates and livestock distribution to protect juniper woodland ecosystems. Incompatible grazing can negatively influence the species, structure, and health of understory vegetation; can increase the density of juniper cover; and can increase soil erosion. Use stocking levels that stabilize or increase native perennial grass and forb cover and prevent juniper over-dominance or nonnative plant invasion. Manage grazing intensity at a level that will maintain the composition, density, and vigor of desired plants and will not promote soil erosion.

- Manage pastures in a rotation grazing system. Where feasible, use a deferred-rotation or rest-rotation system, whereby no pasture is grazed the same season (spring, summer, or fall) two years in a row.

- Allow time for plants to rest and regrow between grazing periods to ensure they remain vigorous and productive. Plants that are continuously grazed during the growth period will lose their vigor and stop producing seeds, and their roots will die back, eventually causing a change in the plant community from more productive, palatable species to less productive and less palatable species.

- Set aside pastures for intensive treatment, e.g. thinning, seeding, or permanent or long-term rest.

- Be aware of the impacts that cowbird nest parasitism has on nesting birds. Increased nest parasitism results when forests are fragmented or livestock grazing occurs near woody habitats during the nesting season. The cowbird is an open-habitat species that commonly associates with livestock because of the foraging opportunities livestock provide. Due to their nomadic behavior, cowbirds build no nest of their own. Instead, females lay their eggs in the nests of host species, often removing a host's eggs in the process. Cowbird eggs hatch sooner than the

hosts' eggs, and cowbird young are larger and more aggressive; therefore, they crowd the hosts' young and receive the majority of food brought to the nest, at the expense and often demise of the hosts' young. In the West, expansion of livestock into forest and woodland areas has allowed cowbird populations to increase and expand their range. Cowbirds are highly mobile, commuting up to 4 miles daily between breeding and feeding sites. In addition to existing in close proximity to cowbird feeding sites (i.e. where cattle graze), juniper woodlands also provide an abundance of available cowbird hosts. Therefore, it is necessary to take a landscape-scale approach to planning grazing regimes to benefit birds.

Photo by U.S. Fish and Wildlife Service

Conserve local breeding sites, migratory stopover sites, and wintering sites in juniper woodlands that are important for the conservation of priority species

- Situations that concentrate livestock during the songbird breeding season (April through July) increase the influence of Brown-headed Cowbird nest parasitism on songbird breeding success. Where possible, rotate livestock use in order to rest units from cowbird concentrations in alternate years and to give local songbird populations (within a breeding radius of 4 miles) the opportunity to nest without high parasitism pressure.

- Keep cattle off burned sites for one to two growing seasons. Grazing after a burn can seriously damage soil and native perennials, delaying recovery.

- In wet years, and near springs and seeps, closely monitor livestock activity to avoid overuse. Rocky Mountain juniper is susceptible to loss from erosion because it often grows on moist sites with highly erodible soils. Overuse by livestock can accelerate the erosion process. Damage by ungulates may be decreased by reducing animal numbers, fencing damaged areas, placing natural barriers such as logs and brush across pathways, and placing salt blocks and feed on uplands.

- Improve livestock distribution and forage use by using salt and mineral blocks, but avoid placing them within wetland and riparian areas or in immediately adjacent uplands (keep them at least ½ mile from wetlands or streams).

- Reduce stocking level, change timing of grazing, or rotate pastures to reduce or eliminate trampling of ground nests and nestlings (from May through mid-July for most songbirds).

- Temporarily remove livestock from an area that is damaged or otherwise needing protection. Livestock exclusion can be a short- or long-term option for locally or regionally rare vegetation types, sites undergoing restoration, recently burned areas, wet sites (e.g. springs, seeps, wet meadows, and 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.

- Management plans should consider other grazers, such as elk and deer, which can impact the vegetation in juniper woodlands. Managing for just one species can sometimes

have negative impacts on other species, such as birds. Consider juniper community conditions and big game impacts when setting herd objective levels. Do not exceed the carrying capacity of juniper habitats. When appropriate, fence livestock out of crucial big game winter range.

- Develop conservation partnerships between landowners, land managers, and private organizations. While landowners need to derive income from the land, this can often be compatible with maintaining regional biological diversity, depending on how the land is used and what land management tools are employed. Identify the habitat needs of the birds in the area and the economic needs of the landowner so a baseline need is established. Combine core preserves and buffer areas to maximize habitat size across the landscape. When possible, manage core preserves (e.g. national parks, national forests, national grasslands, wilderness areas, etc.) strictly for biological diversity. Surround core preserves with buffer areas, like ranches, where some areas of natural vegetation can be sustained. Although buffer areas are used for livestock grazing and other land uses, they establish and protect large areas of habitat across the landscape. Also, important habitat on private land can be protected with conservation easements. In some cases, landowners can derive income from hunters, birders, and naturalists who visit the region.

forestry

Tree harvesting, if properly planned, can have beneficial effects on juniper woodland habitat.

- Single tree selection (whereby individual trees are chosen for harvest on the basis of size, shape, growth potential, or competition with neighboring trees so that the result is an uneven-aged stand) and shelterwood (whereby several large trees are left temporarily as a source of shade for a new crop of seedlings) methods are best for reducing tree densities and for productivity of juniper woodlands. These methods can result in increased shrub, grass, and forb production, while providing a seed source for future junipers. If harvest areas do not exceed 650 feet in width and snags are left standing, this type of harvest can benefit the juniper community in the long term.

- Keep the altered site small and irregular in shape, maintain nearby trees and tall shrubs, and avoid soil erosion.

- Slash should be left unburned, in small piles.

- Use single tree selection, rather than shelterwood, methods in old growth stands to increase interspersion and slow stand decadence. The seed-tree method (whereby several mature parent trees are left as seed sources for blocks of cutover woodland) generally results in unsatisfactory regeneration because of poor seed dispersal.

- Clearcutting of large areas is not appropriate in juniper woodlands because of poor seed dispersal and slow maturation of trees. However, in areas where substantial increases in forage production are required, patchcutting may be used. Patches should be no larger than 5 acres, irregularly shaped, no closer than 1,000 feet to adjacent patchcuts, and should follow natural contours.

Photo by Lee Karney, U.S. Fish and Wildlife Service

Where possible, rotate livestock use in order to rest units from cowbird concentrations in alternate years and to give local songbird populations the opportunity to nest without high parasitism pressure.

Photo by U.S. Fish and Wildlife Service

Rocky Mountain juniper is susceptible to loss from erosion because it often grows on moist sites with highly erodible soils.

rehabilitation

- Recreate the historic, open stands of large size class juniper woodlands and savannahs. Because many juniper woodlands have increased in density in the last century, management through prescribed fire or thinning is probably important to maintain or restore various resource values. However, selection of sites to be treated, the pattern of treated and untreated juniper stands on the landscape, and proper management following treatment will probably determine the success or failure of juniper woodland management.

- Where possible, restore or rehabilitate degraded and disturbed sites to native plant communities. 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 juniper stands, creating small openings, or other strategies.

- Mining and oil/gas development should only be a short-term habitat conversion. Use land reclamation, initiated concurrently with mining operations, to restore juniper habitat for birds. Reclamation efforts should duplicate as closely as possible the original habitat interspersion and the original topography, including exposed rock. Reclamation may be accelerated by the use of locally derived cultivars and by mycorrhizal inoculations of shrubs and trees.

- Reseed large disturbed areas to shorten recovery time and prevent dominance by nonnative cheatgrass and other weedy species where stands of juniper are dense and lack a diverse understory. When 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. Aerial seeding followed by chaining to cover the seed may be the most effective way to establish perennial vegetation on areas with slopes, gullies, rock outcrops, dead tree stumps, and debris. Drill seeding can result in a very high germination response, but can only be used on level areas free from obstacles; therefore, it is not possible in many juniper habitats. Aerial seeding without covering the seed may not result in adequate germination.

farming

- Avoid practices that permanently convert juniper woodland to nonnative grassland. Wherever perennial bunchgrasses and native forbs persist, choose practices that stabilize or increase native grass and forb cover in balance with open to moderate juniper cover. To reduce the likelihood of weed invasion, maintain the vigor of native species, control

livestock stocking levels, avoid large-scale soil disturbances, and minimize habitat fragmentation. Remove exotic plants, like cheatgrass, that compete with native plant species and do not provide foraging or nesting opportunities for wildlife. While treatments in juniper habitat, such as tree removal and prescribed fire, may increase the productivity of native perennial forbs and grasses, they may also cause an increase in undesirable species such as cheatgrass or medusahead. The potential for these exotic weeds to form closed communities usually depends on the composition of the understory prior to treatment, seed pools, slope, aspect, size of treatment, soil condition, dispersion of slash, and management following treatment.

- Avoid joining insect control projects. The use of pesticides for insect control can greatly reduce the food base of many bird species by killing far more than just the target species. Strictly limit insecticide and herbicide application to activities that improve or maintain the juniper woodland community (e.g. elimination of competitive noxious weeds). Where pesticides are needed, use them as part of an Integrated Pest Management (IPM) program. IPM involves closely monitoring pest populations of plants, animals, and insects, and using chemicals only when and where pests are likely to cause economically or ecologically important damage. This reduces exposure of wildlife to harmful chemicals and reduces the destruction of non-target insects and plants. If available, use biological control for specific noxious species rather than chemical control. When possible, apply pesticides and herbicides by hand to target weeds and other pests as specifically as possible. Include birds in IPM plans for insect control, along with natural pathogens, suitable crop and grazing practices, pest-resistant crop strains, minimal use of pesticides, and using less toxic or persistent forms of pesticides.

- While it is better for birds (and cats) if cats are kept indoors, have domestic "barn" cats spayed or neutered, keep pet food and food bowls indoors so predators like raccoons and feral cats do not have an additional food source, and never intentionally feed feral cats. Cats (even well fed domestic cats) can be devastating to local songbird populations. Natural predators, like owls and hawks, are very efficient at controlling rodent pests, even around human dwellings.

Photo by Peter Gaede, courtesy of The National Audubon Society

Develop conservation partnerships between landowners, land managers, and private organizations. Identify the habitat needs of the birds in the area and the economic needs of the landowner so a baseline need is established.

- Develop conservation partnerships between landowners, land managers, and private organizations. While landowners need to derive income from the land, this can often be compatible with maintaining regional biological diversity, depending on how the land is used and what land management tools are employed. Identify the habitat needs of the birds in the area and the economic needs of the landowner so a baseline need is established. Combine core preserves and buffer areas to maximize habitat size across the landscape. When possible, manage core preserves (e.g. national parks, national forests, national grasslands, wilderness areas, etc.) strictly for biological diversity. Surround core preserves with buffer areas, like ranches, where some areas of natural vegetation can be sustained. Although buffer areas are used for livestock grazing and other land uses, they establish and protect large areas of habitat across the landscape. Also, important habitat on private land can be protected with conservation easements. In some cases,

landowners can derive income from hunters, birders, and naturalists who visit the region.

wildlife management

- Management plans should consider wild grazers, such as elk and deer, which can impact the vegetation in juniper woodlands. Managing for just one species can sometimes have negative impacts on other species, such as birds. Consider juniper community conditions and big game impacts when setting herd objective levels. Do not exceed the carrying capacity of juniper habitats. When appropriate, fence livestock out of crucial big game winter range.

- Habitat alterations to increase browse for deer winter range should be made only where historical big game use is documented and where potential shrub productivity is high. Avoid converting old growth stands to shrub stages. Altered areas should be small, irregular in shape, and near thermal cover. Retain all snags in the altered area.

recreation

- Driving vehicles off-road across juniper habitats destroys vegetation, 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 contribute to soil erosion. Reduce impacts by keeping these users to established trails. Limit the number of roads and trails, and reclaim unused roadbeds with native vegetation. This will reduce weed invasion, roadkills, and fragmentation.

information and education

- Establish public education goals and implement programs to inform users of public lands and owners of private lands of the value, sensitivity, and importance of juniper woodlands to resident and Neotropical migratory birds and other species. This could range anywhere from interpretive signs on public lands, to distribution of Best Management Practices to landowners, to presentations at local grade schools, etc.

references and additional reading

Balda, R. P., and N. Masters. 1980. Avian communities in the pinyon-juniper woodland: a descriptive analysis. Pages 146-169 *in* R. M. DeGraaf and N. G. Tilghman, technical coordinators. Workshop Proceedings: Management of Western Forests and Grasslands for Nongame Birds. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. General Technical Report INT-86. 535pp.

Beidleman, C. A. 2000. Colorado Partners In Flight Land Bird Conservation Plan. 319pp.

Belsky, A. J. 1996. Viewpoint: western juniper expansion: is it a threat to arid northwestern ecosystems? Journal of Range Management 49 (1):53-59.

Bock, C. E., V. A. Saab, T. D. Rich, and D. S. Dobkin. 1993. Effects of livestock grazing on Neotropical migratory landbirds in western North America. Pages 296-307 *in* D. M. Finch and P. W. Stangel, editors. Status and Management of Neotropical Migratory Birds. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. General Technical Report RM-229. 422pp.

Erskine, I., and S. Goodrich. 1999. Applying fire to pinyon-juniper communities of the Green River Corridor, Daggett County, Utah. Pages 315-316 *in* S. B. Monsen and R. Stevens, compilers. Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West; 15-18 September 1997; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Proceedings RMRS-P-9. 411pp.

Evans, R. A. 1988. Management of Pinyon-Juniper Woodlands. USDA Forest Service, Intermountain Research Station, Ogden, UT. General Technical Report INT-249. 34pp.

Ferry, G. W., R. G. Clark, R. E. Montgomery, R. W. Mutch, W. P. Leenhouts, and G. T. Zimmerman. 1995. Altered fire regimes within fire-adapted ecosystems. Pages 222-224 *in* E. T.

LaRoe, G. S. Farris, C. E. Puckett, P. D. Doran, and M. J. Mac, editors. Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems. USDI National Biological Service, Washington, D.C. 530pp.

Fitton, S. 1989a. Draft Management Recommendations for Crucial Utah Juniper Habitat in Southwest Wyoming. Wyoming Game and Fish Department.

Fitton, S. 1989b. Nongame Species Accounts: The Utah Juniper Obligates. Wyoming Game and Fish Department, Cheyenne. 52pp.

Goguen, C. B., and N. E. Mathews. 1998. Songbird community composition and nesting success in grazed and ungrazed pinyon-juniper woodlands. Journal of Wildlife Management 62 (2):474-484.

Gottfried, G. J., and K. E. Severson. 1993. Distribution and multiresource management of pinyon-juniper woodlands in the southwestern United States. Pages 108-116 *in* E. F. Aldon and D. W. Shaw, technical coordinators. Managing Pinyon-Juniper Ecosystems for Sustainability and Social Needs: Proceedings of the Symposium; 26 -30 April 1993; Santa Fe, NM. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. General Technical Report RM-236. 169pp.

Graham, R. T., R. L. Rodriguez, K. M. Paulin, R. L. Player, A. P. Heap, and R. Williams. 1999. The Northern Goshawk in Utah: Habitat Assessment and Management Recommendations. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. General Technical Report RMRS-GTR-22. 48pp.

Green, A. W., and R. C. Conner. 1989. Forests in Wyoming. USDA Forest Service, Intermountain Research Station, Ogden, UT. Resource Bulletin INT-61. 91pp.

Gruell, G. E. 1999. Historical and modern roles of fire in pinyon-juniper. Pages 24-28 *in* S. B. Monsen and R. Stevens, compilers. Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West; 15-18 September 1997; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Proceedings RMRS-P-9. 411pp.

Idaho Partners In Flight. 2000. Idaho Bird Conservation Plan. Version 1.0. 156pp.

Knight, D. H. 1994. Mountains and Plains: The Ecology of Wyoming Landscapes. Yale University Press, New Haven, CT. 338pp.

MacDonald, L. 1999. Wildfire rehabilitation in Utah. Pages 410-411 *in* S. B. Monsen and R. Stevens, compilers. Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West; 15-18 September 1997; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Proceedings RMRS-P-9. 411pp.

Meeuwig, R. O., and R. L. Bassett. 1983. Pinyon-juniper. Pages 84-86 *in* R. M. Burns, technical compiler. Silvicultural Systems for the Major Forest Types of the United States. USDA Forest Service, Washington, D.C. Agriculture Handbook 445. 191pp.

Miller, R. F., and P. E. Wigand. 1994. Holocene changes in semiarid pinyon-juniper woodlands. BioScience 44(7):465-475.

O'Meara, T. E., J. B. Haufler, L. H. Stelter, and J. G. Nagy. 1981. Nongame wildlife responses to chaining of pinyon-juniper woodlands. Journal of Wildlife Management 45(2):381-389.

Paige, C., and S. A. Ritter. 1999. Birds in a Sagebrush Sea: Managing Sagebrush Habitats for Bird Communities. Partners In Flight Western Working Group, Boise, ID. 47pp.

Parrish, J. R., F. P. Howe, and R. E. Norvell. 1999. Utah Partners In Flight Draft Avian Conservation Strategy. UDWR Publication Number 99-40. Utah Partners In Flight Program, Utah Division of Wildlife Resources, Salt Lake City. 347pp.

Pashley, D. N., C. J. Beardmore, J. A. Fitzgerald, R. P. Ford, W. C. Hunter, M. S. Morrison, and K. V. Rosenberg. 2000. Partners In Flight: Conservation of the Land Birds of the United States. American Bird Conservancy, The Plains, VA. 92pp.

Paulin, K. M., J. J. Cook, and S. R. Dewey. 1999. Pinyon-juniper woodlands as sources of avian diversity. Pages 240-243 *in* S. B. Monsen and R. Stevens, compilers. Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West; 15-18

September 1997; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Proceedings RMRS-P-9. 411pp.

Pavlacky, D. C. 2000. Avian Community Ecology in Juniper Woodlands of Southwestern Wyoming: Patterns of Landscape and Habitat Utilization. M. S. thesis. University of Wyoming, Laramie. 204pp.

Pavlacky, D. C., and S. H. Anderson. 2001. Habitat preferences of pinyon-juniper specialists near the limit of their geographic range. Condor 103:322-331.

Rust, S. K. 1999. Pinyon-juniper woodland classification and description in research natural areas of southeastern Idaho. Pages 82-93 *in* S. B. Monsen and R. Stevens, compilers. Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West; 15-18 September 1997; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Proceedings RMRS-P-9. 411pp.

Saab, V. A., and J. G. Dudley. 1998. Responses of Cavity-Nesting Birds to Stand-Replacement Fire and Salvage Logging in Ponderosa Pine/ Douglas-Fir Forests of Southwestern Idaho. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Research Paper RMRS-RP-11. 17pp.

Sieg, C. H. 1991. Rocky Mountain Juniper Woodlands: Year-Round Avian Habitat. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO. Research Paper RM-296. 7pp.

Tausch, R. J. 1999. Historic pinyon and juniper woodland development. Pages 12-19 *in* S. B. Monsen and R. Stevens, compilers. Proceedings: Ecology and Management of Pinyon-Juniper Communities Within the Interior West; 15-18 September 1997; Provo, UT. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. Proceedings RMRS-P-9. 411pp.

Telfer, E. S. 2000. Regional variation in fire regimes. Pages 9-15 *in* J. K. Smith, editor. Wildland Fire in Ecosystems: Effects of Fire on Fauna. USDA Forest Service, Rocky Mountain Research Station, Ogden, UT. General Technical Report RMRS-GTR-42-Vol. 1. 83pp.

Tirmenstein, D. 1986. *Juniperus scopulorum*. *In* USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online http://www.fs.fed.us/database/feis/.

Wight, J. R., and H. G. Fisser. 1968. *Juniperus osteosperma* in northwestern Wyoming: Their Distribution and Ecology. Agricultural Experiment Station, University of Wyoming, Laramie. Science Monograph 7. 31pp.

Zlatnik, E. 1999. *Juniperus osteosperma*. *In* USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online http://www.fs.fed.us/database/feis/.

Funding for this publication was provided by the Wyoming Game and Fish Department in partnership with State Wildlife Grants and the Bureau of Land Management.

Photo by Lee Karney, U.S. Fish and Wildlife Service