Sharing the Land with Pinyon-Juniper Birds

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State of Utah
Department of Natural Resources
Division of Wildlife Resources

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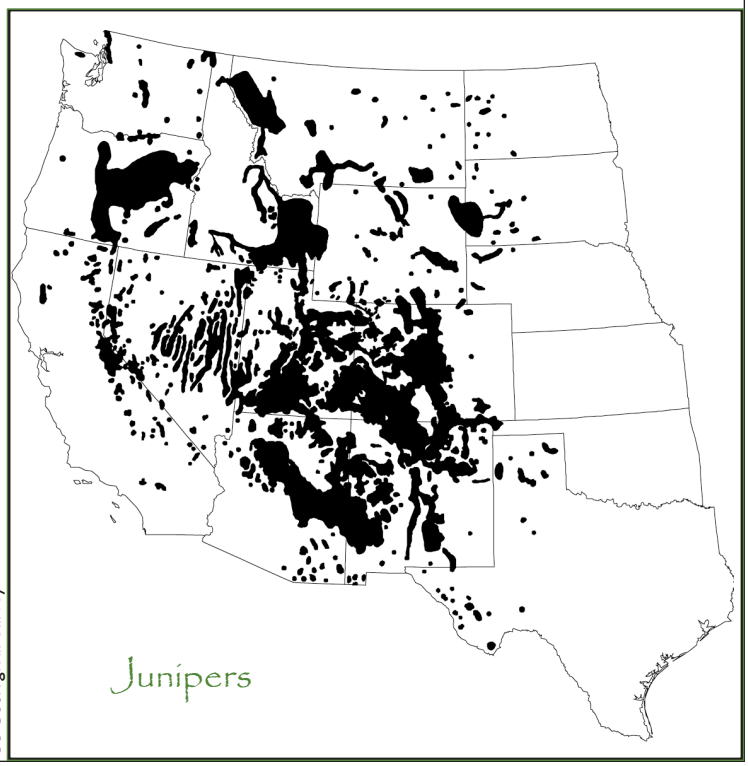
Why Share?

The pinyon-juniper woodland is a widespread ecosystem of the North American West. Estimates of its current extent vary widely, depending on how the habitat is defined and delineated. A recent estimate is 55.6 million acres (22.5 million ha; Mitchell and Roberts 1999). It is widely regarded that the extent of pinyon-juniper is increasing as some grasslands and shrublands are being transformed by pinyon-juniper encroachment. This expansion has been facilitated by a combination of climatic changes, fire suppression and, in some areas, overgrazing, which has removed the grassy understory that ordinarily would carry a fire. In some areas, pinyon-juniper woodlands are moving back into areas that formerly were woodlands but had been cleared in the late 1800s and early 1900s to meet the demand for pinyon-juniper wood products. In other areas, juniper is expanding into grasslands and shrublands where it had never been recorded before. Some researchers maintain that, at least in some areas, pinyon-juniper occurs in a dynamic equilibrium with adjacent vegetation types and that the expansion is part of a natural cycle independent of or, at best, facilitated by, human activities (Belsky 1996; Swetnam et al. 1999). These and other topics are still being debated; a number of conferences and symposia have been held to bring together researchers and managers who work in pinyon-juniper in order to share knowledge and identify information gaps that still exist (e.g., Gifford and Busby 1975; Aldon and Loring 1977; Everett 1987; Aldon and Shaw 1993; Monsen and Stevens 1999). What has come out of those gatherings is an appreciation for the habitat itself and a recognition of the need for more information.

While the body of knowledge regarding pinyon-juniper woodlands grows steadily, some synthesis of the existing knowledge is in order so that landowners and land managers can go about their business of caring for the land. One area where such a synthesis is needed, where an information vacuum exists, is in the area of managing pinyon-juniper woodlands to benefit birds.

Across a broad spectrum of habitat types, no wildlife group is as species-rich, as visible, or as vocal as birds. Pinyon-juniper woodlands are no exception. The pinyon-juniper bird community, especially in mature stands, contains a high number and variety of birds --- more than 70 species are known to breed in pinyon-juniper woodland --- although perhaps no more than 20-30 species may occur at any one site (Balda 1987; Balda and Masters 1980; Paulin et al. 1999). Pinyon-juniper woodlands support one of the highest proportions of obligate or semi-obligate bird species among forest types in the West (Paulin et al. 1999). Species closely tied to pinyon-juniper (scientific names of all species mentioned in the text are listed in the Appendix) include Black-chinned Hummingbird, Ash-throated Flycatcher, Cassin's Kingbird, Gray Flycatcher, Western Scrub-Jay, Pinyon Jay, Juniper Titmouse, Bushtit, Bewick's Wren, Northern Mockingbird, Blue-gray Gnatcatcher, Gray Vireo, Black-throated Gray Warbler, Lark Sparrow, and Black-chinned Sparrow (Balda and Masters 1980). However, little information is available on management practices that benefit bird communities in pinyon-juniper woodlands.

Birds can be useful indicators of biological integrity and ecosystem health (Hutto 1998). They fill this role because they comprise a diverse group of specialists that occupy a broad range of habitats, are sensitive to environmental changes, and reflect the abundance and diversity of other organisms with which they coexist. Responses by bird communities to environmental



US Geological Survey 1999

US Geological Survey 1999

changes are well documented, and changes in bird communities often reflect the effects of resource management, conservation, restoration, and environmental degradation. There is a strong and growing interest, both nationally and internationally, to manage and conserve bird populations. Examples of this interest include the numerous bird conservation plans that have recently been completed (e.g., Brown et al. 2001, Donaldson et al. 2000, Kushlan et al. 2002, North American Waterfowl Management Plan Committee 1998; Rich et al. 2004).

Birds are a tremendous economic resource in and of themselves. Birds provide untold billions of dollars in ecosystem services as pollinators and seed dispersers of ecologically and economically important plants, and as predators on insect pests in forested and agricultural landscapes. Birds are also the basis for a recreation-related economic boon. A recent federal report found that 46 million birdwatchers across the United States spent $32 billion in 2001 on bird watching and related activities (U.S. Fish and Wildlife Service and U.S. Census Bureau 2002). This spending generated $85 billion in overall economic output and $13 billion in federal and state income taxes, and supported more than 863,000 jobs. Communities in pinyon-juniper country shared in this economic vitalization since certain bird species can only be seen in pinyon-juniper habitats and others reach their highest densities in pinyon-juniper.

Pinyons and junipers rely heavily on animals for seed distribution, a dependence that makes the pinyon-juniper woodland unique. Other forest types may require animals to disperse some seeds of some plant species, but in pinyon-juniper, animals are critical to the dispersal of the seeds of the dominant tree species. Birds, in particular, are responsible for this important role in the maintenance of pinyon-juniper woodlands. This unique ecological relationship is yet another reason for landowners and land managers to share pinyon-juniper woodlands with birds and other wildlife.

The purpose of this document is to provide information on the management of pinyon-juniper woodlands that will benefit individual bird species and bird communities while still using the woodlands for other purposes. This information will be useful to private landowners and natural resource managers on public lands in developing more comprehensive management strategies that benefit the long-term health and productivity of pinyon-juniper communities throughout the western U.S.

Renee Rondeau, Colorado Natural Heritage Program

Ecology of Pinyon and Juniper Woodlands

Pinyons are low-growing, rounded pines with one to five needles per bundle (fascicle), depending on species. The pinyon pine is represented by about 11 species, the two most widespread species in the West being the singleleaf pinyon and the Colorado pinyon. The other nine species are found primarily in Mexico, with some ranges extending into the southern portions of California, Arizona, New Mexico, and Texas (Lanner 1981).

Junipers are also conifers but with overlapping scales for leaves and seed-bearing cones that resemble small berries. Junipers associated with pinyon-juniper woodlands include about 17 species, including some in Mexico. The three species most commonly associated with pinyons in the West are alligator juniper, one-seed juniper, and Utah juniper. Other widespread species are Rocky Mountain juniper and western juniper (Lanner (California Partners in Flight 2002; Neel 1999; Parrish et al. 2002); species associated with pinyon-juniper range from Joshua tree and barrel cactus at low elevations to limber pine and bristlecone pine at high elevations (Tausch 1999a).

BLM-Grand Junction Field Office

Moss and biological soil crust in a pinyon-juniper woodland

The soils in some pinyon-juniper woodlands are held in place by a biological soil crust --- a complex community of mosses, lichens, fungi, and algae forming a soil surface layer up to several inches thick. This gray-green crust is firm enough to hold soil in place if undisturbed, but easily breaks down under traffic from humans, vehicles, or livestock (Lanner 1981). The crust is predominantly moss within the dripline of trees, and algae beyond the dripline. The importance of biological soil crusts and their role in promoting soil productivity and preventing erosion has only recently been recognized and additional information is needed to more fully understand its role in pinyon-juniper communities (Belnap et al. 2001, Belnap and Lange 2001, Ladyman and Muldavin 1996).

Temperature and moisture play leading roles in the distribution of pinyon and juniper. Pinyon-juniper woodlands occur where annual precipitation is just 8-20 inches (200-500 mm) (West et al. 1975). That precipitation is delivered as winter snow, spring rain, and infrequent summer thunderstorms. Although mixed stands of pinyon and juniper abound, pure stands of either also occur. Junipers are more tolerant of drought and cold and therefore often dominate at the lower elevations and sometimes at the higher elevations, although the increased moisture usually associated with higher elevations tends to favor pinyons (West 1999).

At higher elevations, junipers may drop out entirely, and pinyons grow larger and in denser stands (Pieper 1977). Both pinyons and junipers have wide elevational ranges, occurring from 2,700 to 11,000 feet (820-3,400 m)

Pinyon-Juniper Animals

Both pinyons and junipers provide food for wildlife species. Mammalian consumers of pinyon seeds include deer mouse, pinyon mouse, Abert's squirrel, rock squirrel, cliff chipmunk, Hopi chipmunk, Uinta chipmunk, Colorado chipmunk, desert woodrat, Stephen's woodrat, white-throated woodrat, Mexican woodrat, bushy-tailed woodrat, black bear, and desert bighorn. Avian consumers include Clark's Nutcracker, Pinyon Jay, Mexican Jay, Western Scrub-Jay, Steller's Jay, and Juniper Titmouse. Some insects consume pinyon needles, as do mule deer occasionally. Bark beetle larvae (mountain pine beetle and pinyon engraver beetle) and rodents (especially porcupines) consume pinyon pine phloem. Weakened or dead trees may also

become host to woodborers or other insects. Other insect consumers include various sawfly species, pitch midges, and gall midges (Lanner 1981). In pinyon-juniper woodlands, the importance of pinyon pines to birds is clear --- the number of breeding bird species increases as the number of pinyon pines increases (Masters 1979).

While pinyons provide food for many animals, the animals in turn provide a service to the trees by dispersing their seeds. Most pine species have winged seeds to facilitate dispersal; the seeds are released from the cone and carried away from the parent tree by the wind. However, pinyon seeds are wingless and enclosed in pockets within the cone, which holds them in place. Rather than being dispersed by wind or gravity, pinyons rely on rodents and certain bird species to remove and disperse their seeds. Birds gather seeds in late summer and early fall and cache them in the soil for later consumption when few other food sources are available. Birds fail to relocate some of the cached seeds, which then may sprout and grow. Seeds dispersed away from the parent trees may give rise to a new stand of pinyons.

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Mature juniper with nest cavity

Birds carry the seeds in their bill or esophagus. Some species are better adapted for carrying seeds than others; the Western Scrub-Jay can carry only 4 or 5 pinyon seeds, the Steller's Jay can carry up to 18, and the Pinyon Jay up to 50. The champion of seed-carrying capacity is the Clark's Nutcracker, which can carry up to 95 seeds thanks to a special pouch under its tongue (Lanner 1981). An individual jay or nutcracker may cache thousands or even tens of thousands of seeds each season, up to 13 miles (21 km) away from the parent tree (Lanner 1981; Vander Wall and Balda 1981). It has been estimated that a flock of 250 Pinyon Jays can cache 4.5 million pinyon seeds during a five-month period (Ligon 1978).

Junipers also provide food for wildlife. If more suitable browse is not available, mule deer will eat juniper foliage, sometimes browsing it extensively. Juniper berries, which consist of a hard-coated seed enclosed in a fleshy outer covering, are eaten by mammals such as rabbits, gray fox, black bear, coyote, striped skunk, and a variety of rodents, and by birds such as Western Bluebird, Mountain Bluebird, Townsend's Solitaire, American Robin, Bohemian Waxwing, and Cedar Waxwing (Lanner 1981; Chambers et al. 1999; White et al. 1999). These animals serve an important role in the future of local juniper populations by dispersing the seeds. When eaten, the hard-coated juniper seed often passes through the digestive system intact and is excreted, falling to the ground where it may germinate and become established. Removing the outer flesh increases by a factor of 10 the probability that a juniper seed will germinate. The junipers themselves facilitate this process by producing berries that are conspicuously colored blue or red and making them readily accessible on the outer layers of foliage.

Birds are the primary seed-dispersal mechanism for some juniper species (Chambers et al. 1999). Birds are effective because they deposit seeds under woody vegetation --- a suitable site for germination and seedling growth. Bird-facilitated dispersal is particularly important for reestablishing junipers within woodlands that have been burned or killed by insects or drought, provided some dead trees remain standing. Also, since seeds are usually deposited singly or in small clusters, the chances of density-dependent seed depredation are reduced. However, juniper seeds must be covered by soil to germinate, something not accomplished by the birds. Bird-dispersed seeds must be buried by some other means such as trampling, frost heaving, soil deposition, or rodent caching. Mammals distribute juniper seeds, too, sometimes traveling a mile or more before

depositing their seed-ladened scats.

For animals that rely on these trees for food, mixed pinyon-juniper woodlands provide overlapping seed supplies. Singleleaf pinyons produce seeds every two to three years and Colorado pinyons produce seeds every five to seven years, although some seeds may be produced every year. Junipers typically produce seeds annually, although there is variation among individuals and years (Tueller and Clark 1975; Janetski 1999). Dry years seem to trigger heavy juniper berry crops, while big crops are rare in wet years.

Animals make use of the trees in other ways, too. Bats use cavities, loose bark, and broken limbs as maternity roosts. Woodrats make nests of shredded pinyon bark or juniper bark fibers (Lanner 1981). Rock squirrels use the tree cavities as caching sites of pinyon nuts and juniper berries. Birds build nests in the foliage or in tree cavities, in some cases using juniper bark fibers. Insectivorous birds search the bark and foliage of pinyon-juniper trees for insects, and raptors perch in the trees while hunting. Downed logs are used as cover by invertebrates, small mammals, and reptiles. Big game species use pinyon-juniper stands for thermal cover, especially where junipers are plentiful.

The Changing Landscape

Mature pinyons may grow to be 600 years old and mature junipers may surpass 1,000 years. Even so, in many areas the trees are less than 140 years old --- roughly the time that has passed since mining and other Euro-American settlement impacts have occurred. Little information is available about pinyon-juniper woodlands prior to Euro-American settlement. Many researchers believe that woodlands of juniper or juniper with pinyon were less common than now and in some areas a more savanna-like landscape prevailed in which the trees were scattered throughout a grass- or shrub-dominated landscape. Pinyon-juniper woodlands and even forests (where tree crowns touch) certainly existed, but they may have been largely confined to areas protected from fire, such as steep and/or south-facing slopes, rocky areas, areas with shallow soils, or other situations that precluded growth of the fine fuels needed to carry fires (Roundy and Vernon 1999; West 1999). Native Americans set fires to improve game habitat by clearing dense brush and possibly to protect their homes by reducing dangerous fuel loads; those fires and lightning-caused fires likely served to control tree expansion into grassy or shrubby areas.

Pinyon-juniper has expanded downward in elevation into areas with deeper soils and, historically, more fine fuels and higher fire frequency. This expansion was facilitated by the removal of fine fuels through heavy grazing and by the active suppression of wildfires (Roundy and Vernon 1999). In contrast, a study in a portion of the Colorado Plateau (Mesa Verde National Park) suggested that pinyon-juniper densities at higher elevations with naturally lower fire frequency have probably not increased greatly over the last 100 years and that the increases observed are probably the result of climatic changes rather than fire suppression (Romme et al. 2003). Fire intervals in much of the Mesa Verde area have likely always been on the order of hundreds of years and infrequent, severe, stand-replacing fires have likely always been the norm, rather than the exception (Romme et al. 2003). Fire history in pinyon-juniper woodlands is poorly understood, and much research remains before a clear picture of pinyon-juniper ecology can emerge (Baker and Shinneman 2004).

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Human History in Pinyon and Juniper Woodlands

Carbon dating of pinyon charcoal and seed coats suggests that human use of pinyons dates back at least 6,000 years (Lanner 1981). Pinyons were prominent in the mythology of indigenous peoples living within the range of the pines and the trees undoubtedly also played an important role in the everyday lives of the people, which included the Anasazi, Zuni, Hopi, Pueblo, and Apache (Lanner 1981). Most were hunter-gatherer societies that also farmed corn and squash on a limited basis (Janetski 1999).

Indigenous peoples used pinyon and juniper woods as firewood for heat, cooking, and pottery firing, for housing material, and for carved tools, and they used pinyon pitch to make glue, dye, varnish, waterproof coating, a dressing for wounds, and even a type of nonstick coating for stone cooking surfaces. Pinyon needles or twigs were prepared as a drink to treat various illnesses, while pollen from both pinyons and junipers was used as a medicine. Pinyon charcoal was used to color ceremonial sand paintings. Shredded juniper bark was used for diapers, mats, sandal insoles, and was smoked in cigarettes (Lanner 1981). Juniper wood was used for cradle boards and spoons, and the ash was used as a leavening agent.

Pinyon nuts were also used as food. The nuts were collected in the early fall, around the time of the first frosts. Collection methods included picking them from the ground after they had naturally fallen, shaking the trees or thrashing them with poles to dislodge seeds from mature cones, or using hooked sticks to knock loose green cones. The green cones were then either stored until winter or placed on a fire to open the cones and roast the seeds. Pinyon nuts were eaten raw, roasted, boiled, ground into a flour or paste, mashed and cooked as soup or mush, or made into a spread to eat on corn cakes (Janetski 1999). Juniper berries were probably not as important a food source as pinyon nuts, but nevertheless the berries were eaten fresh or pounded for use in bread, stew, or tea.

Pinyon nuts could be stored, an important consideration in areas that experienced harsh weather or lean periods when other food was hard to acquire. The oils in raw nuts could turn rancid in one year, but roasted nuts kept much longer. Nuts or cones were stored in pits or other storage facilities and, when available, a two- or three-year supply was cached (Janetski 1999).

Pinyon nuts were an important dietary component because of their high nutritional value --- the nuts contain all 20 amino acids. The levels of seven of the nine essential amino acids are higher in pinyon nuts than in cornmeal, another staple in the indigenous diet (Lanner 1981). Not only were the nuts nutritious, but their occurrence in high concentrations and the relative ease of collection made for efficient gathering, important considerations for people living off the land.

As Euro-Americans arrived in the West, they too used pinyon and juniper trees. Early homesteaders took advantage of the strength and rot-resistance of juniper and used it for fence posts and corrals. Mining for silver in the central Great Basin was literally fueled by pinyons and junipers. The trees provided posts for shoring up mine shafts and constructing buildings, but their primary use was as firewood for smelters and heating and cooking in the mining camps (Young and Budy 1987). Unlike pinyon-juniper stands in other parts of its range, pinyon-juniper woodlands in the Great Basin were adjacent to sagebrush shrublands. In the Rockies and parts of the Southwest, ponderosa pine usually grows upslope from pinyon-juniper, while in other parts of the Southwest pinyon-juniper is associated with oak. Thus, human needs for wood products in the central Great Basin had to be met by pinyon-juniper alone (Young and Svejcar 1999).

The pace of the mining boom led to rapid deforestation of the pinyon-juniper hillsides surrounding active mines. The countryside for 10 miles around the town of Eureka, Nevada, for example, was deforested after just one year of major activity (1873); after two years, the ring extended 20 miles; after five years it was at least 35 miles (Young and Budy 1987). As workers clearcut the woods surrounding their towns, wood was brought by mule, wagon, and train from outlying areas. Much of the wood was used to produce charcoal for smelting ore. Cutting continued until the mining industry collapsed in

the late 1800s (Young and Budy 1987).

In the 1920s and 1930s, about 200,000 acres (89,000 ha) of pinyon-juniper woodland in southwestern Colorado and an adjacent part of Utah were converted to farmland. The deep red soils in the area have produced a high yield of pinto beans ever since, and Dove Creek, Colorado, claims the title of "pinto bean capital" of the world.

A common pinyon-juniper management technique during the 1940s to 1960s was chaining or cabling to remove trees. This basically involved dragging a ship's anchor chain or a heavy cable between two tractors driving parallel paths in order to pull down and/or uproot trees. Uprooting the root ball left behind a shallow basin, which collected water. Removing the pinyon-juniper reduced competition for resources, thus allowing the herbaceous understory to flourish. Chained woodlands with a depleted understory were reseeded, often with plant types palatable to cattle. Chaining was also done to increase water yield, improve watershed conditions, and improve big game habitat. However, careful analysis of chaining showed that the costs of treatment often exceeded the benefits from enhanced livestock forage (Clary et al. 1974, Dalen and Snyder 1987), highlighted the unavoidable damage to archaeological sites that occurred (DeBloois et al. 1975; Haase 1983), and called into question its effectiveness as a pinyon-juniper control method (Aro 1971). For these and other reasons, chaining as a management activity gradually fell out of favor among state and federal land management agencies, although it is still considered a versatile and effective management tool for removing pinyon-juniper where warranted. A thorough review of the rationale and methods is available (Stevens and Monsen 2004).

Demand for pinyon-juniper firewood for home heating was strong for many years. This demand may have peaked during the U.S. energy crisis of the 1970s. Declining demand since that time may be attributed to reduced costs for other heating sources, better-insulated homes, and burning restrictions in large metropolitan areas with air-quality issues.

Changing economic and social conditions in the latter part of the 20th century prompted many Americans to move to the Interior West, home to virtually all of the pinyon-juniper woodlands. Migrants from the Northeast, Midwest, and South fueled the population growth and the Interior West grew faster than the U.S. as a whole throughout the 1970s, 1980s, and 1990s. During the first half of the 1990s, the five states with the fastest growing populations in the nation were in the Interior West: Nevada, Idaho, Arizona, Colorado, and Utah (Riebsame 1997). Concurrent increases in demand for residential development, recreational opportunities, and natural resources in the region increased demands on all forested ecosystems, including pinyon-juniper.

Many of the traditional uses of pinyon-juniper persist today. The woodlands still serve as a source of nuts, firewood, and fence posts, and as places to hunt, cut Christmas trees, graze and shade livestock, and picnic. For indigenous peoples the woodlands also still serve as places to collect medicinal and ceremonial plants, and as places for sweat lodges, ceremonial dances, and other cultural practices (Miller 1997).

Jack Rattier, BLM

Chaining pinyon-juniper in southern Colorado, circa 1958

Pinyon-Juniper Management Activities and Birds

This section describes some typical management activities that occur in pinyon-juniper woodlands. A description of the impacts of each activity on birds is followed by suggestions for steps that can be taken to lessen any negative impacts or to adjust the activity to benefit birds without significantly affecting other land-use practices.

General Guidelines

One goal of a management strategy to maintain or enhance bird populations in pinyon-juniper should be to maintain or create a mosaic across the landscape, reflecting the natural range of pinyon-juniper stand shape, size, and structural stage. This mixture would, by necessity, include young stands and mature stands and everything in-between, but because mature stands offer unique biological benefits that take tens to hundreds of years to develop, and because most of the bird species of conservation concern rely on mature stands, the emphasis should be on retaining those stands whenever possible. Managing for a diversity of stand conditions across the landscape means providing some monocultures that serve select groups of wildlife; this would include conserving mature stands for birds. The benefits offered by mature stands include nest cavities, structural diversity, and bountiful seed and berry supplies (mature pinyons and junipers produce more seeds and berries than do younger trees). Mature stands should contain some snags (standing dead trees), partially dead trees, and diseased trees --- all offer benefits to birds. Creating or maintaining such a mosaic will require employing management techniques and embracing natural processes that shape landscapes. Effective management should produce a plant and animal community that approximates prehistoric conditions, including the presence of rare and sensitive species.

What you can do:

- Form partnerships with landowners and state and federal land managers for more coordinated management of pinyon-juniper woodlands across the landscape. It should be possible to draw a circle on a map covering 100 square miles (260 km^2) of pinyon-juniper and find within that circle a full range of stand ages, from very young to very old, and perhaps other habitat features such as woodland openings, seeps and springs, and examples of other shrub and woodland habitats. Within this mix of stand ages, pinyon-juniper birds should be able to find all the food, shelter, and other components they need to carry out their lives (Pavlacky and Anderson 2001). In addition to enhanced resource management, advantages of partnerships include shared costs, labor, resources, and responsibilities.
- Retain mature stands of pinyon-juniper because of their ecological value and the time required to create them. One definition of old-growth pinyon-juniper stands suggests that they contain scattered (30/acre; 35% canopy closure) large (12-inch diameter at root collar) live trees, some with dead or broken tops, and some large standing dead trees (1/acre, 10-inch diameter at root collar) and large downed trees (2/acre of 10-inch diameter and 10 feet long) (Miller et al. 1999). The numbers of individual birds and bird species generally increase with the age of pinyon-juniper stands (Golden Eagle Audubon Society 1997), partly as a result of the increasing structural diversity found in those stands, which provides more opportunities for nesting and foraging by species that fill different niches, and because only large trees can provide the cavities needed by cavity-nesting birds. Most of the pinyon-ju-

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niper obligates and species of conservation concern are tied to stands of mature trees.

- Maintain large stands of pinyon-juniper as contiguous patches of no less than 1.2 square miles (3 km^2) (Pavlacky 2000).
- Retain some beetle-killed pinyons rather than salvage-cut them. The dead trees offer important habitat for birds and resources for forest regeneration. The fire danger is only elevated while the reddish brown needles are still on the trees --- the needles will fall in a year or less.
- Maintain connectivity between stands by preserving corridors of similar vegetation. Corridors allow birds and other animals to travel among stands and reduce their exposure to predators. Where corridors are not possible, stands should be as close together as possible. Additional research is needed to determine a maximum distance, but common sense suggests that the more separation between two stands, the more difficult the travel between them. Also, nests in small, isolated stands are more susceptible to Brown-headed Cowbird brood parasitism, which reduces nesting success.
- Create openings in dense stands of young and mid-seral stage pinyon-juniper that lack a good shrub or grass component. Such openings provide foraging opportunities for some bird species that nest in pinyon-juniper. Openings should be no more than 60 feet (19 m) wide and have irregular outlines (Sedgwick 1987). See additional information under Big Game Management (page 12).

Brown-headed Cowbirds and Brood Parasitism

Among birds, the Brown-headed Cowbird stands out as a species with an alternative lifestyle. Rather than building its own nest each year, it seeks out the nests of other birds and lays its eggs there, often removing the host's eggs to make room. In some cases, the host simply abandons the nest, and may not attempt another nest that year. In other cases, the host species adopts the eggs and raises the young as its own. However, because the cowbird eggs typically hatch sooner and the chicks grow faster and are often larger than the host's chicks, the young cowbirds soon monopolize their adoptive parents' attention, often becoming the only chicks in the nest to get food. This breeding strategy is known as *brood parasitism* (Ortega 1998).

The cowbird's strategy of relying on other birds to incubate and raise its young allowed it to adopt a nomadic lifestyle. Historically, cowbirds probably followed herds of bison as they moved about the prairie, an ideal lifestyle for the cowbird since the herds' nomadism didn't allow cowbirds time to build a nest and raise a brood before the herd moved on. Instead, cowbirds let other bird species do all the work for them. Most of the bison are gone now, so cowbirds associate with domestic livestock, taking advantage of foraging opportunities created when livestock attract and stir up insects.

Bison grazed an area for a short period and moved on, perhaps not returning for years. In the interim, the local bird population was allowed to breed and develop without pressure from cowbirds. Now, however, livestock often graze the same areas year after year, so local bird populations have no opportunity to breed without cowbirds present, resulting in population declines of some species.

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Cowbird brood parasitism is a natural part of the prairie ecosystem and has been for countless years. Conversion of other habitats to open, prairie-like conditions has resulted in a continental population of cowbirds well beyond that of the pre-Euro-American period, when the bird was largely confined to the Great Plains. Eastern forests that were historically unbroken have been fragmented, creating grassy openings in the forest --- ideal habitat for cowbirds. Likewise, in parts of the West, forest openings created for residential development or other purposes have created habitat conditions favorable to cowbirds. The species is now found throughout the Lower 48.

The challenge for land managers is to avoid creating cowbird-friendly habitat (Morrison et al. 1999). Some simple strategies are to retain intact pinyon-juniper woodlands, keep livestock dispersed or move them frequently, and periodically rest pastures for at least one year to allow local bird populations to develop without cowbird pressure.

Livestock grazing

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No single livestock grazing scheme can be applied uniformly to all pinyon-juniper stands. Grazing plans should be site-specific and should consider the site's productivity, erosion potential, and potential for invasion by cheatgrass or other exotics. A general strategy should be to maintain a mixture of understory species across the landscape.

Livestock grazing in and near pinyon-juniper woodlands during the nesting season increases the potential for brood parasitism of pinyon-juniper birds, especially when cattle are concentrated for prolonged periods and cowbirds have more time to find nearby nests. In grazed pinyon-juniper woodlands, cowbirds may parasitize more than 75% of the nests of some species (Goguen and Mathews 1998).

Typically, when trees dominate a landscape, the understory is diminished. Dense stands of pinyon-juniper have a particularly sparse understory with limited herbaceous cover, plant species diversity, and productivity. Excluding livestock from these stands may not result in development of the understory, because the understory is naturally poor due to competition for light, water, and soil nutrients --- a competition the trees win.

Management objectives and local conditions can support removal of dense stands of pinyon-juniper to release the herbaceous understory for livestock forage. A given site should have the potential to be highly productive and include a source of understory seeds, either in the soil seed bank (which is not likely if the stand is very dense) or via reseeding with appropriate species. Sites that lack a viable seed source are prime candidates for invasion by cheatgrass or other invasive exotics once the trees are removed. Cutting followed by pile burning leads to dead zones in the soil easily invaded by exotics. Reseeding with natives and controlling weeds are important strategies for maintaining a healthy ecosystem. However, in some situations, using less expensive and more readily available exotic species in the seed mix may be necessary.

Setting pinyon-juniper stands back to early seral stages through burning, chaining, cutting, or a combination of these may increase the herbaceous plant density and species diversity. However, the additional structural diversity found in mature pinyon-juniper stands (in the form of snags, cavities, and large trees) provides more opportunities for nesting and foraging by birds, which in turn results in more bird species present (Golden Eagle Audubon Society 1997). Mature pinyon-juniper stands are particularly important for bird species of conservation concern, many of which rely on the habitat features provided only by mature stands such as large-diameter trunks for nest cavities and greater berry and seed production. When contemplating stand conversion actions, managers should consider the importance of mature stands to birds and the general lack of site potential for successful establishment of grasses and forbs. Thus, stand conversion should target young or mid-seral stages --- stands that have developed since the time of Western settlement by Euro-Americans.

What you can do:

- Structure grazing regimes (stocking level, grazing period, kind of livestock) to maintain or increase native perennial grass, forb, and shrub cover. For example, heavy spring grazing can "graze out" native cool-season grasses.
- Remove or significantly reduce numbers of livestock from degraded areas as part of a management plan to facilitate recovery.
- Exclude livestock from sensitive areas (such as springs) to prevent damage.
- Provide at least two seasons of rest in areas reseeded with native species to give the young plants a chance to develop root systems capable of withstanding grazing.

- Where biological soil crusts occur, protect them from damage by stocking at light to moderate levels during spring and by removing livestock before the hot and dry conditions of summer set in, to allow the crusts to recover while moisture is still available. Other strategies include employing a rest-rotation system, keeping livestock dispersed through strategic placement of water and salt, and grazing during wet periods or winter --- the crusts are less susceptible to damage when wet or frozen (Belnap et al. 2001).
- Keep cattle dispersed --- concentrated cattle impact vegetation more heavily and attract more cowbirds. Employ a rotational grazing system that takes into account the available water (Goodloe 1995).
- Curtail grazing during drought years.
- Rest grazing units in some years, thus giving birds a chance to produce young during the years when livestock are absent and local cowbird populations are lower. Rest-rotation systems typically have the added benefits of reducing soil compaction and erosion.
- Defer grazing past the nesting season of April through July to protect ground nests and to keep local cowbird populations lower.
- Keep livestock off burned sites for at least two growing seasons, to protect soils and allow recovery of native perennials. Naturally dry conditions in the West, compounded by drought, may necessitate livestock exclusion for a decade or longer. Livestock should not be returned to a site until monitoring demonstrates that the vegetation has recovered sufficiently to sustain grazing pressure without damage.
- Investigate state and federal programs that offer technical and financial assistance for wildlife habitat conservation projects on private lands, such as EQIP (Environmental Quality Incentives Program) and WHIP (Wildlife Habitat Incentives Program). Both are Farm Bill programs administered by the USDA's Natural Resources Conservation Service to help producers improve their ranching operations and wildlife habitat.

Big game management

Pinyon-juniper woodlands provide valuable habitat for mule deer (especially as winter range) and elk. Mature stands are particularly valuable as thermal cover, but the stands are even more valuable if they contain openings that provide foraging opportunities. Overall, a mixture of mid-seral stages, grassy openings, and patches of mature trees provides the greatest benefit to deer and elk (Goodrich 1999) and provide habitat for birds as well.

Scott W. Gillihan, RMBO

What you can do:

- Retain a mix of pinyon-juniper seral stages, including mature stands, which provide critical habitat for birds and winter cover for big game.
- Create irregular borders when clearing trees for big game habitat improvement. Leave some small stands of trees within any large cleared areas.
- Create clearings of various sizes: no wider than 60 feet (19 m) to benefit birds (Sedgwick 1987), but up to 1/4 mile (400 m) to benefit big game (Fairchild 1999). Retaining areas of pinyon-juniper of at least 40 acres (Fairchild 1999) benefits both big game and birds.
- Retain standing dead trees, dying trees, and trees with cavities near the edges of clearings (Sedgwick 1987).

Weed, insect, and mistletoe management

Without an adequate source of native shrub, grass, or forb seed, mature stands of pinyon-juniper that are cleared either by manual means or fire are susceptible to invasion by cheatgrass and other exotic, fire-susceptible annual weeds. Such invasion increases the frequency of wildfires in pinyon-juniper woodlands. The increased wildfires change the local and landscape structure of pinyon-juniper, preventing normal recovery by pinyon-juniper vegetation and causing more habitat fragmentation as fire breaks up once-continuous stands into smaller stands separated by cheatgrass-dominated openings. One outcome of additional fragmentation is higher rates of brood parasitism by Brown-headed Cowbirds, to the detriment of pinyon-juniper bird species. Also, cheatgrass and other exotic plants displace native plants that birds need for food and cover. Some birds will eat cheatgrass seeds, but they prefer native seeds (Goebel and Berry 1976).

Many bird species rely on insects for food, especially during the nesting cycle when a high-protein insect diet is crucial for developing young birds, even for seed-eating species. In pinyon-juniper country, insecticide use is usually confined to campgrounds, homes, and other high-use areas. In those areas insecticide use can be detrimental to birds because it reduces their food supply.

The berries of juniper mistletoe are an important food source for pinyon-juniper birds. Juniper stands with mistletoe infestation tend to attract more birds --- up to three times as many. As a result of this attraction, birds eat more juniper berries and deposit more juniper seeds in mistletoe-infested stands. The end result is that mistletoe-infested stands typically have more juniper seedlings (van Ommeren and Whitham 2002).

While juniper mistletoe is found on junipers, dwarf mistletoe is found primarily on pinyons. It, too, is beneficial to birds, but for other reasons. Dwarf mistletoe sends its roots down inside the branches of pinyons and other conifers, reducing the vigor of the branch; in some cases the branch or even the entire tree dies. Dead branches or dead trees attract woodpeckers and other birds that search for insect prey under the bark of trees and also attract cavity-nesting birds. In addition, an infested tree may develop a dense cluster of branches --- a "witch's broom" --- which is used by some bird species as a nest site. The importance of dwarf mistletoe to birds was demonstrated in a study of ponderosa pine forest, which demonstrated that stands with dwarf mistletoe infestation hosted more birds and more bird species than stands without infestation (Bennetts et al. 1996).

What you can do:

- On disturbed sites, where invasion by aggressive weeds is likely due to a seed source, plant a mix of native and/or non-native species that can compete with the annual weeds. Utilize good seed-bed preparation methods to ensure good establishment of the seeded species --- use a seed drill or cover the seeds by dragging harrows or a smooth anchor chain over the seeded areas.
- Apply pre-emergent herbicides to suppress cheatgrass until perennial native plants become established.
- Adopt Integrated Pest Management (IPM) practices to reduce potential problems that arise from insect and weed control operations (and save money in the process). IPM control methods selectively target pest species during the periods when they are most vulnerable, employ biological controls, and use less toxic and less persistent pesticides. Such methods reduce the exposure of non-target organisms to pesticides. See the "Additional Sources of Assistance" section in this manual for information on IPM programs.
- Incorporate birds into your IPM program. Although birds cannot control large insect outbreaks after they have begun, under normal conditions they suppress insect populations and can keep them below outbreak level.
- Apply insecticides outside of the nesting season (April through July) because most birds need protein-rich insects to feed their growing young.
- Use pesticides that are proven to be less toxic to vertebrates.
- Wait until after the end of July to remove pinyon trees infested by engraver beetles to protect bird nesting sites.
- Retain mistletoe-infected trees as a natural component of a healthy pinyon-juniper ecosystem.

Tree harvesting

From a timber perspective, pinyon-juniper woodlands are comparatively unproductive. The trees are fairly short and bushy, and each tree yields relatively little usable lumber. Some commercial cutting for firewood occurs, but most permits for cutting on federal land are issued to individuals for household heating --- a pinyon tree with a diameter at chest height of 24 inches (61 cm) will yield a cord of wood. For birds, the downside of firewood harvesting is that both firewood cutters and birds are attracted to large trees and dead trees. Only large trees can provide cavities needed by cavity-nesting birds, and large trees (especially dead or partially dead ones) are favored as perching sites. Cutting pinyons for use as Christmas trees is also popular in some areas.

Junipers are often cut for fence posts. They are preferred over pinyon because of their greater durability, and because the shape of the trees is more conducive to use as fence posts. Fence posts are usually cut in young and intermediate-aged stands, where thinning can be beneficial to birds.

What you can do:

- Retain large trees, standing dead trees, and trees containing cavities, especially near the edges of clearings (Sedgwick 1987). Such trees should be marked in areas of fuelwood cutting, and efforts should be made to educate fuelwood gatherers of the importance of these trees to wildlife.
- Allow tree harvesting only outside the nesting season of April through July.
- Harvest trees in winter when snow cover reduces soil damage.
- For commercial harvesting in pinyon-juniper, apply single-tree selection, group selection, and shelterwood systems (Ellenwood 1995). These systems allow for reduced tree density and enhanced understory development while permitting continued pinyon and juniper productivity. Single-tree selection should be applied in mature stands.
- Scatter slash across a harvested site to reduce soil erosion and enhance understory plant species diversity.
- On private land or other situations where a significant proportion of the woodland is slated for harvest, use sustained-yield principles whereby the harvest rate will be commensurate with achieving and maintaining standing crop goals. Thus:

$$\frac{\text{total acres}}{\text{years needed to recover from harvest}} = \text{acres to harvest each year}$$

- Use artificial nest boxes to boost local populations of cavity-nesting birds where snags and cavity trees are limited. However, not all species will adopt artificial boxes, and because the cost of installing and maintaining boxes is high, they are not a practical alternative to proper forest management. Still, they have value in certain cases, such as research, to support a species in need of direct conservation actions, or to increase viewing opportunities around a dwelling or recreation site (see the bird species accounts in this manual for nest box specifications).

Mineral exploration and extraction

The range occupied by pinyon and juniper also includes rich reserves of fossil fuels and minerals. However, exploration and extraction of oil, natural gas, coalbed methane, and minerals can result in direct and indirect negative impacts to pinyon-juniper bird species, such as habitat loss, habitat fragmentation, disturbance, and the spread of weeds.

What you can do:

- Locate exploration and extraction operations (roads, well sites, compressor stations, etc.) away from sensitive areas such as raptor nest sites or riparian areas.
- Limit the size of disturbed areas and the amount of pinyon-juniper removed for well sites, etc.
- Encourage the use of slant drill techniques and multiple wells per well pad to reduce areas of impact from drill pads and roads.

- Rehabilitate areas used for mineral exploration and extraction. Rehabilitation of such sites should include returning the land to its original contours and replanting with a mix of native species, particularly with local cultivars. Where native species are not available or where an exotic weed problem already exists, non-native non-invasive species may be seeded to prevent erosion or dominance by troublesome exotics.
- Fit the tops of gas field heater-treater stacks with perch baffles to prevent bird mortalities (bluebirds are especially vulnerable).
- Containerize toxic or oily waste fluids or use netting over waste pits (reserve pits) to prevent wildlife mortalities. The netting should have a mesh no greater than 1.5 inches (3.8 cm) and be suspended 4-5 feet (120-150 cm) above the liquid.
- Consider seasonal closures for oil and gas activities that require frequent visits or visits longer than one hour within 0.5 miles (0.8 km) of Ferruginous Hawk nests during the period 1 March to 1 August (Romin and Muck 2002).

Seed crop harvesting

One person collecting pinyon seeds ("nuts") from the ground after seedfall can gather about 20 pounds (9 kg) per day; manually knocking the seeds from ripe cones on the tree and catching the nuts on a blanket can yield about 70 pounds (32 kg) per day; two people working together to rake and screen the woodland litter can collect about 150 pounds (68 kg) per day (Lanner 1981). These collections by individuals add up to an estimated 1 million pounds (450,000 kg) of pinyon nuts harvested in the U.S. each year. Little is known about the effects of this harvest on birds and other wildlife dependent on pinyon nuts, but some common-sense guidelines should help minimize the impact.

What you can do:

- Inventory lands under your control on an annual or biannual basis to locate Pinyon Jay breeding colonies.
- Direct pinyon seed harvesting to areas at least 1 mile (1.6 km) from known Pinyon Jay breeding colonies.
- Employ a rest-rotation harvest system whereby stands are periodically removed from seed harvesting pressure.

Penny Frazier

Recreation

Recreational activities popular in pinyon-juniper country include hunting, hiking, camping, bird watching, off-highway vehicle use, mountain biking, and horseback riding. Provided the disturbance is minimal and not prolonged, such recreational activities should have little impact on pinyon-juniper bird communities. However, threats to birds increase greatly with regular, heavy disturbance by people or vehicles and with habitat alteration such as construction of roads, trails, picnic facilities, parking lots, and other land uses that remove trees.

What you can do:

- Design recreational facilities to protect large, mature trees and strive to preserve visual screening between nearby facilities.
- Cluster recreational developments, leaving patches of native vegetation intact. These patches should be as large as practicable, and roughly round or square in shape, rather than long and narrow. Long, narrow patches do not provide enough secure cover for birds or other wildlife.
- Conduct site surveys to locate Pinyon Jay breeding territories or raptor nest sites before developing new recreational facilities. Construct new facilities away from any such sensitive breeding areas using these guidelines (Romin and Muck 2002): at least

0.25 miles (0.4 km) for owls and Prairie Falcons, 0.5 miles (1 km) for hawks and Pinyon Jays, and 1.0 mile (1.6 km) for Peregrine Falcons.
- Control garbage to reduce concentrations of crows, ravens, raccoons, skunks, and other predators of birds.
- Restrict off-highway vehicles to established roads or areas specifically designated for off-road recreation to limit disturbance to birds and to maintain the integrity of biological soil crusts.
- Establish formal trails and encourage or require recreationists to remain on the established trails.
- Discourage or prohibit cutting of campfire wood around recreation sites.
- Institute measures to reduce activities that damage trees around recreation sites (e.g., target shooting, girdling trees with wire, chopping with axes) that could lead to tree mortality.

Prescribed burning

Prescribed burning can be an effective tool for halting invasion of pinyon-juniper into grasslands and savannas, where individual trees are widely spaced and grass or shrubs are dense enough to carry the fire. However, prescribed fires do not carry well in open pinyon-juniper woodlands as the burns are, by necessity, conducted when conditions make it unlikely that the fire will escape and spread. The often sparse understory makes it difficult for a fire to carry except under hot, dry, windy conditions when the danger of an out-of-control burn is high. Fires do carry well in dense pinyon-juniper stands, where the fire can move from one tree to another without the need for ground fuels to carry the flames. However, such a high-intensity fire is impossible to control, making this an unsuitable management option. Also, pinyons and junipers are easily killed by even low-intensity fires and regenerate very slowly, so a burned area will lack tree cover for a very long time.

After burning, the response of herbaceous understory species depends on several factors, including the amount of pinyon-juniper crown cover present prior to the burn. The understory should respond well where crown cover was less than about 20-30%, but where crown cover was greater than 40% the soil seed bank may be depleted (Huber et al. 1999), necessitating reseeding.

What you can do:

- Use prescribed burns in grasslands where invasion by shrubs and trees would degrade desirable grassland habitat.
- Avoid the use of prescribed burns in areas with cheatgrass, which spreads rapidly in burned areas.
- Use prescribed fires only outside of the nesting season (April through July).
- Reseed burned areas if the pre-fire understory was sparse to head off invasion by cheatgrass or other weedy exotics.
- Reseed with native species, using locally adapted genotypes when available. Species to consider include four-winged saltbush, western wheat-grass, Indian rice-grass, scarlet globe mallow, and Lewis flax. Where the threat of weed invasion is high, reseed with a diverse mixture of native and non-invasive non-natives.
- Keep livestock off burned sites for growing seasons to protect soils recovery of native perennials. Naturally dry conditions in the West, compounded by drought, may necessitate livestock exclusion for a decade or longer. Livestock should not be returned to a site until monitoring demonstrates that the vegetation has recovered sufficiently to sustain grazing pressure.

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Wildfire management

Unlike some other forest types, such as ponderosa pine, low-intensity ground fires were probably never very common in pinyon-juniper woodlands due to the lack of understory vegetation to carry fires (Baker and Shinneman 2004). Instead, high-severity crown fires were more likely, although they probably occurred in a given area only once every few hundred years (Baker and Shinneman 2004). Such fires will probably continue as part of natural cycles and play an important role in the health of this ecosystem. However, many (perhaps most) pinyon-juniper woodlands have passed a threshold of change (Tausch 1999b): overly dense woodlands and invasive weeds in these areas have compromised the ability of the woodlands to return to a natural woodland after a fire. Instead, these areas may become trapped in a cycle of frequent fires fueled by annual weeds, with no return to woodland or even shrubland possible without extensive (and expensive) management.

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After a wildfire, reseeding of understory species may be necessary to prevent soil erosion and establishment of invasive exotics. Factors that increase the need for reseeding include lower elevations, pre-burn lack of understory species, presence of weeds, and a southern or western aspect. Some seeds in the soil may survive, especially pinyon seeds cached by birds in the open areas between trees. Those seeds survive because of the comparatively low temperatures generated when the understory burns, while seeds buried under trees and shrubs are often killed because understory fires typically burn hotter and longer.

What you can do:

- Revegetate with the most effective, adaptive, understory species available, favoring native species wherever possible, to combat invasion by exotic species such as cheatgrass and thistles.
- Revegetate with non-native species if this is the only viable option due to cost or availability of seed --- it would be far better than allowing the invasion of exotic annuals such as cheatgrass. Ensure that the cover crop is not applied too densely or the native vegetation will be choked out. If seed of native species is available, distribute it in large clusters, to create islands of native plants within the non-natives.
- Keep livestock off burned sites for at least two growing seasons, to protect soils and allow recovery of native perennials. Naturally dry conditions in the West, compounded by drought, may necessitate livestock exclusion for a decade or longer. Livestock should not be returned to a site until monitoring demonstrates that the vegetation has recovered sufficiently to sustain grazing pressure without damage.
- Make an effort to control fires that break out in areas with no viable understory or are infested with weeds. If not controlled, fires in these areas may result in a site with an ecological "dead-end" of annual weeds.
- Accept infrequent wildfires (even large, stand-replacing fires) as a natural part of pinyon-juniper woodland ecology. Such burns contribute to landscape heterogeneity and provide nesting and foraging opportunities for a more diverse avian community.
- Limit hazardous fuels reduction in mature pinyon-juniper stands in order to conserve these ecologically valuable woodlands.
- Leave some fire-killed trees standing. The trees will provide foraging, perching, and nesting sites for birds.

Residential development

High-density residential development removes large areas of pinyon-juniper woodland and converts it to a land-cover type that is of little use to pinyon-juniper birds. Low-density residential development fragments pinyon-juniper habitat into many small, isolated patches. These patches may be undesirable to some pinyon-juniper birds because of the lack of deep woodland interiors away from disturbances, non-native predators (domestic cats and dogs), predators adapted to human habitation (such as jays, crows, raccoons, and skunks), and cowbirds. Removing trees and shrubs around low-density developments to reduce the fire hazard also increases the impact on birds by greatly increasing the footprint of each home.

What you can do:

- Locate developments outside of pinyon-juniper woodlands, especially mature stands, rather than clearing woodlands to make room.
- Select mature pinyon-juniper stands to fulfill open space objectives.
- Cluster residential development, leaving patches of native vegetation intact. These patches should be as large as practicable and roughly round or square in shape, rather than long and narrow. Long, narrow patches can serve as travel corridors for wildlife, but they may not provide enough secure cover for nesting birds (Adams and Dove 1989, Dramstad et al. 1996).
- Use conservation easements to protect pinyon-juniper patches.
- Use native plants of the pinyon-juniper community for landscaping to offer some foraging and nesting opportunities for species that will tolerate some disturbance from humans.
- Limit the use of pesticides in developments adjacent to pinyon-juniper woodlands and employ IPM (Integrated Pest Management) practices.
- Keep pets (especially cats) indoors, confined to fenced areas, or restricted by leashes.
- Control garbage, manage landfills, and keep pet food indoors to reduce concentrations of crows, ravens, raccoons, skunks, and other predators of birds and their nests.

Sage Grouse and Pinyon-Juniper

Two sage grouse species inhabit the western U.S., the Greater Sage-Grouse and the Gunnison Sage-Grouse. As their names imply, these species are completely reliant on sagebrush habitats. They nest in sagebrush, rear their broods in sagebrush, and eat sagebrush. Encroachment by trees such as pinyon or juniper into sagebrush habitats is detrimental to these and other sagebrush-dependent species because it results in the loss or fragmentation of sagebrush habitat. Such encroachment is a major cause of concern for these declining sage grouse species, both of which are Partners in Flight *Watch List Species* (Rich et al. 2004). As a result, pinyon-juniper removal from sagebrush communities can be an effective management technique for improving sage grouse habitat (Connelly et al. 2000).

In a Colorado study (Commons et al. 1999), removal of pinyon-juniper resulted in higher numbers (a doubling) of male grouse in years 2 and 3 post-treatment. The authors speculated that the increase was probably due to the loss of perch sites for raptors and increased predator detection distances by grouse. Not all pinyon-juniper should be removed, however, as radio-collared grouse made extensive use of sagebrush areas with scattered pinyon and juniper trees at least 6 feet (2 m) tall during September-November.

Gary Kramer, US Fish & Wildlife Service

Where juniper or pinyon-juniper has encroached on sagebrush communities, acceptable removal methods include prescribed burns (used with caution), mechanical removal, and chemical treatment. The amount of disruption to the sagebrush stand should be a factor in selecting the tree removal method (Connelly et al. 2000). An excellent resource on management of sagebrush habitats for birds is Paige and Ritter (1999).

Water developments

Water developments designed for livestock and wildlife include pipeline and tank systems, catchment systems (guzzlers), and artificial ponds or reservoirs. Such developments provide a source of water in areas where open water is ordinarily quite scarce. However, livestock tend to concentrate their activities near water developments in arid and semi-arid regions. Negative impacts could include soil compaction, local trampling of vegetation, overgrazing, invasion by exotic vegetation, and elevated rates of Brown-headed Cowbird brood parasitism. Arid-land water developments can cause over-utilization of an area or unhealthy concentrations of animals. They may also attract non-adapted species, which then compete with or prey upon the arid land species.

What you can do:

- Create water developments that minimize alteration of natural water flows.
- Design the development to accommodate target species and exclude suspected trouble-makers.
- Provide wildlife escape ladders in stock tanks and troughs.
- Use fences or other means to protect sensitive vegetation around natural water sources (seeps, springs, streams, etc.) from damage by livestock.
- Carefully consider decisions to build or maintain water developments for native wildlife already adapted to dry conditions; the value of such developments has been called into question (Broyles 1995).

Kurt VerCauteren

Stock tank escape ladder developed by Rocky Mountain Bird Observatory

Farming

The low-statured and structurally simple habitat of cropland offers little to pinyon-juniper birds adapted to foraging, nesting, and perching in trees. However, relict stands of pinyon-juniper left standing within cropland still have value to birds, as do stands adjacent to cropland.

What you can do:

- Retain pockets of pinyon-juniper woodland that occupy lands unsuitable for farming. These patches should be as large as possible and roughly round, rather than long and narrow.
- Retain strips of pinyon-juniper between fields. Although these strips of trees and other native vegetation may not provide enough security for nesting birds, they can serve as windbreaks and as travel corridors for birds and other wildlife.
- Limit the use of pesticides to the extent possible and adopt Integrated Pest Management practices.
- Obtain expert advice on management for birds and other wildlife from the local extension service, state wildlife agency, federal land management agency, or non-profit organization.
- Investigate state and federal programs that offer technical and financial assistance for wildlife habitat conservation projects on private lands, such as EQIP and WHIP.
- Adopt conservation tillage practices (no-till or minimum-till), which leave some vegetation in the fields throughout the year, providing cover for birds and the insects and small vertebrates that some birds eat.
- Use ground applications of pesticides rather than broadcast spraying, which could drift into adjacent pinyon-juniper woodlands and other wildlife habitats.

Watershed management

Pinyon-juniper woodlands typically grow in very dry climates. So dry, in fact, that ground cover is usually insufficient to prevent soil erosion, even with the soil-protecting presence of biological soil crusts. Dominance by trees on a given site further limits ground cover. Local streamflow is usually ephemeral, but erosion occurs as a result of fast-moving thunderstorms and the seasonal pulse of melted snow. The hydrologic budget for pinyon-juniper watersheds (primarily grass savanna systems in Arizona and New Mexico) has been estimated as: evapotranspiration 68-96%, interception 17-29%, change in soil moisture storage 4-6%, runoff 1-23% (but usually 4-8%), deep seepage 0% (Roundy and Vernon 1999).

In some areas, historical periods of overgrazing by livestock and the growing density of pinyon-juniper woodlands have led to the loss of understory and harm to the biological soil crusts. As a result, erosion has increased. Where erosion is excessive and conditions are extremely poor, the understory may never return naturally.

Tree removal to increase water yield is most often successful where local geology is favorable, such as where an impermeable subsurface layer blocks deep seepage but allows subsurface flows to recharge springs and streams (Roundy and Vernon 1999). Drawbacks to increasing water yield by increasing overland flow include increased erosion and lower water quality. Water yield is higher when trees and slash are removed than if left in place, but leaving slash in place reduces erosion. Increasing subsurface flows, such as by trapping water in root ball pits left from chaining trees, would be more effective.

What you can do:

- Retain mature pinyon-juniper stands when pinyon and juniper trees are removed to enhance water yield. The mature stands are critical for many pinyon-juniper birds, especially those with high conservation need.
- Remove trees invading areas with high erosion potential.
- Combine projects to enhance water yield with other projects that address erosion control and forage enhancement.
- Leave downed trees and woody debris in treated areas to reduce erosion and increase infiltration.
- Secure the services of a hydrologist to assist in calculating the water yield component of cost-benefit ratios associated with tree-removal projects.
- Maintain the integrity of biological soil crusts where they occur by limiting soil disturbances such as off-trail and off-road foot and vehicle traffic and heavy grazing.

BLM-Grand Junction Field Office

Pinyon-Juniper Birds of Conservation Concern

Birds can be good indicators of environmental quality --- a complete suite of bird species will occur only where habitat conditions are good. Birds are also good "umbrella" species --- other wildlife species benefit from healthy bird habitat. This section provides life history accounts for bird species of conservation concern in pinyon-juniper woodlands. These species were selected based on their ranking as priority species in pinyon-juniper in one or more of the Partners in Flight Bird Conservation Plans covering the core of the pinyon-juniper range, including Arizona (Latta et al. 1999), Colorado (Colorado Partners in Flight 2000), Idaho (Idaho Partners in Flight 2000), Nevada (Neel 1999), New Mexico (New Mexico Partners in Flight 2003), and Utah (Parrish et al. 2002). Each account includes a list of management actions you can implement to help conserve the species.

Black-chinned Hummingbird

Breeding Habitat:

This species typically breeds in riparian zones of arid regions, but also nests extensively in pinyon-juniper woodlands (Andrews and Righter 1992), especially when flowering shrubs and herbaceous plants are nearby.

Nest:

The Black-chinned Hummingbird constructs a tiny cup nest of plant down and spider webs, usually in a tree but sometimes in a shrub, often near or even over water. The nest is usually placed no higher than 10 feet (3 m). It may produce two or even three broods per season, resulting in an extended breeding season: early April to early August.

Wintering:

This species winters primarily in north-central and western Mexico in habitat that is structurally similar to the breeding habitat (Baltosser and Russell 2000).

Feeding:

This species consumes nectar from flowers, also spiders and insects that it picks from vegetation. Dependent young are mostly fed invertebrates.

Status:

For the United States population, which is restricted to the western U.S., Breeding Bird Survey data show a significantly positive population trend of 1.4% per year for the period 1966-2005 (Sauer et al. 2006).

Conservation:

Threats to this species include loss of nectar-producing plants, habitat loss on the breeding or wintering grounds, and pesticide use. This species is fairly tolerant of human disturbance and will inhabit residential areas where the habitat is suitable.

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What you can do:

- Use grazing systems that preserve flowering herbaceous plants, such as a rotation system that allows some pastures to rest without grazing pressure during the breeding season.
- Favor grazing by cattle over sheep, because sheep are more selective for flowering herbs which produce nectar needed by hummingbirds. However, it is easier to control the grazing impact of sheep and thus, if managed closely to leave ample forb stocks, sheep may be the preferred livestock.
- Avoid the use of insecticides; adopt IPM (Integrated Pest Management) practices; limit insecticide use to periods outside the breeding season.
- Plant flowering herbaceous plants, especially natives, in residential landscapes.

Ferruginous Hawk

Breeding Habitat:

This species prefers relatively flat, open grasslands and shrublands and areas where these habitat types meet pinyon-juniper woodlands, especially outlier trees from main woodlots (Bechard and Schmutz 1995; Parrish et al. 2002).

Nest:

The bulky stick nest is usually placed on elevated sites, such as isolated trees (especially large, flat-topped junipers), shrubs, rock outcrops, and utility structures. Nesting occurs from March into July.

Wintering:

Wintering habitat is similar to breeding (i.e., open areas with few trees). This species is particularly attracted to prairie dog colonies in winter.

Feeding:

The Ferruginous Hawk hunts by scanning for prey from an elevated perch, while soaring, or while standing on the ground near burrows of prey species. In pinyon-juniper habitat this hawk hunts jackrabbits, cottontails, and small mammals.

Status:

This species has disappeared from some local areas used in times past. However, population trends over large areas are difficult to discern because the species is so rarely recorded by the Breeding Bird Survey, which records an average of just 0.25 Ferruginous Hawks/survey route (Sauer er al. 2006), which equates to one bird for every 100 survey miles. This is a U.S. Fish and Wildlife Service *Species of Conservation Concern* in Bird Conservation Regions 9 (Great Basin) and 16 (Southern Rockies/Colorado Plateau) and at the national level (U.S. Fish and Wildlife Service 2002). It is also a Bureau of Land Management *Sensitive Species* in Colorado, Idaho, Nevada, and Wyoming, a *Sensitive Species* in U.S. Forest Service Region 2, a Colorado Division of Wildlife and Idaho Department of Fish and Game *Species of Special Concern*, and a Utah Division of Wildlife Resources *Species of Concern*. Throughout most of its breeding range, Breeding Bird Survey trends are not statistically significant for the period 1966-2005, a reflection of the rarity of the species. For the United States as a whole, the population trend is a positive 2.2% per year (Sauer et al. 2006).

Tony Leukering, RMBO

Conservation:

Threats to this species include loss of habitat due to invasion by non-native species or conversion of native land cover types to cropland (although this is more of a problem on the Great Plains than the Intermountain West) and disturbance to nest sites.

What you can do:

- Retain the open savanna structure of pinyon-juniper in areas known to support Ferruginous Hawks.
- Protect known nest trees; this may require fencing to preclude cattle from rubbing against the tree or compacting the soil around its roots.
- Maintain habitat for prey species by controlling invasive plant species such as cheatgrass.
- Maintain prey populations by limiting recreational "varmint" shooting.
- Maintain a buffer zone of 0.5 mile (0.8 km) around nests to reduce disturbance from mineral exploration/development, vehicles, or other human activities (Romin and Muck 2002). This species is extremely sensitive to human disturbance during the breeding season and will abandon nest sites if disturbance is excessive.
- Inventory lands under your control on an annual or biannual basis to locate nests or likely nest sites.

Ash-throated Flycatcher

Breeding Habitat:

This species breeds in mature pinyon-juniper or juniper woodlands, open riparian groves, or in juniper-yucca or juniper-oak ecotones (Cardiff and Dittmann 2002). It prefers low trees or shrubs for perching and foraging, often using the tips of snags or dead portions of trees, which provide unobstructed flight paths.

Nest:

This species nests in tree cavities created by woodpeckers or by rot, breakage, etc. It will use almost any suitable cavity and has been recorded using some unusual sites such as open metal pipes, mailboxes, an empty pail, even a pair of overalls hanging on a clothesline (Cardiff and Dittmann 2002). It produces a single brood during early April to early July.

Wintering:

Much of the wintering habitat in Mexico and the extreme southwestern U.S. is structurally similar to the breeding habitat (i.e., open woodlands).

Feeding:

This is an insectivore, and primarily captures flying insects by sallying out from a perch to capture them in the air. It will occasionally consume mistletoe and other small fleshy fruits.

Status:

The Breeding Bird Survey results for 1966-2005 reflect a gradual, but statistically significant, increasing trend of 1.0% per year for the United States population, which is restricted to the western U.S. (Sauer et al. 2006).

Conservation:

This species needs mature pinyon and juniper trees; younger trees are not large enough to provide nest cavities. The number of available nest cavities is probably a limiting factor. Threats include loss of habitat and pesticide use. This species adapts to human disturbance and will nest in residential areas, sometimes using nest boxes put up for bluebirds.

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What you can do:

- Retain mature pinyon and juniper trees, snags, and partially dead trees.
- Create small openings in woodlands to create foraging opportunities.
- Avoid insecticide use; adopt IPM (Integrated Pest Management) practices; limit the use of pesticides to the periods outside of the breeding season.
- Install nest boxes with floor dimensions of 6" x 6" and an entrance hole of 1.5" diameter 6-10" above the floor; mount the boxes at least 5' high.

Gray Flycatcher

Breeding Habitat:

This species is closely tied to arid woodlands and shrublands, including pinyon-juniper with a sagebrush understory (Sterling 1999). In Wyoming, this species preferred mature Utah juniper stands with high juniper cover, senescent trees (as determined by presence of dead limbs, which are used as perch sites for singing or foraging when the branches extend beyond the canopy), high seedling and sapling density, and presence of pinyon pines; all factors except pinyon presence are typical for mature juniper stands (Pavlacky and Anderson 2001). In Arizona, the Gray Flycatcher is found in woodlands with tall, mature pinyon-juniper and open understory (Latta et al. 1999), although elsewhere it appears to prefer dense understory (New Mexico Partners in Flight 2003).

Nest:

The nest is an open cup of grasses, pine needles, shredded bark, and other plant materials. It is often placed in forks of branches of pinyon or juniper, on top of large branches against the trunk of ponderosa pine, or within shrubs (Sterling 1999). The female lays a clutch of three or four eggs in late April to early June, and a second clutch as late as July (Sterling 1999). This species is a host to the Brown-headed Cowbird (Sterling 1999).

Wintering:

This species winters in western and central Mexico in open habitat with scattered trees and shrubs (Sterling 1999).

Feeding:

The Gray Flycatcher captures flying insects by sallying from an exposed perch, to which it often returns. It also captures insects on the ground and on foliage, branches, and trunks (Sterling 1999).

Status:

This is a Partners in Flight continental *Stewardship Species* (Rich et al. 2004). Breeding Bird Survey (BBS) data for 1966-2005 show statistically significant increasing population trends of 2.2% per year in the BBS Pinyon-Juniper Ecoregion and 5.0% per year in the western U.S. (Sauer et al. 2006).

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Conservation:

Threats on the breeding and wintering range may include pesticide use, grazing that reduces shrub density or grass cover, and loss of mature shrubs and pinyon-juniper trees. This species is fairly intolerant of human disturbance, such as from residential development. The impact of Brown-headed Cowbird brood parasitism has been studied very little, but preliminary results suggest that the rate could be quite high in places (Sterling 1999).

What you can do:

- Retain old-growth shrublands (i.e., large shrubs).
- Retain mature trees.
- Create small openings within pinyon-juniper woodlands (Latta et al. 1999).
- Take steps to discourage Brown-headed Cowbird populations.
- Manage for a pinyon-to-juniper ratio of about 1:1, with at least 13% canopy cover (Latta et al. 1999; LaRue 1994).
- Retain snags and partially dead trees.
- Avoid insecticide use; adopt IPM (Integrated Pest Management) practices; limit insecticide use to periods outside the breeding season.

Gray Vireo

Breeding Habitat:

This species prefers mixed pinyon-juniper, oak scrub, and/or chaparral in hot, arid mountains and high plains shrublands (Barlow et al. 1999), and also occurs in juniper-dominated or pure juniper stands (Colorado Partners in Flight 2000) or open pinyon-juniper woodlands with widely spaced trees; it avoids dense stands (Dexter 1998; Neel 1999). Pairs often establish territories on steep slopes (Colorado Partners in Flight 2000).

Nest:

This species constructs its open cup nest in the fork of tree branches (Barlow et al. 1999), especially if the tree has a dead branch extending above the live foliage --- the dead branch may serve as a singing or foraging perch (Dexter 1998). A clutch of three or four eggs is incubated by both adults. This species is a Brown-headed Cowbird host and pairs typically abandon a parasitized nest (Barlow et al. 1999). Nesting takes place from early April through June with only a single brood produced.

Wintering:

The Gray Vireo winters in southwestern Arizona and northwestern Mexico in desert scrub dominated by elephant trees, the fruits of which are the primary winter food of the species (Barlow et al. 1999).

Feeding:

This is an insectivorous species, gleaning insects from foliage and bark of trees and shrubs (Barlow et al. 1999) and catching insects in flight.

Status:

This is a Partners in Flight continental *Watch List Species* (Rich et al. 2004), and a U.S. Fish and Wildlife Service *Species of Conservation Concern* in Bird Conservation Regions 9 (Great Basin) and 16 (Southern Rockies/ Colorado Plateau) and at the national level (U.S. Fish and Wildlife Service 2002). Due to very low sample sizes, Breeding Bird Survey data for 1966-2005 reveal no statistically significant trends for any geographic area covered by BBS (Sauer et al. 2006).

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Conservation:

Threats to the species include habitat loss from conversion of pinyon-juniper to rangelands (Barlow et al. 1999) and comparatively high rates of depredation by jays and squirrels (Dexter 1998). However, the greatest threat may be the clearing of winter habitat, as the species is dependent upon a couple species of elephant trees in a restricted range.

What you can do:

- Maintain stands of mature pinyon-juniper.
- Take steps to discourage Brown-headed Cowbird populations.
- Maintain open pinyon-juniper woodlands with a shrubby understory, especially on moderate to steep rocky slopes.
- Use mechanical thinning to prevent stands from becoming too dense and to create small openings with shrubs and edge.
- Avoid insecticide use; adopt IPM (Integrated Pest Management) practices; limit the use of pesticides to the periods outside of the breeding season.

Pinyon Jay

Breeding Habitat:

This species is closely tied to pinyon-juniper woodlands, but also breeds in sagebrush, scrub oak, chaparral, ponderosa pine, and Jeffrey pine forests (Balda 2002). It prefers mature stages of pinyon (Short and McCulloch 1977), which produce more seeds. If habitat conditions are suitable, a flock may occupy the same home range for decades (Ryser 1985). However, because pinyon crops are unpredictable, flocks may wander in search of adequate seed supplies.

Nest:

The nest is a relatively large, bulky, open cup composed of sticks and lined with grasses, hair, feathers, and soft plant parts (Balda 2002); the bulkiness presumably provides insulation because this species begins nesting in winter, as early as February (Balda 2002). Some nesting attempts may start later in the spring with young still in the nest as late as August. The nest is placed in ponderosa, pinyon, or juniper trees, often on the south-facing side (Balda 2002). This species nests colonially.

Wintering:

This species is a year-round resident, although individuals may disperse far from their normal range in years of cone crop failure.

Feeding:

The Pinyon Jay is an omnivore, consuming pine seeds, acorns, juniper berries, invertebrates, and small vertebrates; food items are collected on the ground, from vegetation, and occasionally by aerial capture (Balda 2002).

Status:

This is a Partners in Flight continental *Watch List Species* (Rich et al. 2004), a U.S. Fish and Wildlife Service *Species of Conservation Concern* in Bird Conservation Region 16 (Southern Rockies/Colorado Plateau) (U.S. Fish and Wildlife Service 2002), and an Idaho Department of Fish and Game *Species of Special Concern*. This species is undergoing a significant decline throughout its range; Breeding Bird Survey (BBS) data reveal statistically significant declines in the United States (-4.6% per year), the western U.S. (-4.7% per year), BBS Pinyon-Juniper Ecoregion (-7.3% per year), BBS Basin & Range Ecoregion (-7.2% per year), California (-8.4% per year), Colorado (-5.5% per year), and Nevada (-9.3% per year) during the period 1966-2005 (Sauer et al. 2006).

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Conservation:

The Pinyon Jay is a species of concern because of loss of pinyon-juniper habitat through conversion to other land cover types including clearing for residential development. Other factors include a widespread, prolonged drought in the Southwest, which has resulted in diminished cone crop production, engraver beetle infestations, and tree mortality. Also, this species is critically important in pinyon pine seed dispersal. Partners in Flight has called for a 100% increase in the continental populations of this species (Rich et al. 2004).

What you can do:

- Retain patches of mature pinyon or pinyon-juniper of at least 7 square miles (18 km^2), which is approximately the area of each flock's home range (Balda and Bateman 1971).
- Retain large trees (which are the most prolific cone-producers) since successful breeding is very closely tied to pinyon pines and seed production.
- Inventory lands under your control on an annual or biannual basis to locate nesting sites.
- Develop roads, picnic areas, or other sources of disturbance no closer than 0.6 miles (1 km) from known nesting sites since colonies are sensitive to human disturbance.

Juniper Titmouse

Breeding Habitat:

This species is a resident of juniper woodlands or pinyon-juniper woodlands where juniper is dominant; it requires large trees that provide natural cavities for nesting (Cicero 2000). In Wyoming, this species preferred mature juniper stands with high juniper cover, senescent trees, dead limbs, and presence of pinyon pines; the old trees provide cavity-nest sites; the pinyon pines may be preferred foraging substrate (Laudenslayer and Balda 1976).

Nest:

This species nests in tree cavities excavated by woodpeckers or formed by rot or broken branches. It will also use artificial nest boxes. It may partially excavate its own nest cavity if the wood is soft or rotten (Cicero 2000).

Wintering:

The Juniper Titmouse is nonmigratory, and pairs defend their territories year-round, although some birds may move upslope into ponderosa pine forests during winter.

Feeding:

This species eats seeds (and is known to be a major consumer of pinyon seeds), terrestrial invertebrates, and fruits. In fall and winter it eats mainly seeds and juniper berries. The insects are gleaned from the foliage and bark of trees and shrubs and from the ground (Cicero 2000).

Status:

Breeding Bird Survey (BBS) data for 1966-2005 do not show statistically significant population trends at the national scale or the scale of the western U.S., but they do show significant declines for the BBS Pinyon-Juniper Woodland Ecoregion (-2.7% per year), Colorado (-4.3% per year), and New Mexico (-2.8% per year) (Sauer et al. 2006).

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Conservation:

This species is a pinyon-juniper obligate. Because it is a cavity-nester, it needs mature woodlands, which provide trees large enough to support nest cavities.

What you can do:

- Retain older juniper trees with large, twisted trunks (Cicero 2000), which provide nest cavities.
- Retain trees with cavities.
- Retain large snags and partially dead trees.
- Avoid insecticide use; adopt IPM (Integrated Pest Management) practices; limit the use of pesticides to the periods outside of the breeding season.
- Install nest boxes with floor dimensions of 4" x 4" and an entrance hole 1.25" diameter, 6-10" above the floor; mount the boxes at least 5' high on a tree or post.

Townsend's Solitaire

Breeding Habitat:

This species is found in montane habitats up to and even above treeline. It inhabits a variety of open coniferous forest types, occasionally including pinyon-juniper (Bowen 1997).

Nest:

This species nests on the ground in a well-protected site, such as among tree roots, or in a rocky niche on a slope or rock wall.

Wintering:

During winter, the Townsend's Solitaire moves into juniper or pinyon-juniper woodlands where it establishes and defends a feeding territory. The size of the territory is linked to the availability of juniper berries --- smaller territories where juniper berries are plentiful, larger territories where the berries are scarce (Salomonson and Balda 1977).

Feeding:

Individuals commonly catch flying insects in mid-air by sallying out from an exposed perch. Solitaires collect spiders, other invertebrates, and small berries such as mistletoe from vegetation or the ground. In winter, this species lives almost exclusively on juniper berries, which it picks off the ground or from tree branches. Each solitaire eats an estimated 42,000-84,000 one-seed juniper berries each winter (Salomonson and Balda 1977).

Status:

Breeding Bird Survey data for 1966-2005 reveal a statistically significant population trend for the United States (2.5% per year) (Sauer et al. 2006).

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Conservation:

This species serves an important role in the dispersal of juniper seeds, and is almost completely dependent on junipers for food during winter. Mature trees produce the greatest berry crop.

What you can do:

- Maintain open woodlands through thinning or prescribed burning.
- Retain mature juniper trees, which provide winter food --- mature junipers produce more berries than do younger trees.
- Retain mistletoe-infected trees.
- Retain fruiting shrubs such as currants and elderberries.
- Avoid insecticide use; adopt IPM (Integrated Pest Management) practices; limit the use of pesticides to the periods outside of the breeding season.

Western Bluebird

Breeding Habitat:

This species breeds in open woodlands with snags and grassy areas, and burned forest with standing snags. It is most commonly associated with ponderosa pine and aspen forests, but also breeds in open pinyon-juniper woodlands (Guinan et al. 2000).

Nest:

This species nests in tree cavities, either those formed naturally by the tree or excavated by woodpeckers. It will also use artificial nest boxes. Nesting may begin as early as March, followed by a second brood as early as May. In some areas, pairs will produce a third brood (Guinan et al. 2000).

Wintering:

During winter, the Western Bluebird moves down in elevation from its montane breeding sites to open woodlands, shrublands, and riparian areas. Some populations also move south as far as central Mexico.

Feeding:

The summer diet is primarily invertebrates while the winter diet includes small berries such as mistletoe and juniper. It frequently captures flying insects by sallying out from an exposed perch, and collects invertebrates and small berries from foliage or on the ground.

Status:

Breeding Bird Survey (BBS) data for 1966-2005 fail to reveal a statistically significant population trend for any geographic region other than U.S. Fish and Wildlife Service Region 6 (Montana, Wyoming, Utah, Colorado, Kansas, Nebraska, and the Dakotas), where the population is increasing at a rate of 7.3% per year (Sauer et al. 2006).

Conservation:

The Western Bluebird is dependent on large trees and snags, which provide substrate for nest cavities. It also serves an important role in the dispersal of juniper seeds.

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What you can do:

- Leave snags and dying trees for foraging perches and nesting sites, especially those that already contain cavities.
- Use thinning and prescribed burning to convert dense forest into more favored open woodland, but retain all large trees and snags.
- Avoid insecticide use; adopt IPM (Integrated Pest Management) practices; limit the use of pesticides to the periods outside of the breeding season.
- Retain fruiting shrubs such as currants and elderberries.
- Install nest boxes with floor dimensions of 5" x 5" and an entrance hole 1.5" diameter, 6-10" above the floor; mount the boxes 4-6' above the ground on a post. Mount them at least 1/4 mile (400 m) from buildings to reduce competition with the non-native House Sparrow.

Virginia's Warbler

Breeding Habitat:

This species is typically associated with pinyon-juniper and oak woodlands with a shrubby understory (Olson and Martin 1999). A dense, tall shrub layer is critical for foraging and nesting, and the species may breed in various montane shrub habitats.

Nest:

This species places its small, shallow cup nest on the ground, where the nest is concealed by vegetation. Nesting occurs from mid-May to mid-July. Virginia's Warbler pairs raise a single brood each season.

Wintering:

Virginia's Warbler winters in south-central Mexico in open woodlands and shrubby areas.

Feeding:

This species is insectivorous, gleaning insects from vegetation and the ground and occasionally capturing insects in flight.

Status:

This is a Partners in Flight continental *Watch List Species* (Rich et al. 2004), a U.S. Fish and Wildlife Service *Species of Conservation Concern* in Bird Conservation Region 16 (Southern Rockies/Colorado Plateau) (U.S. Fish and Wildlife Service 2002), and an Idaho Department of Fish and Game *Species of Special Concern*. The Breeding Bird Survey does not show a statistically significant population trend for any geographic region during the 1966-2005 period (Sauer et al. 2006). Reasons for this lack of a clear trend could be highly variable counts or too few birds counted.

Conservation:

The rate of Brown-headed Cowbird nest parasitism is comparatively low for this species, possibly due to its well-hidden nest. However, introducing livestock into the range of this species could result in increases in cowbird nest parasitism. Other potential hazards associated with grazing include nest trampling and livestock range projects that reduce shrub density.

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What you can do:

- Maintain livestock at levels that preserve shrub cover. Accept some shrub stands that are too thick for ungulates to penetrate.
- Protect shrub cover from prescribed burns, wildfires, or management actions that could remove them. Shrub removal negatively impacts this species in the short term by removing its nesting cover and principal foraging substrate (Olson and Martin 1999).
- Avoid the use of pesticides in nesting or foraging areas, especially during the breeding season.

Black-throated Gray Warbler

Breeding Habitat:

This species breeds in open or dense pinyon-juniper or other coniferous woodlands with a shrubby understory (Guzy and Lowther 1997; Neel 1999) and in mature pinyon-juniper (Versaw 1998). In Wyoming juniper stands, it was more commonly found with pinyon pines with high seedling and sapling density and a strong shrub component; the pinyon pines and shrubs might provide more invertebrate prey for this insectivore (Pavlacky and Anderson 2001).

Nest:

The nest is a deep open cup nest of grasses and other plant fibers lined with feathers and fur, commonly placed on a horizontal tree branch, 3 to 10 feet (1 to 3 m) away from the trunk (Guzy and Lowther 1997). Nesting occurs from early April into August. Each pair raises a single brood each year, but double-brooding is suspected (Guzy and Lowther 1997).

Wintering:

This warbler winters in western and central Mexico in habitat similar in species composition (or at least in structure) to breeding habitat, and in shrubby areas and tall montane and riparian forest (Guzy and Lowther 1997).

Feeding:

This species is insectivorous, and gleans insects from the foliage of trees and shrubs (Guzy and Lowther 1997).

Status:

This is a Partners in Flight continental *Stewardship Species* (Rich et al. 2004) and a U.S. Fish and Wildlife Service *Species of Conservation Concern* in Bird Conservation Region 16 (Southern Rockies/Colorado Plateau) (U.S. Fish and Wildlife Service 2002). Breeding Bird Survey data for 1966-2005 show statistically significant population decline for the Arizona-New Mexico-Texas-Oklahoma state group of -3.7% per year (Sauer et al. 2006).

Conservation:

This species is a pinyon-juniper obligate throughout much of its range. It is a host species to Brown-headed Cowbirds (Goguen and Mathews 1998).

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What you can do:

- Retain mature overstory pinyon-juniper trees (Guzy and Lowther 1997), tall shrubs, and seedling/sapling cover.
- Maintain at least a 15% pinyon-juniper canopy cover (Parrish et al. 2002).
- Avoid using insecticides in areas known to contain Black-throated Gray Warbler populations; if they must be used, adopt IPM (Integrated Pest Management) practices, and limit the use of pesticides to periods outside the nesting period.
- Take steps to discourage Brown-headed Cowbird populations (see page 10).

Scott's Oriole

Breeding Habitat:

The Scott's Oriole breeds in open pinyon-juniper or pure juniper woodlands, especially with yuccas, and in canyon forests, Joshua tree woodlands, and desert scrub (Flood 2002).

Nest:

This species uses fiber from yucca leaves, grass, and cactus fibers to build its hanging cup nest in juniper trees. Nesting occurs from late April through July.

Wintering:

The Scott's Oriole winters in open woodlands and desert scrub of western and central Mexico.

Feeding:

This species is insectivorous, collecting prey on the ground or low in vegetation. It also consumes berries, cactus fruits, and nectar.

Status:

This is an Idaho Department of Fish and Game *Species of Special Concern*. Breeding Bird Survey data for 1966-2005 do not demonstrate a statistically significant population trend for this species for any geographic region (Sauer et al. 2006) due to very low sample sizes.

Conservation:

Wildfires, prescribed fires, or management actions that remove shrubs negatively impact this species. However, where those same actions thin dense low-elevation stands of pinyon-juniper, they may benefit Scott's Oriole. Some west Texas populations of this species are significantly impacted by brood parasitism of the Bronzed Cowbird (Flood 2002).

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What you can do:

- Where practical, avoid insecticide use, adopt IPM (Integrated Pest Management) practices, or limit the use of pesticides to the periods outside of the breeding season.
- At the lowest elevational range of pinyon-juniper, manage for open juniper stands with no more than 60 trees per acre (150 trees per ha) (Colorado Partners in Flight 2000).
- Take steps to reduce cowbird brood parasitism (see page 10).

Other Pinyon-Juniper Birds

Western Scrub-Jay

This species inhabits shrubby habitats, especially oaks, but is also found regularly in pinyon-juniper woodlands. It is nonmigratory, but individuals may wander widely in winter. It adapts well to suburbia and is not very sensitive to human disturbance. Like other jays, this species is omnivorous, eating invertebrates, small vertebrates, small fruits, acorns, and pine nuts (Curry et al. 2003).
What you can do: Preserve oak stands, especially mature mast-producing stands.

Bushtit

The Bushtit is a resident of open habitats with conifers, including pinyon-juniper woodlands. It is comfortable in suburban settings. It builds a pendulous, gourd-shaped nest of spider webs and plant material. It gleans insects and spiders from plant foliage, especially from pinyons (Sloan 2001).
What you can do: Reduce or eliminate the use of insecticides.

Bewick's Wren

This species prefers dense shrubs mixed with open woodland such as pinyon-juniper. It picks invertebrates from vegetation or the ground. It is a cavity-nester, and will accept artificial nest boxes (Kennedy and White 1997).
What you can do: Preserve mature stands, especially junipers, which tend to have more cavities. Reduce or eliminate the use of insecticides. Install nest boxes with floor dimensions of 4" x 4" and an entrance hole of 1.25" diameter, 4-6" above the floor; mount 5-10' high on a tree. Note: nest boxes may not be successful where House Wrens are present, as they may usurp Bewick's Wrens.

Blue-gray Gnatcatcher

This species inhabits pinyon-juniper woodlands and shrublands. It eats small invertebrates gleaned from vegetation. Its open cup nest leaves it susceptible to brood parasitism by the Brown-headed Cowbird; in some areas the rate is quite high (Ellison 1992).
What you can do: Take steps to reduce Brown-headed Cowbird parasitism (see page 10). Reduce or eliminate the use of insecticides.

Mountain Bluebird

The Mountain Bluebird prefers open woodlands and forest edges. It consumes insects, spiders, and small fruits. A cavity-nester, it will use artificial nest boxes (Power and Lombardo 1996).
What you can do: Preserve trees with cavities, especially at forest or woodland edges or in open woodlands. Preserve standing dead trees as foraging perches. Reduce or eliminate the use of insecticides. Retain fruiting shrubs such as currants or elderberries. Install nest boxes to encourage nesting (see nest box dimensions for Western Bluebird on page 29); place nest boxes at least 1/4 mile (400 m) from buildings to discourage House Sparrows.

Chipping Sparrow

This species inhabits coniferous forests, including pinyon-juniper woodlands. In particular, it prefers open woodlands with little or no shrub cover, and often places its flimsy cup nest in trees or shrubs at the edge of a woodland. It feeds on insects and small seeds, which it collects from the ground. This is a frequent host to the Brown-headed Cowbird (Middleton 1998).
What you can do: Take steps to reduce Brown-headed Cowbird brood parasitism (see page 10).

Glenn Giroir, RMBO

Female Bushtit

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Additional Sources of Assistance

Partners in Flight

Partners in Flight is a cooperative effort involving government agencies, professional organizations, conservation groups, industry, the academic community, and private individuals, dedicated to keeping common birds common and reversing the downward trends of declining species. Each state in the West has completed a bird conservation plan through the Partners in Flight initiative. These plans are valuable sources of information on conserving birds of pinyon-juniper and other habitats; states with plans include Arizona (Latta et al. 1999), California (California Partners in Flight 2002), Colorado (Colorado Partners in Flight 2000), Idaho (Idaho Partners in Flight 2000), Nevada (Neel 1999), New Mexico (New Mexico Partners in Flight 2003), Oregon/Washington (Oregon/Washington Partners in Flight 2004), Utah (Parrish et al. 2002), and Wyoming (Nicholoff 2003). These plans are available through the Partners in Flight web site (http://www.partnersinflight.org).

Rocky Mountain Bird Observatory

Rocky Mountain Bird Observatory maintains the Partners in Flight Species Assessment Database, which includes a scoring system for determining bird species of conservation concern. This is a valuable tool for identifying species in your region that might benefit from appropriate conservation actions. The database is accessible online at http://www.rmbo.org --- follow the links to the PIF database.

Integrated Pest Management

The US Department of Agriculture is one of the best places to search for information on IPM; their web site is a good starting point: http://www.reeusda.gov/ipm/. Other sources include county extension agents and local colleges and universities.

Technical and Financial Assistance for Private Landowners

The US Department of Agriculture's Natural Resources Conservation Service administers a number of programs that can provide assistance to landowners in conserving wildlife habitat, including EQIP and WHIP (http://www.nrcs.usds.gov). Many communities have local offices.

Trust for Public Lands

This non-profit organization that can provide information and assistance in buying and selling conservation easements. Visit their web site (http://www.tpl.org) for more information.

Appendix
Scientific Names of Species in the Text

Plants

dwarf mistletoe	*Arceuthobium* spp.
pinyon dwarf mistletoe	*Arceuthobium divaricatum*
juniper mistletoe	*Phoradendron juniperinum*
singleleaf pinyon	*Pinus monophylla*
Colorado pinyon	*Pinus edulis*
ponderosa pine	*Pinus ponderosa*
Jeffery pine	*Pinus jeffreyi*
limber pine	*Pinus flexilis*
bristlecone pine	*Pinus aristata*
alligator juniper	*Juniperus deppeana*
one-seed juniper	*Juniperus monosperma*
Utah juniper	*Juniperus osteosperma*
Rocky Mountain juniper	*Juniperus scopulorum*
western juniper	*Juniperus occidentalis*
elephant tree	*Bursera* spp.
barrel cactus	*Ferocactus* spp.
elderberry	*Sambucus* spp.
four-winged saltbush	*Atriplex canescens*
sagebrush	*Artemesia* spp.
oak	*Quercus* spp.
currant	*Ribes* spp.
Lewis flax	*Linum lewisii*
scarlet globe mallow	*Sphaeralcea coccinea*
aspen	*Populus tremuloides*
yucca	*Yucca* spp.
Joshua tree	*Yucca brevifolia*
western wheat-grass	*Agropyron smithii*
cheatgrass	*Bromus tectorum*
Indian ricegrass	*Oryzopsis hymenoides*

Invertebrates

pinyon engraver beetle	*Ips confusus*
mountain pine beetle	*Dendroctonus ponderosae*

Birds

Ferruginous Hawk	*Buteo regalis*
Gunnison Sage-Grouse	*Centrocercus minimus*
Greater Sage-Grouse	*Centrocercus urophasianus*
Black-chinned Hummingbird	*Archilochus alexandri*
Ash-throated Flycatcher	*Myiarchus cinerascens*
Cassin's Kingbird	*Tyrannus vociferans*
Gray Flycatcher	*Empidonax wrightii*
Gray Vireo	*Vireo vicinior*
Steller's Jay	*Cyanocitta stelleri*
Western Scrub-Jay	*Aphelocoma californica*
Mexican Jay	*Aphelocoma ultramarina*
Pinyon Jay	*Gymnorhinus cyanocephalus*
Clark's Nutcracker	*Nucifraga columbiana*
Juniper Titmouse	*Baeolophus ridgwayi*
Bushtit	*Psaltriparus minimus*
Bewick's Wren	*Thryomanes bewickii*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Townsend's Solitaire	*Myadestes townsendii*
Mountain Bluebird	*Sialia currucoides*
Western Bluebird	*Sialia mexicana*
American Robin	*Turdus migratorius*
Northern Mockingbird	*Mimus polyglottos*
Bohemian Waxwing	*Bombycilla garrulus*
Cedar Waxwing	*Bombycilla cedrorum*
Virginia's Warbler	*Vermivora virginiae*
Black-throated Gray Warbler	*Dendroica nigrescens*
Black-chinned Sparrow	*Spizella atrogularis*
Chipping Sparrow	*Spizella passerina*
Lark Sparrow	*Chondestes grammacus*
Brown-headed Cowbird	*Molothrus ater*
Bronzed Cowbird	*Molothrus aeneus*
Scott's Oriole	*Icterus parisorum*
House Sparrow	*Passer domesticus*

Mammals

black bear	*Ursus americanus*
raccoon	*Procyon lotor*
coyote	*Canis latrans*
gray fox	*Urocyon cinereoargenteus*
striped skunk	*Mephitis mephitis*
mule deer	*Odocoileus hemionus*
elk	*Cervus canadensis*
desert bighorn sheep	*Ovis canadensis nelsoni*
jackrabbit	*Lepus* spp.
cottontail	*Sylvilagus* spp.
deer mouse	*Peromyscus maniculatus*
pinyon mouse	*Peromyscus truei*
cliff chipmunk	*Tamias dorsalis*
Hopi chipmunk	*Tamias rufus*
Colorado chipmunk	*Tamias quadrivittatus*
Uinta chipmunk	*Tamias umbrinus*
rock squirrel	*Spermophilus variegatus*
Abert's squirrel	*Sciurus aberti*
desert woodrat	*Neotoma lepida*
Stephen's woodrat	*Neotoma stephensi*
white-throated woodrat	*Neotoma albigula*
Mexican woodrat	*Neotoma mexicana*
bushy-tailed woodrat	*Neotoma cinerea*
porcupine	*Erethizon dorsatum*

Western Working Group of Partners in Flight

is part of the international coalition known as Partners in Flight. This coalition includes government agencies, conservation groups, academic institutions, private businesses, and other citizens who share a common vision: to keep bird populations and their habitats healthy. These individuals and groups are dedicated to voluntary actions that will help preserve the magnificent diversity of birds throughout the Western Hemisphere.