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June 4, 2025

To: USFS, Intermountain Regional Office

Objection Reviewing Officer

RE: Humboldt Toiyabe Forestwide Prescribed Fire Restoration Project

324 25th Street

Ogden, Utah 84401

NOTICE OF OBJECTION

1. Objectors

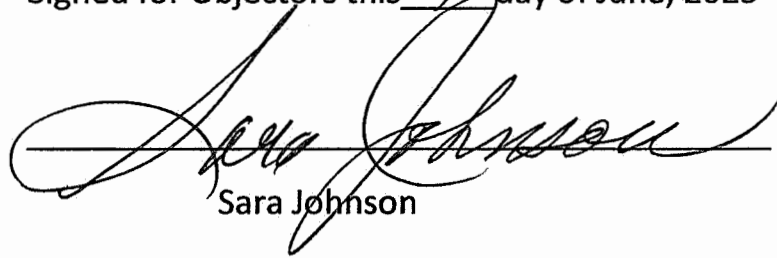
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Signed for Objectors this 4th day of June, 2025


Sara Johnson

2. Project being Objected to

Humboldt-Toiyabe Forestwide Prescribed Fire Restoration Project

3. Responsible Official

Jon Stansfield, Forest Supervisor

4. Attachments

This Objection includes one attachment, Attachment #1. This attachment includes hard copies of 28 reports and/or publications to support claims made in the Objection.

5. Connections between Prior Public Involvement and Issues and Concerns Raised in the Objection

On February 7, 2022, Objectors submitted joint comments on the Preliminary Environmental Assessment (PEA) for the Forestwide Prescribed Fire Restoration Project. We are incorporating these comments into this Objection in order to avoid repetition. We have expanded on many issues, however, to provide supporting documentation as per the current best science.

Our primary issue was that the Forest Service **“has skipped”** 2 important steps before a forest-wide program of intensive fuels management can be implemented in Inventoried Roadless lands on this forest. This is a massive change from past management of these IRAs, including what the public expected for their management. Instead of maintaining natural, undisturbed conditions, the Forest Service has decided, without any programmatic NEPA evaluation, or amendments to the current Forest Plan, to change management of IRAs from past management of natural undisturbed landscapes that provide “reference conditions,” to a new one of massive disturbances. This is a violation of the National Forest Management Act (NFMA) which requires that a forest plan amendment needs to be completed before massive changes of IRAs is implemented by the agency. As well, given that fuels management activities, as we document in the following objection, will result in massive mortality of birds, either directly due to management activities, or indirectly through massive reductions in habitat, and massive increases in cheatgrass, the requirements of the Roadless Area Rule cannot be met due to these effects. AS such, the Forest Service needs to complete a process whereby IRAs are removed from this national forest in order to implement vast vegetation management activities. It is unclear exactly what this process would be, but it clearly will require public involvement and NEPA assessments.

In our joint comments of 2/7/22, we identified many issues and concerns that we are not incorporating into this Objection to avoid repetition. This Objection is expanding on these issues and concerns by providing documentation via reports and publications.

We note that massive fuels treatments, including within IRA, require amendments to the forest plan since current fuels management treatment projections are far below what the forest-wide burning program will require. We note that the current monitoring plan for these forests is a violation of the 2012 Planning Rule due to a lack of conservation measures for species of conservation concern. We note that the proposed project is a violation of the NEPA because the agency is falsely claiming that treatments of pinyon-juniper habitats is to reduce fuels when

this is just a continuation of the pinyon-juniper removal program these forests have implemented for many years to increase forage for cattle. This treatment program for pinyon-juniper forests is also a violation of the NEPA because killing trees is habitat destruction, not restoration. These pinyon-juniper removal projects are also a violation of the NEPA because the agency claims that these forests are "too dense" for wildlife without providing any supporting documentation. The agency is violating the NEPA by claiming that burning pinyon-juniper woodlands will create a "diversity of age classes," while the existing conditions in most stands is never defined; many or most of these stands likely contain multiple age classes of pinyon and juniper trees, so already have a diversity of age classes. The agency is violating the NEPA by claiming that pinyon-juniper forests are unsuitable wildlife habitat due to a lack of fire (departed from historic conditions) without ever providing any supporting analysis as to why older unburned pinyon-juniper woodlands are poor habitat for wildlife. There was no information on where the 10% juniper old growth habitats occur. The planned burning and spaying of sagebrush will also have massive detrimental impacts to wildlife, including the imperiled sage grouse. The current as well as planned compliance for sage grouse with the Forest Plan direction for this species as per the 2015 amendment is never demonstrated. Claims that wildlife management in sagebrush is achieved by burning in a mosaic are never supported for wildlife species highly dependent upon large unfragmented sagebrush stands, such as the Brewer's Sparrow, Sage Sparrow, Sage Thrasher, and Pygmy Rabbit. There was no documentation in the PEA that slashing and burning mule deer winter range maintains, let alone, improves winter habitat. Claims that burning pinyon-juniper habitats will increase their resiliency are clearly false, as killing smaller seedlings and saplings reduces resilience, not increases it; these smaller trees are essential for recovery of stands from disturbances. We raised concerns about the massive motorized use in IRAs, from the use of bulldozers to create fire lines, and use of other heavy equipment, such as masticators. The agency is providing a false claim that there will be no new road construction for this project; use of motorized trails is limited to vehicles 50 or less inches; larger equipment use on these motorized trails thus constitutes a road, not trail. The expected extent of massive increases in cheatgrass from this program were never quantified. The agency is using a 20-year project to escape the monitoring requirements of the NFMA. The agency is using a 20-year project to escape the timeliness requirement of the

NEPA, which is 5 years. The agency is using a large, forest-wide project to avoid providing any specific information to the public on site-specific impacts, including the results of wildlife surveys and what mitigation measures were implemented to avoid disturbances to wildlife, including sensitive species as the Flammulated and Great Gray Owls, and Northern Goshawk. The agency did not define why increases in cheatgrass will be controlled, as to date, the agency has not controlled this invasive annual on the forests. The agency did not provide any scientific basis for affecting Protected Activity Centers for the Northern Goshawk and spotted owl at 5% per year; The agency also did not define why impacting up to 200 acres per year in habitat of the Sierra Nevada red fox will avoid significant impacts on this species. The agency did not define what the expected burning of sage grouse habitat per year would be, or how this complies with Forest Plan direction, including required levels of nesting, brood-rearing, and winter habitat; if Forest Plan levels of these habitats are already being violated, why would further removal constitute “restoration” of sage grouse habitat. The agency is violating the NEPA by claiming that there is an emergency for fuels management within IRAs, without providing what the basis is for humans and wildlife, while at the same time ignoring the ongoing decline of many western forest and arid land birds, which is truly an emergency conservation issue.

6. Remedy

The Humboldt-Toiyabe National Forest needs to complete a Forest Plan amendment to complete public involvement and an evaluation of impacts to wildlife and cheatgrass from the proposed significant change in management of IRA lands on the Forests from providing natural, undisturbed reference landscapes with high wildlife values, to massive interventions for pinyon-juniper and sagebrush control actions across all IRAs. The effects to wildlife will be drastically different from the current management regime (e.g., massive mortality to western and arid land birds as well as massive habitat loss) so this change without an amendment is a violation of both the NFMA and the NEPA. It is also a violation of the 2012 Planning Rule, as there currently are no conservation strategies for a host of wildlife species of conservation concern on these forests.

The agency also needs to complete a Forest Plan amendment to demonstrate to the public that massive slashing and burning within IRAs qualifies as “restoration” of wildlife habitat. To date, these claims, including in the Forest-wide Prescribed Restoration Project, are not supported with anything but vague suppositions. For example, there are no actual criteria or measures provided to define how treatments in IRAs promote “resilience” for wildlife. The public needs to know how these changes are being measured, and how wildlife resilience is being measured. For example, the agency needs to demonstrate why the massive killing of forest and arid land birds will promote their populations within IRAs. As is currently demonstrated in the Forest-wide Prescribed Burning Proposal, these questions about impacts of these treatments remain unaddressed.

We have added 2 new issues based on new information since the project was scoped in 2022. This is the listing of whitebark pine as a threatened species, and the 90-day review for potential listing of the Pinyon Jay as a threatened or endangered species.

7. Legal Violations that Will be Triggered if the Forest-wide Prescribed Burning Program is implemented

- A. The agency is violating the NEPA by failing to evaluate program impacts on a host of landbirds, including many that have an identified conservation concern; slashing and burning pinyon-juniper trees and sagebrush are adverse actions that will reduce bird populations and exacerbate ongoing declines, an impact that must be measured to meet the “hard look” requirements of NEPA analyses.**

There are at least 16 bird species that are identified as Birds of Conservation Concern (BCC) in the USFWS Bird Conservation Region #9, or the Great Basin (USFWS 2021) that covers the Humboldt-Toiyabee National Forest. These include the following:

Calliope Hummingbird, Rufous Hummingbird, Northern Harrier, Flammulated Owl, Long-eared Owl, Short-eared Owl, Lewis's Woodpecker, Olive-sided Flycatcher, Pinyon Jay, Belding's Thrasher, Sage Thrasher, Evening Grosbeak, Cassin's Finch, Cassin's Crossbill, and Virginia Warbler.

The Rocky Mountain Bird Observatory (Gillihan 2006) also listed the following bird species associated with Pinyon-juniper habitats as species of conservation concern:

Black-chinned Hummingbird, Ferruginous Hawk, Ash-throated Flycatcher, Gray Flycatcher, Gray Vireo, Pinyon Jay, Juniper Titmouse, Townsend's Solitaire, Western Bluebird, Virginia's Warbler, Black-throated Gray Warbler, and Scott's Oriole.

The North American Bird Conservation Initiative (2022) identified tipping point bird species that have already lost 50% of their population, but are also expected to lose another 50% of their populations in the next 50 years if nothing changes; these include the Pinyon Jay, Rufous Hummingbird, Evening Grosbeak, and Greater Sage Grouse; the Olive-sided Flycatcher has lost 50% of its population in the last 50 years.

The Humboldt-Toiyabe Forest lists the following birds as sensitive species on this forest (page 17 or Preliminary EA):

Flammulated Owl, Great Gray Owl, California Spotted Owl, and Northern Goshawk.

In spite of the massive habitat impacts that will be triggered on the above birds of conservation concern, there is not a single habitat management plan identified for any of these species. Examples of habitat management requirements have been provided by Gillihan (2006):

Black-chinned Hummingbird: nests extensively in pinyon-juniper woodlands; provide ungrazed areas where there are abundant flowering herbaceous plants, including in riparian areas.

Ferruginous Hawk: in pinyon-juniper woodlands, this hawk hunts jackrabbits, cottontails, and small mammals; this species has disappeared from local areas in the past; retain the savanna structure of pinyon-juniper woodlands; protect known nest trees; maintain habitat for prey; control invasions of cheatgrass; maintain a buffer of 0.5 miles around nests to reduce disturbances during nesting; conduct annual inventories to locate nests.

Ash-throated Flycatcher: breeds in mature pinyon juniper forests or woodlands, riparian grooves or juniper-oak ecotones; shrubs provide hunting perching sites; is a cavity nesting bird, so needs mature pinyon and juniper trees large enough to provide cavities.

Gray Flycatcher: closely tied to woodlands and shrublands, including pinyon-juniper woodlands with a shrub understory; prefers pinyon-juniper woodlands with a high canopy cover, and high seedling and sapling density; need to maintain at least a 13% canopy cover level in pinyon-juniper woodlands; avoid increases in Brown-headed Cowbirds, who may impact nesting of this species.

Gray Vireo: prefers pinyon-juniper woodlands as well as high plains shrublands; is sensitive to nest parasitism by Brown-headed Cowbirds; maintain mature pinyon-juniper woodlands with shrubby understory.

Pinyon Jay: closely tied to pinyon-juniper woodlands, but also breeds in sagebrush; prefers mature stages of pinyon, which produce the most seeds; consumes pine seeds, juniper berries, invertebrates and small insects; populations have been impacted by the loss of pinyon-juniper habitats, as well as long periods of drought that reduce pine seed crops; management recommendations include retaining at least 7 square miles of mature pinyon-juniper forests, which is the

approximate size of a flock's home range; inventory lands on an annual basis to locate nesting sites.

Juniper Titmouse: breeds in pinyon-juniper forests, and prefers stands of mature juniper of high juniper cover, senescent trees and dead limbs; old trees provide cavities for nesting; is a major consumer of pinyon seeds; in fall consumes juniper berries; retain all trees with cavities.

Townsend's Solitaire: inhabits a variety of open coniferous forests, including pinyon-juniper; depends heavily on juniper berries in the winter; mature juniper trees produce the biggest berry crops; also consumes mistletoe berries; retain mature juniper and mistletoe-infested trees; retain fruiting shrubs.

Western Bluebird: uses snags in open woodlands, and burned forests with standing trees; breeding including open pinyon-juniper woodlands; winter diet includes mistletoe berries and juniper berries; mature and older pinyon-juniper woodlands, or those that have burned, are required to provide snags with nesting cavities.

Virginia's Warbler: associated with pinyon-juniper woodlands with shrubby understory; dense, tall shrub layer critical for nesting and foraging; reduction of shrub understories increase livestock trampling of ground nests; nest protection is provided by shrub stands too dense for livestock penetration; protect shrub cover from prescribed burning, as shrubs are critical for both nesting and foraging.

Black-throated Gray Warbler: breeds in open or dense pinyon-juniper woodlands with a shrubby understory, or stands with a high seedling and sapling density; is considered a pinyon-juniper obligate; is host to Brown-headed Cowbirds; management recommendations including maintaining a mature pinyon-juniper overstory, tall shrubs, and seedling/sapling cover; a canopy cover of pinyon-juniper should be at least 15%; discourage Brown-headed Cowbird populations.

Scott's Oriole: breeds in open pinyon-juniper woodlands or pure juniper woodlands, including other species as yuccas and Joshua trees and canyon forests; management actions that remove shrubs are detrimental to this species; may be highly vulnerable to cowbird parasitism.

Gillihan (2006) also identified habitat recommendations for other birds associated with pinyon-juniper woodlands that are not an identified conservation concern. The Bewick's Wren, a species that prefers dense shrubs mixed in with open woodlands, such as pinyon-juniper woodlands; it requires older pinyon-juniper woodlands that provide nesting cavities. Gillihan (2006) also identified the Blue-gray Gnatcatcher as a pinyon-juniper/shrubland bird that is highly sensitive to parasitism by cowbirds. Gillihan (2006) also noted that the Mountain Bluebird will nest in cavities in open pinyon-juniper woodlands; fruiting shrubs in the understory provide important forage. Also, the Chipping Sparrow will breed in pinyon-juniper woodlands with limited shrub cover; it is a frequent host to cowbird parasitism.

Somershoe (et al. 2020) provided extensive conservation recommendations for the Pinyon Jay. The Pinyon Jay is most abundant in the southwest and Great Basin region, which includes Nevada. 27.3 percent of the regional pinyon jay population occurs in Nevada (Id. at Table 1). Nesting areas for this jay comprise roughly 141 acres (Figure 7), with home ranges up to 8,645 to 15,800 acres; they depend heavily on pinyon pine nuts where this tree species occurs, but also feed heavily on limber pine seeds where this tree species occurs; the current recommendation for undisturbed buffers for nesting locales is 0.6 miles; management impacts on Pinyon Jays within pinyon-juniper woodlands is largely unexplored; it is also possible that thinning of pinyon-juniper woodlands increases their vulnerability to drought-related bark beetle mortality; thinned stands may also be more vulnerable to drought conditions than undisturbed stands; prescribed surface fire is not recommended as a follow-up to thinning in persistent pinyon-juniper woodlands because these ecosystems did not evolve with frequent low-intensity fire; currently, knowledge of how vegetation management may affect Pinyon Jay populations is not sufficient to support comprehensive recommendations for their conservation; we do not have sufficient knowledge to describe and quantify management actions that would actively improve habitat for Pinyon Jays at this time; rather we focus on minimizing adverse effects when woodland treatments are conducted for other purposes; vegetation thinning within a traditional nesting colony site can cause the birds to abandon treated areas; therefore, avoiding treatment of nest colony sites is recommended; management of Pinyon Jays

requires that clearance surveys are required to determine if and where jays are nesting; thinning of pinyon pine woodlands will be particularly detrimental to Pinyon Jays by reducing the production of pinyon pines this jay depends upon; old and very old pinyon pine trees are likely in their prime for nut production.

In June of 2022, the USFWS completed a 90-day finding on a petition to list the Pinyon Jay as a threatened or endangered species under the ESA (USFWS 2022). This petition provided limited available information that certain habitat treatments in pinon-juniper habitats will potentially have negative impacts on Pinyon Jay occupancy and nesting colony sites and these treatments are occurring at a species level such that a listing may be warranted; the petition provides credible evidence that regulatory mechanisms to manage Pinyon Jay habitat across their range may be inadequate to ameliorate the impacts of woodland management. The petition also provides credible evidence that increases in cheatgrass due to woodland disturbance, such as fuels reduction, can increase the potential for wildfires and loss of pinyon-juniper woodlands that provide habitat for the Pinyon Jay. The petition also provides credible evidence that climate change is affecting pinon-juniper woodlands; negative effects include increased rates of tree mortality and reduced pinon pine seed crops, along with reduced tree recruitment.

It should be noted that slashing and burning pinon-juniper woodlands will severely reduce the ability of these stands to recover from various disturbances, as their recruitment potential will have been largely removed. This effect will exacerbate the above acknowledged declines of pinyon-pine recruitment potential due to climate change.

In addition to the massive reduction of bird habitat due to slashing and burning of pinon-juniper woodlands (an impact that was never measured in the Forest-wide Prescribed Restoration Proposal) along with what will be a corresponding decline in bird populations, there will also be massive increase in bird mortality from these fuels treatments. This impact of the proposed pinyon-juniper and sagebrush

slashing and burning on bird mortality was never evaluated in this project, but it will clearly involve at least several million birds. These birds will be directly killed by slashing and burning activities, including due to smoke toxicity (Defiance Canyon Raptor Rescue 2022), but also due to a loss of fitness due to the adverse effects of smoke toxicity. This would be an approximation of at least one bird killed per acre of treatment from direct burning (including young nestlings and fledglings), or by smoke toxicity of young as well as adult birds. Given that many acres will have pre-treatment activities followed by a second round of treatments, the actual bird mortality would be double the identified treatment acres within IRAs.

One would assume that our western forest and arid land birds are so abundant and resilient that loss of several million birds would have no significant population impacts. This is contradicted by the identified population losses of many birds in the Partners in Flight Landbird Conservation Plan (2016). This report identified 3 categories of bird species that are a Watch List. Bird species and their overall population loss levels on the Red Watch List, where conservation actions need to present further declines, include the Belding's Thrasher. Birds on the Yellow "R" Watch List where preventing further declines is the conservation goal include the Flammulated Owl and Gray Vireo (population loss levels are unknown); on the Yellow Watch List "R", which are birds that population recovery is needed, include the following:

Greater Sage Grouse: 67% loss

Long-eared Owl: 91% loss

Rufous Hummingbird: 60% loss

Lewis Woodpecker: 67% loss

Olive-sided Flycatcher: 78% loss

Pinyon Jay: 84% loss

Virginia's Warbler: 38% loss

Grace's Warbler: 52% loss

Black-chinned Hummingbird: 61% loss

Cassin's Finch: 68% loss

Evening Grosbeak: 92% loss

These 2016 population losses are consistent with a more recent report by Rosenberg et al. (2019) where it was noted that North American landbirds have lost over 3 billion birds since the mid-1970s; currently 64.5% of 67 species of western forest birds are in decline, while 56.5% of 62 aridland bird species are in decline.

The planned massive mortality of landbirds occupying the Humboldt-Toiyabe National Forest through slashing and burning a majority of these forests will add to the expected bird mortality that will occur from the ongoing impacts of climate change. During the fall migration of birds in New Mexico in 2020, hundreds of thousands, if not millions of migratory birds died in unprecedented numbers due to a combination of severe extreme weather and a lack of food (D'Amass 2022). Starvation and unexpected weather were to blame for this mortality (USGS 2020); migrating birds entered New Mexico in poor body condition and some birds were already succumbing to starvation; the unusual winter storm exacerbated conditions, causing birds to become disorientated and fly into objects and buildings; some were struck by vehicles and many landed on the ground where cold temperatures, ice and snow and predators killed them.

Slashing and burning of pinyon-juniper woodlands will directly reduce forage for breeding as well as migrating birds. These woodlands produce large crops of pine seeds every 4-5 years, with some trees producing up to 1800 cones per tree of highly nutritious seeds; while junipers produce berry crops every 2-3 years; in a year of a good berry crop, one hectare of juniper may contain between 19 and 38 million berries; a cubic meter of foliage may contain 20,000 berries (Balda and Masters 1980).

There are at least 22 forest bird species that depend upon conifer seeds as forage (Smith and Aldous 1947; Smith and Balda 1979; Dobkin 1992). Thinning out pinon pine and other conifer trees, which may include limber pines, within the Humboldt-Toiyabe National Forest will reduce the forage for all these birds, with corresponding declines in local populations. This will also impact these birds during migration. This adverse impact is another effect that prevents IRAs from providing “reference conditions” for ecosystems, which would of course include bird populations.

Opening pinyon-juniper woodlands will also result in increased summer temperatures and reduced fall-winter temperatures for landbirds. Openings may have temperatures 18 degrees Fahrenheit higher than surrounding forests (Knoss 2022). And more dense forested landscape will have lower temperatures than more open, thinned forests, due to the transpiration of water of trees which cools the air (Milman 2024). And temperature differences between forested and more open areas tend to equalize, to the detriment of more heavily forested landscapes, due to “vegetation breeze” (Lawrence et al. 2022). The impact of increased temperatures on birds is unknown, but there is clearly a potential for high summer heats to exceed the physiological tolerance of many birds, thus reducing their ability to use these areas for breeding. For example, temperatures may exceed the bird’s physiological tolerance, preventing foraging activity. Also, the adverse impact of increased wind disturbances within openings and open forest areas will create additional breeding limitations for birds, such as nests being blown out of trees.

Another adverse impact of the proposed prescribed burning of pinon-juniper woodlands and sagebrush is the increase in Brown-head Cowbirds that occurs with habitat fragmentation. The best way to control for this brood parasite, which can severely reduce breeding success of many birds, is to maintain large unfragmented blocks of more dense forests, as well as sagebrush (Rothstein et al. 1992). Slashing and burning pinon-juniper habitats as well as sagebrush is a prescription for increasing cowbird parasitism. *Id.* This adverse impact would add

to the many other adverse impacts that the prescribed burning proposal will have on landbirds.

There are an estimated 73 species of birds that use pinyon-juniper woodlands (Balda and Masters 1980). For all these birds, including the dozen or more than are identified as a conservation concern, the severe planned degradation of pinyon-juniper woodlands in the Humboldt-Toiyabe forest-wide burning program will clearly exacerbate ongoing declines of a majority of these species. This impact clearly was never identified by the Forest Service, and in turn, this impact was not clearly represented with completion of an Environmental Assessment, a NEPA analysis that requires no significant adverse impacts will occur.

The Forest Service has justified the slashing and burning of pinon-juniper woodlands by claiming that they have become degraded for wildlife because historic fire cycles have been suppressed. This suppression has supposedly resulted in pinon-juniper woodlands that are “too dense” for wildlife. The claim that wildlife values decline as pinon-juniper forests age and increase in density were never actually evaluated in the project’s EA or BE.

Gillihan (2006) in his review of birds in pinon-juniper woodlands discussed the effects of fire in pinyon-juniper forests; he noted the effects are poorly understood; mature pinyons may grow to be 600 years old and mature junipers may surpass 1,000 years. These ages would correspond to the time period these stands last burned. In general, the fire frequency in pinon-juniper woodlands is believed to be quite long, not only due to the age these trees can reach, but due to fire history studies. For example, Bauer and Weisberg (2009) noted that Nevada pinyon-juniper woodlands had an historic fire frequency of 427 years. As such, post-settlement fire control would not have been a factor in current pinyon-juniper forest conditions, where restoration would represent thinning by prescribed.

B. The agency is violating the NEPA by suggesting that birds will be protected from mortality during slashing/burning treatments because surveys will be conducted and buffer areas created around identified active nests; the agency is also violating the Migratory Bird Treaty Act (MBTA) by failing to assure that “beneficial practices” will minimize incidental take of migratory birds.

It is not clear if surveys will be done for various bird species, as design features and implementation schedules note that it will be determined if surveys are required. This conflicts with other claims in these NEPA documents that bird surveys will be done prior to implementation. On its face, claims that birds will be protected during slashing/burning activities is highly implausible. For example, if the agency reaches the goal of burning up to 100,000 acres per year, it would take a massive army of biologists to conduct bird surveys on these acres prior to treatment. At present, the agency is burning only up to several thousand acres a year. Increasing these treatment acres by over 100 times means that survey work would also require a corresponding increase in person-power. As just one example, Clough (2000) reported that location of a goshawk nest required over 300 hours of survey work in Montana. There are 14 bird -species identified as USFWS Birds of Conservation Concern (previously identified in this Objection). It is unclear how many acres can be surveyed for these birds each year prior to burning, as this information was never provided. This lack of specific information being provided to the public as to how birds will be protected from direct mortality during slashing and burning activities is likely why the agency failed to make any estimates of the cumulative bird mortality that will occur from this project, including within IRAs. It is also impossible for the agency to evaluate project impacts on birds based on uncompleted and hypothetical surveys. Conclusions that significant mortality will not occur to birds are also “hypothetical” rather than actual measurements required within NEPA documents. This massive failure of the agency to define the estimated mortality of birds that will be triggered by this project means that agency conclusions of no significant populations impacts will occur to birds is unfounded and arbitrary.

The failure of the Forest Service to demonstrate that surveys will be done for BCC in the proposed treatment areas means that the “take” of songbirds in this project is not legal. Incidental take that is legal is based on the implementation of “beneficial practices” for neotropical migratory birds (USDWS 2020, 2021).

Beneficial practices identified by the USFWS include avoidance of treatments during the maximum bird nesting season from December through August, or if not possible, avoidance of treatments during the minimum bird nesting season from April 1 through July 15 (Id.). If these nesting period cannot be avoided, the USFWS then recommends that bird nesting surveys be conducted in proposed treatment areas and buffers established around known nests through the fledging period. Id. The agency did not note that treatments will be prohibited during either the maximum or minimum nesting period. And as noted, there is no actual assurance that surveys will be done before treatment. The only actual activity the agency claims will be a “beneficial practice” for birds is to burn their habitat in a “mosaic.” There is no reference cited as to why burning in a mosaic constitutes a beneficial practice that reduces mortality to birds. This is an “invented” practice that agency is using in order to burn landbird habitats during their nesting season.

The USFWS identified the recommended buffer and timing periods to protect forest raptors, as developed by Romin and Muck 2002. These timing and buffer recommendations are as follows:

Golden Eagle: 0.5 miles, nesting 1/1-8/1

Northern Goshawk: 0.5 miles, nesting 3/1-8/15

Northern Harrier: 0.5 miles, nesting 4/1-8/15

Cooper’s Hawk: 0.5 miles, nesting 3/15-8/31

Ferruginous Hawk: 0.5 miles, 3/1-8/1

Red-tailed Hawk: 0.5 miles, nesting 3/15-8/15

Sharp-shinned Hawk: 0.5 miles, nesting 3/15-8/31

Swainson's Hawk: 0.5 miles, nesting 3/1-8/31

Boreal Owl: 0.25 miles, nesting 2/1-7/31

Flammulated Owl: 0.25 miles, nesting 4/1-9/30

Great Horned Owl: 0.25 miles, nesting 12/1-9/31

Long-eared Owl: 0.25 miles, nesting 2/1-8/15

Northern Saw-whet Owl: 0.25 miles, nesting 3/1-8/1

Mexican Spotted Owl: 0.5 miles, nesting 3/1-8/31

Northern Pygmy Owl: 0.25 miles, nesting 4/1-8/1

Western Screech Owl: 0.25 miles, nesting 3/1-8/15

It appears to be highly unlikely that any of these forest-woodland raptors will be protected during vegetation treatments within IRAs. This is an example of the reason the Forest Service needs to complete a Forest Plan amendment to evaluate how fuels treatments within IRAs will change ongoing management impacts for these forest raptors, including the sensitive Flammulated Owl and Northern Goshawk, as well as a BCC the Long-eared Owl. Without fuels treatments within IRAs, there will be no impacts on breeding activity for these species across over a million acres of the forest. Implementing a new management regime that will impact breeding activity of these forest raptors due to the unproven and highly questionable ability of the agency to conduct adequate surveys for these raptors on up to 100,000 acres per year. The NEPA documents for this program do not address how these massive increases in personnel to conduct these surveys would be achieved. This is also the case for conducting surveys for songbirds prior to slashing and burning. Mitigation measures for agency activities need to be demonstrated to the public that they will be effective, as per the NEPA. Currently, any mitigation on any wildlife for this proposed project remains highly uncertain. The agency needs to provide much more detail as to how many acres can be effectively surveyed for forest raptors and songbirds each year, and how person-power needs will be met.

C. The agency has failed to identify how this forest-wide slashing/burning program will impact the threatened whitebark pine.

In their 2023 standing analysis of vegetation management impacts to whitebark pine, a threatened species, the USFWS identified a number of management concerns that vegetation treatments would have on this species, which would include slashing and burning within stands of whitebark pine. One impact would be the removal of roughly 40 years of recruitment, which would be seedlings up to 29 years of age, and saplings from 29-40 years of age. These seedlings and saplings would generally be killed via slashing and burning activities. This mortality from treatment was noted for a proposed project on the Shoshoni National Forest, with millions of seedlings and saplings estimated to be killed via slashing and burning activities (USDA 2024). The USFWS also noted that removing competing conifers from whitebark pine stands likely increases their eventual attack by pine bark beetles, who attack fast-growing older trees. This report also noted that Clark's Nutcrackers cache 85% of whitebark pine seeds in trees, rather on the ground. So opening whitebark pine stands will generally not create caching sites for their seeds by this nutcracker. Finally, the loss of 40 years of whitebark pine recruitment will also eliminate the genetic diversity that exists within these seedlings and saplings. So the destruction of whitebark pine seedlings and saplings will not do what the Forest Service slashing and burning will do, or restore these stands and increase their resilience. Without an understory, a whitebark pine will have less, not more resilience. Added to this loss of resilience will be the increased likelihood of bark beetle mortality. There will also likely be many mature whitebark pine trees that will be killed via prescribed burning, as this conifer is the most sensitive to fire out of 29 conifer species (Id). In conclusion, the implementation of vast fuels treatments within IRAs will have a severe adverse impact on whitebark pine, which is contrary to the purpose of these IRAs as reference, undisturbed areas as opposed to the impacts of management actions across roaded portions of the forests.

D. The agency did not define how the proposed fuels treatments will impact old growth pinon-juniper woodlands; the killing of large, old trees of pinon pine and juniper is a violation of the Roadless Area Rule for killing of generally small diameter trees.

The pinon-juniper old growth stands in the Intermountain Region have been defined by Hamilton (1993). These stands are defined as having at least 12 trees per acre over 12 inches dbh on low productivity sites, and 30 or more trees per acre of 18 inches dbh or greater on high productivity sites; minimum canopy cover for these sites is 15-35%, respectively. Snags per acre should be 12-15 inches, respectively, at 1 per acre. Ages of oldest trees should be 200-250 years, respectively. The agency did not define how many acres of pinon-juniper old growth would be slashed and burned, and thus eliminated as old growth. It is unclear if the 10% old growth requirement will be met within this ecosystem. If trees 12 inches dbh are burned and killed, this is a violation of the Roadless Area Rule.

E. The agency did not demonstrate that only small dbh trees will be cut during slashing activities.

The Roadless Area Rule requires that only small dbh trees are cut during vegetation treatments. The Forest-wide prescribed fire NEPA documents do not demonstrate that slashing activities will be limited to small dbh trees. Killing of larger trees would be commensurate to cutting them down. The agency did not demonstrate that trees at 12 inches dbh or larger will not be killed with burning.

F. The agency did not demonstrate that treatment of mule deer winter ranges will improve winter forage and habitat quality.

The total acres of big game winter range to be slashing and burned is unclear. What is clear is that these activities will be detrimental to mule deer, as they depend upon junipers on winter range for hiding and thermal cover (Coe et al. 2019).

F. The agency did not define what the expected increase will be for the annual invasive cheatgrass, or why this represents habitat restoration within IRAs or addresses the ongoing crisis of cheatgrass infestations across western public lands; there was no action alternative that addresses this crisis.

The agency acknowledges that cheatgrass will increase within all treatment areas. The expected acreage increase, however, is never evaluated. There is no discussion in these NEPA documents as to the growing crisis of massive cheatgrass infestations across the western U.S. AS per a report in 2024 (High Country News 2024), there are over 31.3 million acres of cheatgrass infestations across this western forest landscape. What is clear is that this invasive annual has not been successfully controlled, and as such, there is no possibility that the massive increases in cheatgrass infestations that will result from slashing and burning millions of acres on the Humboldt-Toiyabe National Forests will be controlled as well. This crisis is also contributing to the increased fire frequency on western public lands, a crisis that is being exacerbated by fuels treatments. The contradiction between actual and claimed impacts of fuels reduction treatments on the Humboldt-Toiyabe National Forest is clearly not just a violation of the Roadless Area Rule, but as well, is a violation of the NEPA and Administrative Procedures Act (APA) because there is no rationale connection between the claimed project benefits to reduce fires, and the actual impact which will increase fires due to increases in cheatgrass.

Attachment #1 for the Objection filed against the Forest-wide Prescribed Fire Restoration Project on the Humboldt and Toiyabe National Forests by NEC et al. on June 4, 2025.

Attachment #1 contains relevant portions of literature and/or reports cited in the Objection, including:

Balda, R. and N. Masters. 1980. Avian communities in the pinyon-juniper woodland: a descriptive analysis. Pages 146-168 in Proceedings of a symposium on the management of western forest and grasslands for nongame birds. INT-GTR-96.

Bauer, J. and P. Weisberg. 2009. Fire history of a central Nevada pinyon-juniper woodland. Can. J. Forestry 39:1589-1599.

Clough, L. 2000. Nesting habitat selection and productivity of Northern Goshawks in West-central Montana. MS Thesis, University of Montana.

Coe, P., D. Clark, R. Neilson, S. Gregory, J. Cupples, M. Hedrick, B. Johnson, and D. Jackson. 2019. Multiscale models of habitat use by mule deer in winter.

D'Ammassa, A. 2020. 'Hundreds of thousands, if not millions'" New Mexico sees massive migratory bird deaths. Las Cruces Sun-News September 12, 2020.

Defiance Canyon Raptor Rescue. 2022. Cal fire burns next to Bald Eagle nest, eaglets die. Daily Kos April 15, 2022.

Dobkin, D. 1992. Neotropical migrant landbirds in the Northern Rockies and Great Plains" a handbook for conservation and management. USDA Forest Service, Northern Region.

Gillihan, C. 2006. Sharing the land with pinyon-juniper birds. Partners in Flight Western Working Group, Salt Lake City, UT.

Hamilton, R. 1993. Characteristics of old-growth forests in the Intermountain Region. USDA Forest Service, Intermountain Region.

High Country News. 2024. 31.3 million acres of cheatgrass domination on western U.S. lands.

Knoss, T. 2016. Temperature changes wreak havoc in deforested areas. Colorado Arts and Sciences Magazine. 2/22/16.

Lawrence, D. M. Coe, W. Walker, L. Verchot, and K. Vandecar. 2022. The unseen effects of deforestation: biophysical effects on climate. Frontiers in Forests and Global Change, volume 5, article 756115.

Milman, O. 2024. Very cool: trees stalling effects of global heating in eastern US, Study finds. The Guardian 2/14/24.

North American Bird Conservation Initiative. 2022. State of the Birds Report, United States of America. Stateofthebirds.org.

Parks, N. 2009. On the track of the elusive wolverine. Science Findings 114, July 2009. USDA Forest Service, Pacific Northwest Research Station.

Partners in Flight Landbird Conservation Plan. 2016. Species of continental concern.

Robinson, S., J. Grzybowski, S. Rothstein, M. Brittingham, L. Petit, and F. Thompson. 1992. Management implications of cowbird parasitism on neotropical migrant songbirds. Pages 93-103 in Proceedings of a symposium on the status and management of neotropical migratory birds. USDA Forest Service Gen. Techn. Report RM-229.

Rosenberg, K., A. Dokter, P. Blancher, J. Sauer, A. Smith, P. Smith, J. Stanton, A. Panjabi, L. Helft, M. Parr, and P. Marra. 2019. Decline of the North American avifauna. Science September 2019. www.sciencemag.org.

Romin, L. and J. Muck. 2002. Utah field office guidelines for raptor protection from human and land use disturbances. USFWS, Utah Field Office, January 2002 update.

Smith, C. and S. Aldous. 1947. The influence of mammals and birds in retarding artificial and natural reseeding of coniferous forests in the United States. Journal of Forestry 45:361-369.

Smith, C. and R. Balda. 1979. Competition among insects, birds and mammals for conifer seeds. American Zoologist 19: 1065-1083.

Somershoe, S., E. Ammo, J. Boone, K. Johnson, M. Witt, and E. Duvuryei. 2020. Conservation strategy for the Pinyon Jay (*Gymnorhinus cyanocephalus*). Partners in Flight Western Working Groups and USFWS.

USDA. 2024. Green Union draft Environmental Assessment. USDA Forest Service, Shoshoni National Forest.

USFWS. 2020. Project recommendations for migratory bird conservation, U.S. Fish and Wildlife Service, Utah Field Office, May 2020.

USFWS. 2021. Director's Order No.225. 2021. Incidental take of migratory birds.

USFWS. 2021. Birds of conservation concern. 2021: migratory bird program.

USFWS. 2022. 90-day finding petition review form listing as a threatened or an endangered species: evaluation of a petition to list the Pinyon Jay as an endangered or a threatened species under the act. .

USFWS. 2023. Standing analysis for effects to whitebark pine (*Pinus albicaulis*) from low effect projects and whitebark pine restoration and recovery activities within Montana and Wyoming.

USGS. 2020. Starvation, unexpected weather to blame in mass migratory songbird mortality. U.S. Geological Survey National Wildlife Health Center.

In DeGraff, R. & N. Tilghman, Eds.
1980. Workshop Proceedings:
Mngt of Western Forests &
Grasslands for nongame birds
SL City ~~Ogden~~, UT Feb 11-14.
Intermt. F & R Exp. Stn.
INT-CTR-86.

AVIAN COMMUNITIES IN THE PINYON-JUNIPER WOODLAND:

A DESCRIPTIVE ANALYSIS

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ABSTRACT

The expansive range and elevational distribution of the pinyon-juniper woodland in the western United States contributes to the wide variety of forms of this habitat type. Similarly, the breeding-bird community expresses this variety. A total of at least 73 different bird species are known to breed here. About 31 of these species breed with regularity in pinyon-juniper woodlands. Only about 5 of these species are restricted to this habitat type. Usually less than half of the breeders are permanent residents. A high proportion of the breeding birds forage for seeds or insects on the ground. The number of species that breed in cavities and/or forage on trunks and branches is positively correlated with pinyon pine density. Seasonal densities of breeding birds vary greatly depending on annual fluctuations in precipitation and seed and berry production. Winter diversity and density is strongly correlated with juniper berry production. Both junipers and pinyons show an adaptive suite of characters for dispersal by birds.

KEYWORDS: pinyon pine, juniper, avifauna, guilds, diversity, density, breeding-birds, winter birds.

The pinyon-juniper woodland could be labeled the characteristic habitat-type of the southwest because of its expansive range.

Extending over large areas of Arizona, Colorado, Nevada, New Mexico, and Utah it occupies somewhere between 43 and 76 million acres of land in the West. In New Mexico alone the woodland covers over 32,000 square miles or 26 percent of the state (Pieper 1977). The woodland stretches from the east slope of the Sierras to Oklahoma and from Oregon to Texas and into Mexico. It is the common vegetation-type of the foothills, low mountains, escarpments, and mesas of the southwest (Fig. 1). Throughout its range this "pygmy forest" shows broad tolerance limits ranging in elevation from a high of 10,000 ft. in the Sierras to a low of 3200 ft. in the four corners area, with junipers alone extending even lower in many areas (West et al. 1975). It is found on a variety of soils derived from granite, basalt, limestone, and mixed alluvium (Hurst 1975).

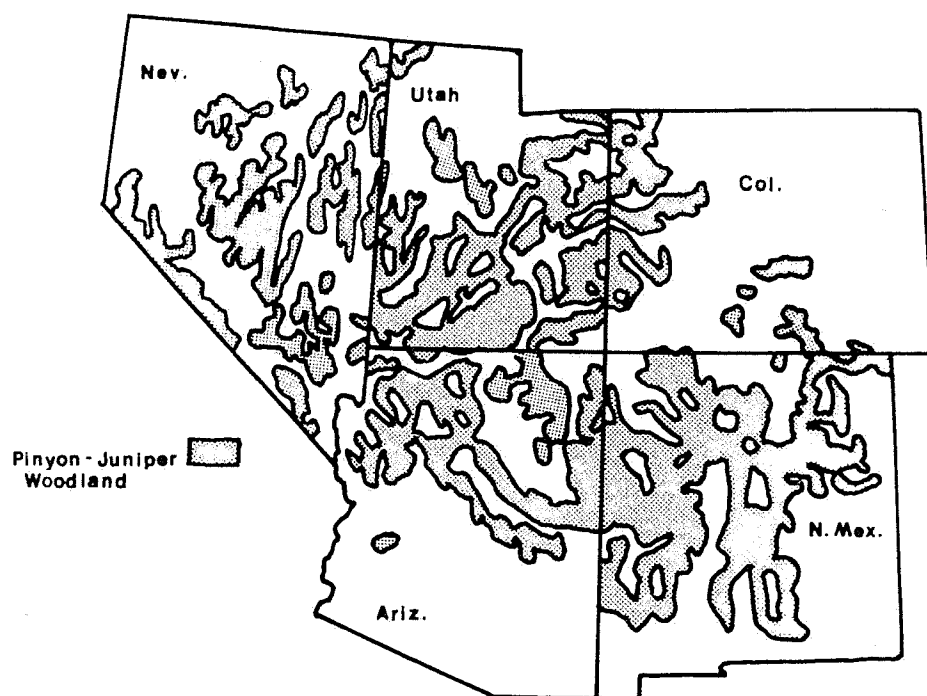


Figure 1. The distribution of pinyon-juniper woodland in the five western states where it is most abundant (From Clary 1975).

The major trees of this woodland consist of four species of junipers, Juniperus occidentalis, J. deppeana, J. monosperma and J. osteosperma. The latter species is the most wide-spread of the junipers. The two most common pinyon pines are Pinus monophylla and P. edulis with the latter species having the most extensive distribution. The dominant trees of the area are relatively small (hence the name pygmy forest) ranging in height from 15-40 ft. with individual trees having dense foliage. In general the junipers are more drought-resistant than pinyon pines and therefore occur in highest densities at lower elevations, whereas, pinyon pines become more abundant at higher elevations in this woodland (Short and

McCulloch 1977). The density of these trees varies from very sparse to very dense depending on elevation, climate, and soil type. Total plant cover increases with elevation up to about 6600 ft. (Tueller et al. 1979).

The understory vegetation of the pinyon-juniper woodland is highly variable depending on soil type, exposure, and climatic pattern. Tueller et al. (1979) lists 240 positively identified species of vascular plants from the Great Basin pinyon-juniper woodlands. The list includes 67 species of shrubs and succulents, 46 grasses, and 122 forbs that grow under pinyon and juniper trees. Major shrubs include sagebrush (*Artemisia* sp.), bitterbrush (*Purshia tridentata*), rabbitbrush (*Chrysothamnus* sp.), and various species of oaks (*Quercus* spp.). Few of these species are found growing in association with one another, as the understory is reasonably depaupered. None of the shrubs, succulents, grasses or forbs are listed as rare and endangered and none are restricted to this vegetation type. Most woodlands contain only a few of these species. Thus, plant species diversity (as well as density) is reasonably low compared to other vegetation types in the southwest.

The climate of this vegetation-type can be summarized as being rather severe with hot summers, cold winters, low amounts of precipitation in the form of rain and snow, low relative humidity and high winds. Mean daily maximum temperatures for the hottest month of the year vary from 26°C to 36°C. Total yearly precipitation varies between 8 and 18 inches (West et al. 1975).

The lower limits of this woodland now mingle with grassland, desert scrub, Great Basin Desert or shrublands in different parts of its range. Because of climatic cycles (cool, moist to hot, dry) this lower boundary has been very active during the last 10,000 years (Martin and Mehringer 1964, Wright et al. 1973, Wells and Berger 1967). Evidence from pollen deposits, sloth dung, and wood rat middens indicate a considerable lowering of this boundary. This depression caused isolated areas of the woodland to come into contact with other such areas thus increasing the potential for redistribution of the flora and fauna. The return of a warmer, drier climate caused an upward retreat leaving behind isolated relict pockets of pinyon-juniper woodland, with its faunal components.

Even though early settlers heavily used pinyons and junipers for mine props, fence posts, and fuel, during the last 130 years the vegetation type is undergoing an expansion into low shrublands, grasslands and Great Basin Deserts (West et al. 1975). At the same time the density of trees in more permanent stands is also increasing. Numerous causes have been proposed to explain this increase, but the major culprit seems to be overgrazing by cattle and sheep (Aro 1971). Improper grazing has reduced forage production thereby releasing the trees from competition with the herbs and shrubs. Johnsen (1962) believes the spread of juniper in northern Arizona is due to the increased spread of seeds by livestock, lack of periodic fire, overgrazing which reduces competition of grasses with juniper seedlings, and a gradually changing climate which favors the spread of juniper. La Marche (1974) presents evidence that the period from 1850 to 1940 was wetter and warmer than the period before or after this.

It is evident that this woodland as a whole is an extremely complex, variable community. As stated by West et al. (1975), "Early attempts to explain distribution, composition, successional changes, and management responses in terms of single factors were overly simplistic. These variations can be better explained in terms of a complex of environmental patterns, historical events, and successional mechanisms. The relative importance of each factor of the environmental complex varies with the synecological context."

A major characteristic of this woodland as far as birds are concerned is the periodic production of vast quantities of pinyon pine seeds and juniper berries. Large crops of pine seeds are produced once every five or six years whereas juniper berry production occurs every two to three years. In many years neither tree forms reproductive propagules. Both life-forms appear to have intra-specific synchrony. For example, in a year of a good berry crop, one hectare contains between 19 and 38 million berries. A cubic meter of foliage holds 20,000 berries. The number declines steadily through the late fall and winter as birds and mammals consume them. The flesh of a single berry has about 315 calories making it a desirable source of energy. The berries are a shiny blue in color making them conspicuous; they ripen in the fall when insects are sparse and bird densities are high due to migration (Salomonson 1978). Thus junipers have adaptations favoring zoochory (Morton 1973). The pinyon pine also has a constellation of adaptations that favor dispersal by animals, especially birds (Table 1) (Vander Wall and Balda 1977). This pine not only allows animals easy access to its seeds but may entice dispersal agents. This means the seeds are easily located, extracted from the cones and eaten or cached for future use (Vander Wall and Balda 1977, Ligon 1978). More *Pinus edulis* seeds are cached in dry, exposed soils than can be used by the birds in years of high cone crops. In some years, pinyon pines produce absolutely no cones per hectare (Balda, unpubl. data), whereas in other years they may produce as many as 1800 cones/tree (Ligon 1971). These seeds are extremely nutritious, containing about 7400 cal/g (Little 1938). A pinyon pine seed contains 14.5 percent protein, 60 percent fat, and 18.7 percent carbohydrate (Botkin and Shires 1948). The large size, high energy content, and high protein level makes this seed a highly desirable food stuff.

Management of pinyon-juniper woodlands since the mid-40's has largely consisted of control of the spread of junipers (and in some cases pinyon) into grasslands and type-conversion of pinyon-juniper woodlands into grazing lands. Both eradication of the type and control has been justified on public lands because the trees are generally considered as of low commercial value relative to other harvestable trees of the West. During the period 1950 to 1964 Box et al. (1966) estimate that approximately three million acres of pinyon-juniper woodland were converted to grazing lands. Between 1950 and 1961, more than one million acres were converted in Arizona alone (Arnold et al. 1964).

The major objective of most type-conversion projects, often referred to as "Range Improvement Projects" is to produce additional forage for livestock (Terrel and Spillett 1975). These conversions represent "a change from multiple use to one use, grazing" (Little 1977). Land managers today are going through a period of cautious

soul-searching about how to proceed with management on these lands. This treatment has not been popular, leaves the area an aesthetic diaster, has questionably proven long range benefits and "Most questions concerning wildlife and pinyon-juniper range conversion are unanswered and probably will remain so." (Terrel and Spillett 1975). The best synopsis of pinyon-juniper management and guidelines for future use can be found in a symposium edited by Gifford and Busby (1975).

TABLE 1. Features of pines with different dispersal strategies

Characteristic	<u>P. ponderosa</u> (wind)	<u>P. edulis</u> (animal)
Seed size	small	large
Seed conspicuous	no	yes
Seed quickly released	yes	no
Seed coat labelled	no	yes
Synchronous cone opening	yes	no
Position of cone	down, out	up, out
Cone scales	present	absent

BREEDING BIRDS

A total of 73 different species of birds are reported to breed in pinyon-juniper woodlands (Table 2). Undoubtedly more records are known but these will most often be rare or unusual occurrences. These 73 species are taxonomically aligned in 8 orders and 25 families. Because of the geographic area span by this plant community and the wide physiognomic variety (over its range), no one area contains near this breeding diversity. For example, in north-central Arizona 5 pinyon-juniper plots were sampled intensively during two breeding seasons (Grue 1977, Masters 1979) and the number of breeding species per 40 ha plot ranged from 12 to 24 and averaged 19 species. Rasmussen (1941) reports 43 species inhabiting the pinyon-juniper woodland on the Kaibab Plateau in summer but has good evidence for breeding by only 12 species. Hardy (1945) lists 22 species as regular breeders in Utah pinyon-juniper woodlands whereas Hering (1957) reports 15 breeding species.

Relatively few of the 73 species are restricted to pinyon-juniper woodland. Table 2 lists 5 obligates and 13 semi-obligates. An obligatory species is defined for purposes of this presentation as one which nests only in pinyon-juniper woodland within a geographic area that contains other habitat types. A semi-obligatory species may nest in one additional plant community. This definition is knowingly broad as most of these species nest in different habitat types in portions of their range where pinyon-juniper woodland is absent. Hardy (1945) mentions only the Piñon Jay and Plain Titmouse as being obligatory ^{1/} and the Bushtit as a semi-obligatory species in this woodland type. But, the Piñon Jay often nests and forages in ponderosa pine forest (Balda and Bateman 1971) and the Bushtit is also known to use other habitats.

^{1/} Scientific names for all birds mentioned in the text or tables are given in Appendix I.

TABLE 2. Breeding birds of pinyon-juniper woodlands¹⁾

Species	Status ²⁾	Distribution ³⁾	Niche Width ⁴⁾
Turkey Vulture✓	S	4	
Cooper's Hawk✓	p	2	
Red-tailed Hawk✓	p	4	
Swainson's Hawk✓	S	1	
Ferruginous Hawk✓	p	2	
Golden Eagle✓	p	3 (Sp.)	
Prairie Falcon✓	p	2 (Sp.)	
American Kestrel✓	p-S	4	
Gambel's Quail	p	2	
Mourning Dove✓	p-S	7	
Screech Owl✓	p	3	obligatory
Great Horned Owl✓	p	3	
Long-eared Owl✓	S	1	
Saw-whet Owl✓	p	1	
Poor-will✓	S	2	
Common Nighthawk✓	S	3	
Lesser Nighthawk	S	2	
White-throated Swift✓	S	2 (Sp.)	
Black-chinned Hummingbird	S	4	semi-obligatory
Costa's Hummingbird	S	1	
Broad-tailed Hummingbird	S	3	
Common (red-shafted) Flicker✓	p	6	
Hairy Woodpecker✓	p	4	
Ladder-backed Woodpecker	p	1	
Western Kingbird	S	1	
Cassin's Kingbird	S	2	
Ash-throated Flycatcher	S	7	semi-obligatory
Say's Phoebe	S	2	
Gray Flycatcher	S	2	obligatory
Western Wood Pewee✓	S	1	
Violet-green Swallow✓	S	2	
Cliff Swallow✓	S	1 (Sp.)	
Scrub Jay	p	6	obligatory
Black-billed Magpie✓	p	2	
Common Raven✓	p	6	
Pinon Jay✓	p	5	semi-obligatory
Mountain Chickadee✓	p	3	
Plain Titmouse	p	7	obligatory
Bushtit	p	6	semi-obligatory
White-breasted Nuthatch✓	p	3	
House Wren✓	S	1	
Bewick's Wren	p-S	3	semi-obligatory
Cañon Wren✓	p-S	3 (Sp.)	
Rock Wren✓	p-S	4	
Mockingbird	S	4	semi-obligatory
American Robin✓	p-S	1	
Western Bluebird✓	p-S	1	
Mountain Bluebird✓	p-S	4	
Blue-gray Gnatcatcher	S	5	semi-obligatory
Loggerhead Shrike✓	S	2	

30
15
5

TABLE 2. (cont.)

<u>Species</u>	<u>Status</u> ²⁾	<u>Distribution</u> ³⁾	<u>Niche Width</u> ⁴⁾
Gray Vireo	S	3	obligatory
Solitary Vireo ✓	S	2	
Black-throated Gray Warbler	S	5	semi-obligatory
Scott's Oriole	S	3	
Brown-headed Cowbird ✓	S	4	
Hepatic Tanager	S	1	
Black-headed Grosbeak ✓	S	5	
Lazuli Bunting ✓	S	2	
Cassin's Finch ✓	S	1	
House Finch ✓	P-S	5	semi-obligatory
Lesser Goldfinch	S	2	
Red Crossbill ✓	S	1	
Green-tailed Towhee ✓	S	2	
Rufous-sided Towhee ✓	P	6	semi-obligatory
Brown Towhee	P	2	semi-obligatory
Vesper Sparrow ✓	P-S	2	
Lark Sparrow ✓	S	4	semi-obligatory
Black-throated Sparrow	P-S	3	
Sage Sparrow	S	1	
Dark-eyed Junco ✓	S	1	
Gray-headed Junco	P-S	1	
Chipping Sparrow ✓	P-S	6	
Brewer's Sparrow ✓	S	1	
Black-chinned Sparrow	P	2	semi-obligatory
Total: n = 74	P = 23 (32%) S = 38 (51%) P-S = 13 (17%)	s-o = 13 o = 5	

- 1) Data from Rasmussen (1941), Hardy (1945), Miller (1946), Hering (1957), Grue (1977), Masters (1979)
- 2) P = permanent resident; S = summer resident
- 3) The number indicates the number of census plots or study areas used for breeding. The maximum is 7. Sp. = special landscape required.
- 4) Obligatory = in a given geographic area the species breeds only in the pinyon-juniper woodland; semi-obligatory = same as above but breeds in one additional plant community.

Few, if any other natural habitat-types in North America have so few truly obligatory species. The reason(s) such should be the case is not clear but may relate to the great physiognomic diversity found in the pinyon-juniper woodland. Just as there is no typical pinyon-juniper woodland there are few obligate pinyon-juniper birds.

Just as the number of breeding species varies between woodlands so does breeding bird density. In southwestern Arizona where many oaks are found in the woodlands breeding bird density may reach 250 pairs per 40 ha (Balda 1967). This density is seldom if ever reached in the pinyon-juniper woodland where densities vary between 30 and 190 pairs

per 40 ha (Table 3). Ninety-five pairs is about an average figure. Grasslands usually have fewer breeding pairs and ponderosa pine forests more than the pinyon-juniper woodland.

TABLE 3. Characteristics of the avian woodland breeding birds

Study	Habitat	No. of Breeding Species	No. of Breeding Pairs/40 ha
Balda, 1967	oak-juniper	36	224
Balda, 1967	oak-juniper-pine	36	267
Grue, 1977	juniper-parkland	17-23	54-179
Beatty, 1978	juniper-grassland	11-12	35-40
Grue, 1977	juniper-pinyon	24-26	66-130
Masters, 1979	pinyon-juniper I	9-10	90-87
Masters, 1979	pinyon-juniper II	18-21	191-138
Masters, 1979	pinyon-juniper III	19-19	122-133
Hering, 1957	pinyon-juniper (?)	15	33
Seidleman, 1960	pinyon-juniper	2	30
Hardy, 1945	pinyon-juniper	22	--
Miller, 1946	pinyon dominated	55	--

Breeding bird densities in a single location show rather large annual fluctuations that appear to be linked to biotic and physical factors. In very dry years the breeding bird populations may be reduced between 50 and 70% (Grue 1977). Possibly pinyon pine seed crops may attract breeding birds the next spring. Masters (1979) found a 28% increase in populations after a large cone crop (Table 4).

Table 4. Changes in breeding bird densities (pairs/40 ha) and diversities between years

Study	First Year Density/Diversity	Second Year Density/Diversity	%Change	Reason
Masters, 1979	191/21	138/18	28/14	Pinon seed crop before first year
Grue, 1977	130/26	66/24	49/8	Annual fluctuation in precipitation
Grue, 1977	179/23	54/17	70/26	Same as above

Masters (1979) attempted to explain the relationship between various habitat parameters and characteristics of the breeding bird

fauna. At the level of the community, she found that the number of breeding bird species was significantly correlated with a) the density of pinyon pine, b) total tree density and c) pinyon pine foliage volume. Foliage height diversity (as measured in two-meter height classes) was a significant predictor of bird species diversity. Breeding bird density was significantly correlated with pinyon pine density when the bird population figures following a large pinyon pine cone crop are ignored.

A "typical avifauna" of the pinyon-juniper woodland thus appears to be as simplistic an approach as trying to describe a typical vegetation for this woodland type. Never-the-less we have selected from the list of 74 breeding species a group that has a distribution score (Table 2) of four or higher and/or is listed as obligatory or semi-obligatory in niche width. A major danger here is that two closely related species may be sympatric and thus neither would have achieved the criteria for inclusion. Such could have been the case for nighthawks, kingbirds, hummingbirds, bluebirds, medium-billed sparrows and a few other cases. In these instances the most common of the dyad or triad was added to the list to make it as representative as possible. From Table 2, 29 species met the first criteria and the nighthawk and kingbird were added for reasons given above.

Resident Status

Of the 31 species that fit our "typical avifauna" criteria 14 (45%) are summer residents and 11 (35%) are permanent residents. Six species show variable patterns of residency either based on geographic considerations (i.e. summer residents in the northern portion of their range and permanent residents in the more southern areas) or variable weather conditions (i.e. migrate in harsh winter, remain stationary in mild winters). Hardy (1945) in eastern Utah described 36% of the nesting species as permanent residents and 64% as summer residents, almost identical to our typical avifauna if one includes the "switchers" in the summer category.

Data from intensively censused plots in central Arizona over a two year period showed about the same split as does the Utah data (Grue 1977). The proportion of permanent resident species ranged from 35 to 40%.

In north-central Arizona however, Masters (1979) censusing three pinyon-juniper plots for two years found a range of permanent resident breeders from 32 to 56% (Table 5), and Hering (1957) near Mesa Verde, Colorado had 53% permanent residents. One could expect permanent residency to increase in the woodlands with decreasing latitudes but such an increase is not apparent from either the proportion of the breeding population that is permanent or the absolute number of species that do so. On both of Masters' (1979) plots with proportion of permanent residence above 50% the ratio of pinyon to juniper trees was better than 2:1. (Hardy's 1945 ratio was 0.36 to 1). Hering (1957) did not provide the necessary data to assess this habitat feature but the general area of her study contains high densities of P. edulis (pers. obs. R. P. Balda). Of the 55 species of breeding birds (a woodland high!) listed by Miller (1946) in a southern California woodland predominated by pinyon pine, 27 species or 49% were apparently permanent residents. Two areas without pinyons had 33 and 35%

permanent resident breeders. Thus, we suggest with caution that a positive correlation may exist between the proportion of permanent residents in the community and the proportion of trees in the woodland that are pinyon pines. In all probability no one factor will answer the question, but this one does deserve future investigation. Of the 18 species listed as either obligatory or semi-obligatory in this woodland 8 are permanent residents.

Table 5. Residence status of breeding birds from specific sites in north-central Arizona (Masters 1979)

Status	Number of Species (%)		
	Sites		
	I	II	III
Permanent Resident	3.0* (32)	8.0 (53)	7.5 (56)
Summer Resident	6.5 (68)	7.0 (47)	6.0 (44)

* 2 yr. average

Foraging Guilds

An instructive way to look at avian communities is the use of foraging guilds (Root 1967). A guild is defined as one or more species in a community that use similar foraging techniques. Guilds can be defined as broadly or narrowly as the observations and data base permit. Here for the sake of simplicity and accuracy (but sacrificing specifics) I define foraging guilds only by substrate-type. This is done because very little information is known about the species under consideration to allow for finer distinctions. Foraging guilds used include ground, foliage, air, bark, and flowers. If a species used two of these substrates I assigned half the value to each guild.

The descriptive analysis from nine different intensively studied woodland sites shows few trends. The number of ground foragers varied from 6 (Hering 1957) to 16 (Grue 1977) species. Relative proportions of ground foragers varied between 40% (Hering 1957) and 57% (Grue 1977). No significant correlation (Spearman Rank Correlation) between the density of pinyon pine or juniper and either the number or proportion of ground foraging species was found.

The number of foliage foragers in the breeding community varied from a low of three in a juniper-grassland (Beatty 1978) to a high of 12 in a predominantly pinyon pine stand. The mean number of species that used foliage as a substrate where both pinyon and junipers were represented was 5. The number or proportion of foliage foraging species showed no significant correlation with pinyon or juniper density.

The number of species of hummingbirds (nectar feeders) also shows no correlation with tree species density. Hummingbirds most likely respond more to the species composition and flowering patterns of the shrub and forb strata which may be limited by physical factors (temperature, moisture, etc.).

There is also no trend for aerial feeders. Aerial foraging species number between 1 (Hering 1957) and 9 (Miller 1946). On areas containing both pinyon and junipers the mean number of aerial feeders was 4.

In some woodlands a small group of breeding species forage extensively on trunks and large branches. In no intensive study area analyzed for this report where the ratio of pinyon to junipers was less than 1:1 did any of these species breed. Where pinyons outnumbered junipers by 2:1 or better two species appeared. Almost invariably these two species were the Hairy Woodpecker and White-breasted Nuthatch. The former species obtains insects by hammering holes through the bark or flaking layers of bark off in small plates. The latter species probes the crevices in the bark to obtain insects. Both species reach higher densities in ponderosa pine forests (Szaro and Balda 1979) than in the woodlands. Either there are more insects in, under, and on pinyon pine bark than juniper or the bark pattern is such that insects are easily extracted.

The "typical avifauna" for pinyon-juniper woodlands has a slightly higher number of ground and foliage foragers than the studies described above (Table 6). This probably occurred because our selected sample of birds is slightly larger than would be found in any one woodland area.

Table 6. Foraging Guilds for a "typical pinyon-juniper woodland"

Guild	* Number of Breeding Species (%)	
Ground	14.5	(52)
Foliage	7.0	(24)
Aerial	4.5	(16)
Bark	1.0	(4)
Flower	1.0	(4)
*Carnivores not included		

The above analysis has dealt solely with numbers of species because of the high year-to-year variability in densities. Master's (1979) regression models to predict characteristics of the bird populations included foraging guilds. Eight independent foliage variables were used. Pinyon density was significantly correlated with densities of aerial feeders, bark feeders, and total density of all insectivorous birds (Table 7). No variable contributed solely by junipers was important as a predictor of any of the breeding bird characteristics measured. Why the above result should occur is not immediately obvious but suggests pinyon pine may provide a more suitable foraging substrate than juniper.

Only fragmentary data exists to support the contention that juniper is less attractive as a foraging substrate than is pinyon pine. In an oak-juniper-pine (Pinus cembroides and P. leiophylla) woodland in southeastern Arizona, Balda (1969) studied foliage use by the 36 breeding species. The number of observations in each tree species were compared to the foliage volume contributed by each tree species. Based on foliage volume an expected number of bird observations per tree species was calculated. Actual foraging

observations in juniper were far less than expected, whereas foraging observations in pines were much greater than expected. At that time Balda proposed that the breeding birds may simply have not yet learned to use juniper as it is known that juniper is presently spreading into new areas and increasing in areas where it was once sparse. The Black-throated Gray Warbler, Chipping Sparrow, Bridled Titmouse and Common Bushtit utilized juniper more than any other species. Three of the four species listed above are members of our "typical woodland avifauna." In a pinyon-juniper-ponderosa pine ecotone Laudenslayer and Balda (1976) found that pinyon pine was selected more intensely than predicted by expected numbers generated from foliage volume. Juniper was selected approximately as often as expected. We explained this difference by using the relative proportion of foraging surface within both trees. Although both species have their green foliage concentrated on the outer edges of the branches, needles of pinyon pine are found growing farther inward than in juniper. Thus, if the growing areas and areas of green vegetation on these trees are used as prime foraging surfaces then pinyon provides more of this surface per tree than does juniper.

Table 7. Percent variability explained (r^2) of breeding bird parameters by vegetation factors which are significantly correlated (Masters 1979)

Factor	Density of Feeding Guilds		
	Aerial Feeders	Bark Feeders	Insectivores
Pinyon Pine Density	.980	.781	.949
Total Tree Density	.979	.776	.947
Pinyon Foliage Volume	.902	NS	.834

Insect densities in pinyons and junipers may also be a reason why pinyon density is a good predictor of density of insect eating birds. Masters (1979) found, however, that junipers had a higher number of insect taxa than did pinyon. Insect abundance (as measured by total length) was about the same in both trees. The similarity coefficient (a measure of community similarity) indicated that pinyon and juniper have different arthropod faunas associated with them.

Nesting Guilds

The classification of the avian community by nesting habits may also provide clues as to how breeding birds interact with the structure of the vegetation. Of the 31 species used as a "typical avifauna" 60% (18.5) nested in foliage (the 0.5 is for the Mourning Dove that uses both foliage and ground for a nest substrate), 23% (7) used cavities and the remainder nest on the ground. Hardy's data (1945) fits well with 61% of the breeding birds nesting in the foliage, 21% in cavities, and 18% of the species nesting on the ground.

On two intensively studied plots in central Arizona Grue (1977)

found an average of from 60 to 68% foliage nesting species in the breeding bird community. From 15 to 20% of the species nested in cavities. Again the fit is reasonable with what a "typical avifauna" would show (Table 8).

Table 8. Nesting guilds of breeding birds from specific sites in central Arizona (Grue 1977)

Nesting Guild	Number of Species (%)	
	Pinyon-Juniper Woodland	Juniper Parkland
Foliage	16.5* (66)	14.0 (68)
Cavity	5.0 (20)	3.0 (15)
Ground	3.5 (14)	3.5 (17)
Total	25.0	20.5

* 2 yr. averages

In north-central Arizona Master's (1979) found cavity nesters to make up almost half of the breeding species on areas where pinyons outnumbered junipers (Table 9). Hering (1957) found cavity nesting species made up 47% of the breeding species on an area of presumable high pinyon densities. Both studies had 7 to 8 cavity nesting species present. The pinyon dominated woodland in California (Miller 1946) contained 11 cavity nesting species.

Table 9. Nesting guilds of breeding birds from specific sites in north-central Arizona (Masters 1979)

Nesting Guild	Number of Species (%)		
	I	II	III
Foliage	7.0* (74)	7.5 (50)	6.5 (48)
Cavity	2.0 (21)	7.0 (47)	6.5 (48)
Ground	0.5 (5)	0.5 (3)	0.5 (4)

* 2 yr. averages

The emerging pattern is more than suggestive that cavity nesting species will occur with higher probability in woodlands containing large numbers of pinyon pines. On three study sites in north-central Arizona Masters (1979) found that 79% of the variability (r^2) in density of the combined cavity nesting species (not species numbers as discussed above) was explained by the density of pinyon pines.

Both density and diversity of cavity nesting species may be related to pinyon pine in some manner. Since cavity nesters depend on weakened or diseased trees to excavate cavities in, it is possible that pinyon pine are more prone to attack by insects and other disease

causing organisms. Also, it may be that pinyon branches are more brittle and are therefore more prone to breaking thus allowing disease agents entry. Dead junipers are hard whereas dead pinyon pines contain soft wood (pers. obs.).

The question that remains deals with tree-type selection by the foliage breeding birds: Do foliage breeders select for either juniper or pinyon when choosing a nest site? Both Hardy (1945) and Short and McCulloch (1977) make unsubstantiated comments that foliage nesting birds prefer junipers over pinyons for nest-sites. Based on the amount of data presently available it is not possible to answer that question and more research is required to show if any preference is shown (Table 10). The two species that showed regular use of juniper were the Black-chinned Hummingbird and Black-throated Gray Warbler whereas the Chipping Sparrow showed no preference for either tree (Masters 1979, Balda 1969).

Table 10. Nest sites of foliage nesting birds in western woodlands

Study	Number of Nests in			
		pinyon	juniper	other
Balda, 1967	oak-juniper 67 1	(not present)	1	12
Balda, 1967	juniper-oak-pine 46 46 29	--	11	10
Laudenslayer and Balda, 1976	pinyon-juniper-ponderosa pine 48 46 27	3	--	--
Masters, 1979	pinyon-juniper I 32 33	--	1	--
Masters, 1979	pinyon-juniper II 87 33	10	5	--
Masters, 1979	pinyon-juniper III 87 34	6	2	--

WINTERING BIRDS

Winter bird populations of the woodland have been studied in central Arizona by Grue (1977) and in north-central Arizona by Shrout (1977). A total of 32 species have been recorded as wintering in these woodlands. These 32 species belong to five orders and 14 families. Of these, 18 are permanent residents, 10 are winter residents, and 4 are switchers. The most regular winter residents are the two species of juncos, White-crowned Sparrow, and Ruby-crowned Kinglet. Three of these four species are seed eaters. Prominent "switcher" species are the Mourning Dove, American Robin, the two bluebirds, and the House Finch. Only the Bushtit, kinglet and wren are insectivorous (Table 11).

Species numbers vary considerably from year-to-year. Shrout (1977) reported a diversity of 10 species in one winter and 20 the next on the same 40 ha plot. Mean number of wintering species in Arizona woodlands is about 15 (Grue 1977, Shrout 1977).

Table 11. Birds wintering in pinyon-juniper woodlands

Species	Status*	Distribution (max = 3)
Rough-legged Hawk	W	1
Merlin	W	1
Prairie Falcon	P	(pers. obs.)
Gambel's Quail	P	1
Mourning Dove	P-S	2
Hairy Woodpecker	P	1
Common (red-shafted) Flicker	P	3
Horned Lark	P	1
Common Raven	P	3
Piñon Jay	P	1
Scrub Jay	P	3
Mountain Chickadee	P	1
Plain Titmouse	P	3
Common Bushtit	P	3
White-breasted Nuthatch	P	(pers. obs.)
Red-breasted Nuthatch	W	(pers. obs.)
Bewick's Wren	P	2
Ruby-crowned Kinglet	W	2
American Robin	P-S	1
Townsend's Solitaire	W	1
Western Bluebird	P-S	1
Mountain Bluebird	P-S	1
Sage Thrasher	W	1
Evening Grosbeak	W	1
House Finch	P-S	2
Cassin's Finch	W	(pers. obs.)
Rufous-sided Towhee	P	1
Vesper Sparrow	P	1
Dark-eyed Junco	W	3
Gray-headed Junco	W	3
Chipping Sparrow	P	3
White-crowned Sparrow	W	3
n = 32	P=16, W=11 and P-S=5	

Winter densities vary greatly from place-to-place and from year-to-year. For example during the winter of 1973-74 Grue (1977) reported 318 individuals per 40 ha in a pinyon-juniper woodland and 251 wintering birds in a 40 ha juniper parkland. This is a 21% difference.

Year-to-year variations are even more striking. In some years the woodland supports huge flocks (too large to count) of bluebirds, American Robins and mixed flocks of juncos. In other years one can walk for hours seeing only a very few birds (Vaughan pers. comm., R. P. Balda pers. obs.). ShROUT (1977) found 293 wintering birds per 40 ha in the winter of 1973-74 and 75 individuals during the winter of 1974-75 on the same plot. Using a conservative calculation this is a 74% change in population density between years.

Fire history of a central Nevada pinyon-juniper woodland

John M. Bauer and Peter J. Weisberg

Abstract: Our study reconstructed fire history (1445–2006) from tree rings for a Great Basin single-needle pinyon pine (*Pinus monophylla* Torr. & Frém.)–Utah juniper (*Juniperus osteosperma* (Torr.) Little) woodland. Information from multiple lines of evidence, including dateable fire scars ($n = 83$), tree demography, and charred coarse woody debris, was used to quantify fire frequency, severity, and extent. Fire cycle models were developed using survivorship analysis of time-since-fire estimates. We investigated the spatial and temporal variation in historical fire regime, addressing the plausibility of postsettlement fire exclusion as an explanation for increased woodland area and density since the late 1800s. Historical fire regime was characterized by infrequent, small, high-severity fires. Estimated fire cycle (1570–1880) was 427 years, with no evidence of postsettlement stand-replacing fires. Topographic analyses indicated that in this drought-prone landscape, more mesic conditions favor continuous fuels that lead to more frequent or extensive fire. Superposed epoch analysis showed increased fire occurrence during drought years but with no influence of antecedent climatic conditions. More frequent grassland and shrubland fires were recorded by fire scars near valley floors. Thus, anthropogenic fire exclusion in adjacent, shrub-dominated communities presents a plausible mechanism for woodland expansion in the study area. However, there is little ecological justification for reintroducing fire to areas of historic woodland, where effects of fire exclusion have been minimal.

Résumé : Notre étude dendrochronologique a permis de reconstituer l'historique des feux (1445–2006) dans un boisé de pin faux-arolle (*Pinus monophylla* Torr. & Frém.) et de genévrier (*Juniperus osteosperma* (Torr.) Little) situé dans le Great Basin. L'information provenant de plusieurs sources, incluant les cicatrices de feu datables ($n = 83$), la démographie des arbres et les débris ligneux grossiers carbonisés, a été utilisée pour quantifier la fréquence, la sévérité et l'étendue des feux. Des modèles du cycle de feu ont été développés en utilisant l'analyse de survie des estimations du temps écoulé depuis un feu. Nous avons étudié les variations spatiales et temporelles du régime de feux passé en abordant le fait que l'exclusion du feu après la colonisation pourrait expliquer l'augmentation de la superficie et de la densité des boisés depuis la fin des années 1800. Le régime de feux passé était caractérisé par des feux de forte sévérité, petits et peu fréquents. La durée du cycle de feu (1570–1880) a été estimée à 427 ans et il n'y avait pas d'indices de feux causant le remplacement des peuplements après la colonisation. Des analyses topographiques indiquent que, dans ce paysage sujet à la sécheresse, des conditions plus mésiques favorisent la présence continue de combustibles associés à des feux plus fréquents et plus étendus. Une analyse par superposition d'époques a montré que l'occurrence des feux a augmenté durant les années de sécheresse mais sans que les conditions climatiques antérieures exercent une influence. Des feux de prairie et de broussailles ont été enregistrés par les cicatrices de feu près du fond des vallées. L'exclusion du feu par l'homme dans les communautés adjacentes dominées par des arbustes constitue par conséquent un mécanisme plausible pour expliquer l'expansion des boisés dans la zone d'étude. Cependant, il y a peu de justification écologique pour réintroduire le feu dans les zones historiquement boisées, où l'exclusion du feu a eu peu d'effets.

[Traduit par la Rédaction]

Introduction

Characterization of historical fire regimes has emerged as an important component for ecological restoration of North American forests and woodlands (Landres et al. 1999; Bergeron et al. 2002). However, fire regimes are difficult to quantify for many vegetation types, and existing methodological approaches cannot be universally applied (Veblen 2003). Fire-history studies for low-severity fire regimes typi-

cally apply a chronology-based approach, determining fire return intervals at a location based on precisely dated fire scars (e.g., Brown and Swetnam 1994). Fire-history studies for high-severity fire regimes typically apply a chronosequence-based approach, where fire cycle is estimated statistically from reconstructed time-since-fire maps (e.g., Johnson and Gutsell 1994), or natural fire rotation is calculated empirically from maps of historical fire perimeters (e.g., Floyd et al. 2004).

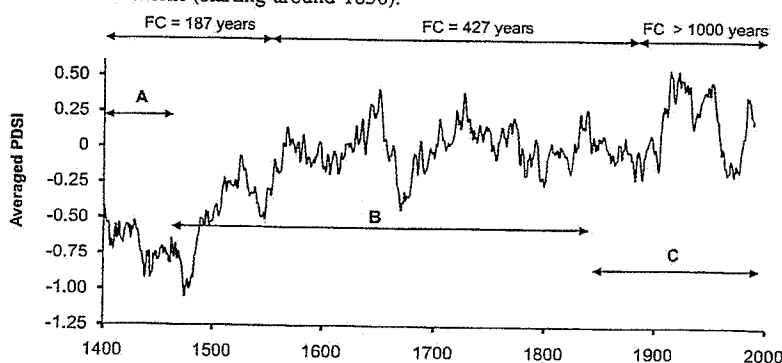
Methodological approaches for fire history are complicated by the prevalence of mixed-severity fire regimes across much of North America (Barrett et al. 1991; Fulé et al. 2003; Lentile et al. 2006). Mixed-severity fire regimes describe fire behavior resulting in a complex mixture of high-severity and low-severity burn patches. Because fire-history methodology differs for high- versus low-severity fire regimes, this can cause lack of consistency within and

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Fig. 6. Averaged Palmer Drought Severity Index (PDSI), using 50 year moving window mean, for point 58, 40.0°N, 117.5°W (Cook et al. 2004), generalized late Holocene climatic divisions (Tausch 1999), and fire cycle (FC) estimates for Barrett Canyon watershed (Table 3). The conditions in the periods are as follows: (A) generally dry and cool; (B) Little Ice Age, with cooler and wetter conditions; (C) warmer and coincident with Euro-American settlement (starting around 1850).



likely to occur during drought years than could be attributed to chance. The influence of a single drought year on probability of fire occurrence, lacking any association with antecedent climatic conditions, agrees with studies from the Colorado pinyon-juniper system (Floyd et al. 2004) but differs from other studies (Miller and Rose 1999), where antecedent moist years are hypothesized to have allowed for accumulation of fine fuel loads that increase the probability and extent of fire during the subsequent drought year. Fuel loads in Barrett Canyon may have been more shrub dominated and not as influenced by precipitation patterns as are more monsoonal systems with dominant grass cover. Stand-replacing fires in pinyon-juniper woodlands of the Great Basin are likely rare events that are climate driven and are not dependent on a fuel buildup model (Veblen 2003), either from one or more antecedent moist years building up fine fuel loads, or from increased fuel loading as a stand ages.

Broad century-scale changes in Great Basin climate are well described in the literature (Miller and Wigand 1994; Tausch 1999). Tausch (1999) described three late-Holocene divisions that roughly coincide with the temporal divisions identified by fire cycle analysis as well as reconstructed PDSI (Fig. 6). The three late-Holocene periods (Tausch 1999), the reconstructed PDSI (Cook et al. 2004), and the temporal divisions identified from this study's fire cycle analysis are in rough agreement. The PDSI time series (Fig. 6) suggests that the 16th century shift toward less area burned may have been influenced by the climatic shift to moister but cooler conditions starting in the late 15th century.

The lower fire cycle estimate prior to 1575 may have been influenced by factors other than climate. If the oldest trees in a stand succumb to nonfire-related mortality, the measurement of the time-since-fire is reduced, causing a downward bias in fire-cycle estimate. Fox (1989) emphasized the need to publish tree mortality rate estimates concurrently with fire-cycle estimates, as mortality from nonfire agents can randomly and unknowingly censor the distribution of tree ages. This point is not commonly considered in fire-history studies (but see Sibold et al. 2006). Many tree species conform to a U-shaped mortality rate curve, with high seedling mortality, followed by low rates of background mortality, concluding with an increased mortality rate as a population reaches a maximum age (Harcombe 1987). We currently

lack information on age-dependent background mortality rate for pinyon pine. However, even a low background mortality rate may significantly bias fire-cycle estimates. Using a constant background mortality rate estimate of 0.14%/year for pinyon, as determined by Shaw et al. (2005), a tree has a 50% chance of surviving to 495 years. In stands that experienced the last stand-replacing fire event >500 years ago, the initial cohort may disappear in the age-class sample, decreasing the time-since-fire datum for that plot and, thus, decreasing the fire-cycle estimate.

Fire-atlas records for central Nevada are limited to 1970 and later and confirmed a recent absence of fire in the study area (Brown et al. 2002). The most recent fire-cycle division (i.e., a near absence of fire) may have been driven in part by climate and by land-use history. Other studies attribute the dramatic reduction in postsettlement fire frequency to land-use history but, in general, cannot decouple climate effects from possible vegetation changes. Settlement of the nearby Reese River Valley commenced in the 1870s, with presumed late-season grazing in the higher elevations. Although effective fire suppression did not occur in remote Nevada woodlands until the mid-20th century, fire exclusion from overgrazing, resulting in reductions of fine fuel mass and continuity (Savage and Swetnam 1990) is a plausible explanation for the observed reduction in fire frequency since approximately 1880. A reduction in Native American burning practices may have occurred with Euro-American settlement, although such activity in the Great Basin is poorly understood in general (Griffin 2002).

Plausibility of fire exclusion as a mechanism for woodland expansion and infill

Expansion and infill of pinyon-juniper woodlands are commonly attributed to fire exclusion, although alternative mechanisms involving climate change, grazing effects, and increased atmospheric CO₂ concentrations have been proposed (Miller and Wigand 1994; Knapp et al. 2001). However, the fire-exclusion hypothesis has seldom been tested empirically (Baker and Shinneman 2004). Expansion of woodland into neighboring vegetation types (e.g., sagebrush grassland) due to fire exclusion would depend upon a reduction in fire frequency of those neighboring types. Data limitations did not allow us to quantify changes in fire regime of

sagebrush-dominated communities that were adjacent to woodland. The use of fire scars from proxy ecotonal trees to reconstruct historical sagebrush fire frequencies is fraught with methodological bias and uncertainty (Baker 2006). However, fires in Barrett Canyon were apparently more frequent in the sagebrush- and grassland-dominated canyon bottom. Many fire-scarred trees in the study area were adjacent to the valley floor ($n = 45$ of 95 total scars) or occurred along side drainages that extended upwards in elevation from the valley floor ($n = 20$ scars). Age-class data suggested that the younger trees below the fire-scarred trees had established after a fire event had burned through the valley floor up to the point of the fire scar. Few fires that burned woodland were reconstructed as originating in the woodland, suggesting that historical fire frequencies of adjacent vegetation types were greater than the rather low fire frequencies observed for the woodland. Although our study does not provide a critical test for the fire-exclusion hypothesis, anthropogenic fire exclusion in shrub-dominated communities at lower and possibly higher altitudinal belts presents a plausible mechanism for pinyon-juniper expansion in Barrett Canyon and in other areas of the central Great Basin (Weisberg et al. 2007).

Infill of pinyon-juniper woodlands refers to often dramatic increases in tree density over recent decades, as has been reported for the study area (Bauer 2006) and nearby mountain ranges (Tausch et al. 1981; Weisberg et al. 2007). It is plausible that infilling processes could result from fire exclusion if historical fires were either very patchy or of low severity. However, most of the sampled stands originated following high-severity fire events, with no evidence of subsequent fires. The observed pattern of fire-scarred trees near the edges of intense burns is supported by systematic surveys of fire evidence for three recent burns in pinyon-juniper woodlands (Bauer 2006), where all observed fire scars occurred at burn boundaries. At Barrett Canyon, no stands had evidence suggesting a frequent, low-severity fire regime, which is consistent with other studies showing a lack of low-severity surface fires in pinyon-juniper woodlands (reviewed in Baker and Shinneman 2004; Huffman et al. 2008). Although Barrett Canyon and the Shoshone Mountain Range have experienced dramatic increases in tree density since the 1880s (Bauer 2006; Miller et al. 2008), it is unlikely that the infilling process is related to fire exclusion because there is little evidence for low-severity or extremely patchy wildfires prior to fire exclusion.

Management implications

Although additional fire-history studies are needed to assess the generalizability of our results to other Great Basin watersheds, the Barrett Canyon study has important management implications. Firstly, not all young pinyon-juniper woodlands are expansion woodlands representing novel tree establishment in areas that were formerly dominated by other vegetation types. Several of the sampled woodland plots were relatively young stands (<120 years) that established following high-severity fire, although diligent searching was required to uncover the evidence for such previous fire events. This is an important distinction for ecological restoration activities.

Secondly, as pointed out by others (Baker and Shinneman

2004; Romme et al. 2008), pinyon-juniper woodlands burn infrequently, with active crown fires occurring only under extreme conditions. Some old-growth woodland plots showed no evidence of having burned at any time over the past centuries. There is little ecological justification for reintroducing fire to areas of "persistent" (i.e., historic) woodland, at least within the context of restoring natural disturbance regimes, because these have not experienced the effects of fire exclusion. Furthermore, because historical low-severity fires were not reconstructed and have likely played an unimportant role in these woodlands, there is little justification for introducing low-severity underburns or for emulating low-severity fire through thinning treatments. These conclusions are similar to those of researchers who have conducted fire-history studies of woodlands dominated by two-needle pinyon pine (*Pinus edulis* Engelm.) of the Colorado Plateau region (Eisenhart 2004; Floyd et al. 2004), although fire appears to have played a greater role in our Great Basin study area than is generally reported for Colorado Plateau woodlands, where any direct evidence of historical fire can be difficult to find.

Shrub-dominated communities adjacent to pinyon-juniper woodlands, including many areas now dominated by trees, are likely to have burned more frequently in the past. Reintroduction of fire to such communities may be warranted as an ecological restoration activity. However, our investigation was not able to develop robust estimates of fire frequency for sagebrush-dominated areas. Rigorous fire-history studies are urgently needed for sagebrush communities to determine if fire exclusion has been an influential cause for tree invasion of former shrublands (Baker 2006).

It is critical that management plans for restoring woodlands consider the variability in presettlement woodland structure and the extent of old-growth woodlands (Miller et al. 2008). This requires an understanding of landscape-scale influences on tree establishment, productivity gradients, and historical fire regime. Woodland fire regimes have varied according to topography, landform, and the pattern of fire occurrence in adjacent vegetation types. Not all dense woodlands are in need of active restoration, and the appropriate restoration treatments should fit the underlying disturbance regime.

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References

- Allison, P.D. 1995. Survival analysis using SAS: a practical guide. SAS Press, Cary, N.C.
- Baker, W.L. 2006. Fire and restoration of sagebrush ecosystems. Wildl. Soc. Bull. 34(1): 177-185. doi:10.2193/0091-7648(2006)34[177:FAROSE]2.0.CO;2.
- Baker, W.L., and Shinneman, D.J. 2004. Fire and restoration of



Research Article

Multiscale Models of Habitat Use by Mule Deer in Winter

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ABSTRACT Mule deer (*Odocoileus hemionus hemionus*) populations have experienced widespread declines in much of western North America and alteration or loss of habitat could be contributing to these declines. Consequently, understanding habitat features that are important to mule deer is necessary for effective management of the species and their habitat. From 2005–2012 we radio-marked 452 mule deer with global positioning system collars across 9 distinct winter ranges to evaluate winter habitat use along the east slope of the Cascade Range in south-central Oregon, USA. Using data from 357 mule deer across 9 analysis areas, we developed regional habitat use models for mule deer on winter range at 3 spatio-temporal scales: herd range based on 100% minimum convex polygons around deer locations, home range based on 90% kernel density estimates of deer locations, and foraging range based on locations obtained within 2 hours of sunrise or sunset within the boundaries of the home range scale. We assessed habitat use of mule deer using a generalized linear model with a negative-binomial link function. We validated our models with locations from an independent dataset of 95 deer that wintered within 8 of our analysis areas. Model validation indicated that regional models for all spatio-temporal scales predicted probability of use moderately to very well. At all spatio-temporal scales, predicted use by mule deer was greater in areas with forest canopy cover. These findings call into question large-scale removal of western juniper (*Juniperus occidentalis*) in Oregon and other portions of western United States to enhance habitat for sagebrush-dependent wildlife species. Across all spatio-temporal scales, we documented increased probability of use of areas farther from roads open to motorized vehicle use by mule deer, highlighting the importance of limiting motorized vehicle use and access on mule deer winter range. We also documented increased use of areas with lower snow depth and on moderate slopes by mule deer. Our models can be used in land management planning to spatially predict mule deer distribution and probability of use under alternative management scenarios that affect forest canopy cover or motorized vehicle use on roads while accounting for other physical features of the landscape. Additionally, our models can be used to develop juniper removal projects to mitigate effects on mule deer winter range habitat while benefiting other wildlife. © 2018 The Wildlife Society.

KEY WORDS habitat use, juniper, *Juniperus occidentalis*, mule deer, multiscale, *Odocoileus hemionus*, Oregon, roads, winter range.

Mule deer (*Odocoileus hemionus hemionus*) populations throughout the western United States have experienced

decades-long population fluctuations over the past century (Wallmo 1981, Unsworth et al. 1999), including populations in Oregon (Cliff 1939, Ebert 1976, Salwasser 1979, Peek et al. 2002). Mule deer populations in Oregon peaked at approximately 575,000 in the 1960s (Workman and Low 1976) and declined to nearly 230,000 by early 2015 (Oregon Department of Fish and Wildlife [ODFW] 2003; ODFW, unpublished data). Several hypotheses have been proposed to explain population declines of mule deer (Ballard et al. 2001, Peek et al. 2001, Hurley et al. 2011, Shallow et al. 2015, Johnson et al. 2017). One compelling argument is that

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Table 3. Home range coefficients for analysis areas in models of mule deer habitat use during winter in south-central Oregon and northern California, USA, 2006–2012. Regional estimates are the geometric mean of coefficients from individual analysis areas.

Analysis area	Intercept	Proportion forest	Proportion forest ²	Mean snow depth (cm)	Slope (%)	Slope ²	Distance to open road (km)
Metolius	-8.110	1.884	-1.610	-0.006	0.007	-0.000	0.251
North Paulina	-7.782	1.717	-1.002	-0.014	0.030	0.000	-0.781
Wagontire	-9.498	1.566	-1.546	-0.030	0.095	-0.002	0.238
South Paulina	-8.347	0.362	-0.472	-0.001	-0.007	0.000	0.136
Fort Rock	-7.586	1.633	-1.400	-0.001	-0.018	0.000	-0.163
Silver Lake	-8.239	1.826	-1.314	-0.002	-0.034	0.000	-0.054
East Interstate	-8.528	2.476	-2.525	0.002	0.064	-0.001	0.188
West Interstate	-8.878	0.346	-0.347	0.000	0.160	-0.006	0.352
Klamath	-8.398	3.573	-1.817	-0.003	0.006	-0.001	0.097
Regional	-8.374	1.709	-1.337	-0.006	0.034	-0.001	0.029
Lower 95% CI		1.255	-1.715	-0.011	0.003	-0.002	-0.154
Upper 95% CI		2.232	-0.997	-0.001	0.067	-0.000	0.185

($r_s \geq 0.75$) at 1 of 8 analysis areas, moderately correlated ($0.75 > r_s > 0.50$) at 3 analysis areas, and marginally or weakly correlated ($r_s < 0.50$) at 3 analysis areas, and negatively correlated at 1 analysis area (Table S4). Across our 3 spatio-temporal scales of analysis, Wagontire, Silver Lake, and Klamath had consistently high validation scores, whereas Metolius, North Paulina, and Fort Rock had the lowest.

DISCUSSION

Perhaps the primary determinant of distribution of mule deer during winter is snow depth, with depths >46 cm effectively precluding use (Gilbert et al. 1970). Our results supported this conclusion; one of the strongest relationships we observed in our analysis was decreased use of areas with

increased snow depth in the herd range and home range models. This pattern of increased use in areas with decreased snow depth is likely influenced by energy costs and foraging efficiency. For example, increased snow cover and depth reduces forage availability and foraging efficiency of ungulates (Wickstrom et al. 1984). Further, energy expenditure from locomotion increased in a log-linear manner with increased snow depth (Parker et al. 1984). Consequently, it was not surprising that mule deer used areas with lower snow depth within our analysis areas. We did not observe a relationship between snow depth and habitat use by mule deer in our foraging range models. We contend we did not observe this relationship because patterns of habitat use at coarser scales (e.g., herd range and foraging range) already accounted for deer using areas with reduced snow cover.

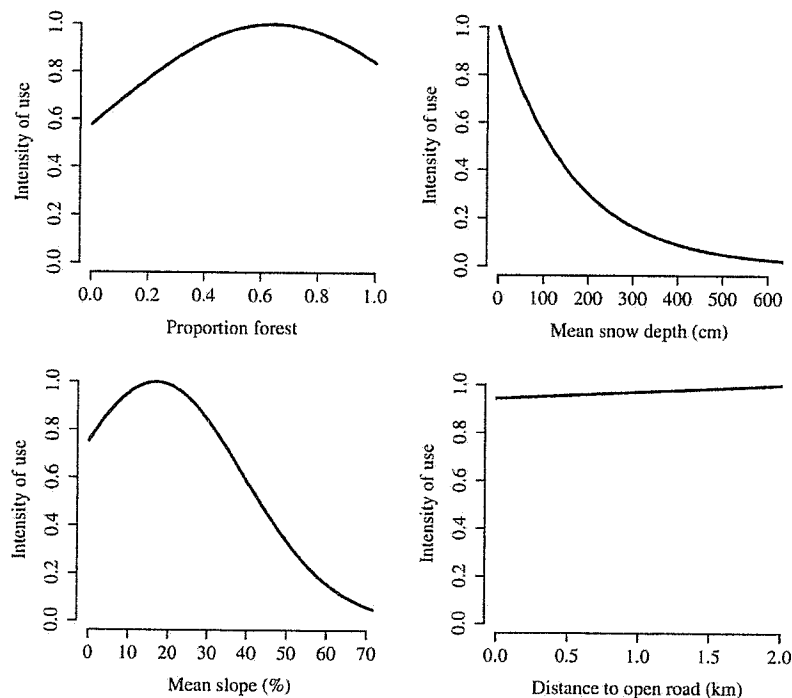


Figure 3. Marginal plots from an analysis of mule deer winter habitat use in south-central Oregon and northern California, USA, 2006–2012. Plots are for the regional home range model and show intensity of use in relation to individual model covariates, when all other covariates included in the model are held at their medians.

Table 4. Foraging range coefficients for analysis area models of mule deer habitat use during winter in south-central Oregon and northern California, USA, 2006–2012. Regional estimates are the geometric mean of coefficients from individual analysis areas.

Analysis area	Intercept	Proportion canopy cover 1–20%	Proportion canopy cover >20%	Slope (%)	Slope ² (%)	Distance to open road (km)	Distance to open road ² (km)
Metolius	–8.221	0.654	0.007	0.003	–0.000	–0.126	0.198
North Paulina	–7.711	0.895	0.565	0.015	–0.000	–0.677	0.004
Wagontire	–9.721	0.426	–0.007	0.090	–0.003	0.795	–0.266
South Paulina	–8.234	0.106	–0.226	0.005	–0.001	–0.519	0.306
Fort Rock	–7.879	0.518	0.197	–0.004	0.000	0.565	–0.334
Silver Lake	–8.389	0.879	0.356	–0.020	0.000	–0.145	0.074
East Interstate	–8.634	0.630	–0.083	0.064	–0.001	0.887	–0.361
West Interstate	–9.823	0.660	0.183	0.170	–0.006	2.295	–0.915
Klamath	–9.421	1.944	1.673	0.021	–0.001	2.015	–0.803
Regional	–8.670	0.746	0.296	0.038	–0.001	0.566	–0.233
Lower 95% CI		0.517	0.041	0.009	–0.003	0.012	–0.459
Upper 95% CI		1.042	0.618	0.074	–0.000	1.149	–0.001

Across our 3 spatio-temporal scales of analysis, we documented several associations between forest cover and habitat use by mule deer. Interpretation of these patterns varied across spatial and temporal scales and likely highlighted the importance of mule deer balancing the needs of thermal and hiding cover with foraging opportunity. At the herd range scale, we documented increased intensity of use by deer in areas closer to forest cover and at the home range scale, increased intensity of use was associated with areas composed of 60–70% forest. We contend this indicates mule deer were using areas at these spatial scales that allowed them to seek thermal or hiding cover. In contrast, at the foraging range scale, we documented increased use of areas

with low forest canopy cover (i.e., 1–20%) and decreased intensity of use of areas with >20% forest canopy cover. Areas with lower canopy cover likely had increased forage because herbaceous understory vegetation decreases substantially where juniper cover is >20% (Miller et al. 2000, Witt and Patterson 2011). The need for shrubs and associated vegetation for forage (Leckenby 1977) and tree cover for thermal and hiding (Leckenby and Adams 1986) necessitates the use of forested and unforest areas during winter (Kie et al. 2002). We contend mule deer in our study area concentrated use in areas that provided sufficient thermal and hiding cover while also providing foraging opportunities in areas with relatively low forest canopy cover (<20%).

60–70%
forest

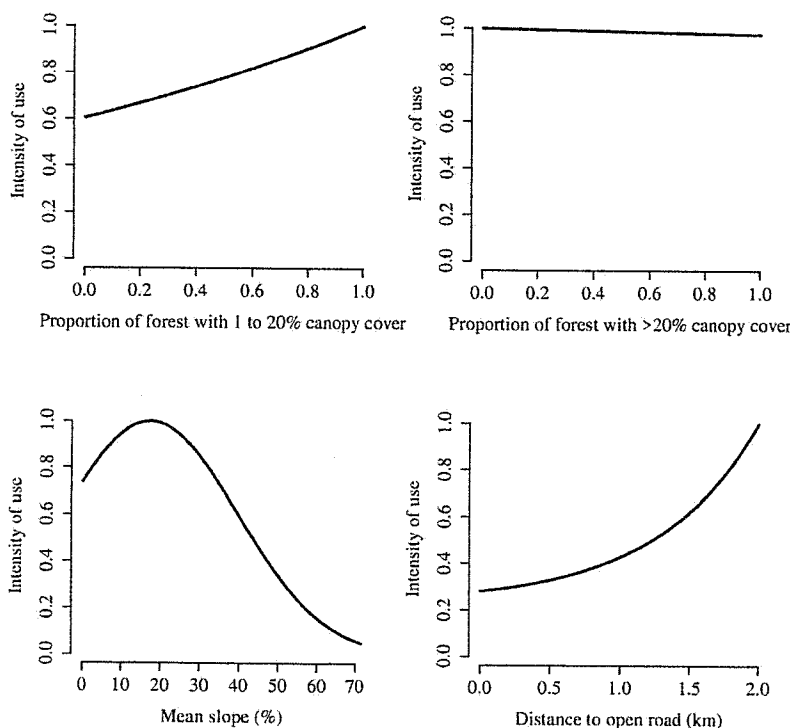


Figure 4. Marginal plots from an analysis of mule deer winter habitat use in south-central Oregon and northern California, USA, 2006–2012. Plots are for the regional foraging range model and show intensity of use in relation to individual model covariates, when all other covariates included in the model are held at their medians.

Forest cover is an important component of mule deer winter habitat use throughout the inter-mountain west in Colorado, Oregon, Washington, British Columbia, and Idaho (Leckenby and Adams 1986, Carson and Peek 1987, D'Eon and Serrouya 2005, Anderson et al. 2012, Smith et al. 2015). Perhaps the most compelling function of forest cover is that it provides important energetic benefits for mule deer. Because of their low ratio of body mass to surface area, mule deer have a small thermal neutral zone and may have increased needs for thermal cover, particularly during winter (Raedeke and Taber 1982). Consequently, mule deer in our study likely used forest cover to regulate body temperature during cold winter conditions (Leckenby and Adams 1986). Further, forest canopy intercepts snowfall and influences snow accumulation patterns so that snow depth is lower in forested areas (Pomeroy et al. 1998). Mule deer use areas with forest cover to mediate effects of snow (Mysterud and Østbye 1999) and this pattern was present in our study area.

Predation is often a proximate cause of mortality in mule deer populations (Bleich and Taylor 1998, Ballard et al. 2001, Forrester and Wittmer 2013) and forest cover may be used by mule deer in an effort to reduce risk of predation (Mysterud and Østbye 1999). For example, forest cover may allow increased concealment and escapement from predators (Bowyer and Bleich 1984, Jedrzejewska et al. 1994). Consequently, minimization of predation risk may be an alternative or supplemental explanation to the patterns we documented of increased use of forest cover by mule deer on winter range. However, we lacked data on mule deer predators within our study areas to test this hypothesis, so we can not explicitly link use of forest cover to reduced predation risk.

In our analysis areas, western juniper was the primary tree species and given our associations between mule deer habitat use and forest cover, juniper is likely an important habitat feature for mule deer winter range. Western juniper has been expanding within shrub-steppe communities in Oregon since 1900 (Miller and Rose 1999). In Oregon, juniper removal has occurred on >165,000 ha from 2010–2015 in efforts to benefit sage-grouse (*Centrocercus urophasianus*; Natural Resources Conservation Service 2015, Sage-Grouse Conservation Partnership 2015) and other sagebrush-dependent species; however, evidence to support any positive or detrimental benefits of juniper removal on mule deer habitat use or demography is lacking. Leckenby (1978) suggested that clear-cutting juniper on winter range could be detrimental to mule deer because thermal and hiding cover would be removed. Increases in juniper cover across mule deer winter range, however, may have negatively affected forage availability for mule deer because abundance of shrubs, forbs, and grasses decline in juniper stands (Miller et al. 2000, Peek et al. 2001). Past research has indicated that nutritional resources during winter can influence survival and population dynamics of mule deer (Baker and Hobbs 1985, Bishop et al. 2009, Bergman et al. 2014) and if increases in juniper cover have reduced forage quantity and quality for mule deer, this could have population-level consequences. Given the lack of knowledge on effects of juniper treatments on mule deer habitat use and demography,

future research to elucidate effects of juniper removal on mule deer is warranted.

One of the strongest patterns we observed across all 3 spatio-temporal analyses was a consistent avoidance of roads open to motorized vehicle use, which has also been documented in Wyoming, Colorado, and southeast Alaska (Sawyer et al. 2006, Webb et al. 2013, Northrup et al. 2015, Gilbert et al. 2017). In contrast, in Idaho, where mule deer shared winter range with elk, mule deer were closer to roads during winter, whereas elk used areas farther from roads (Stewart et al. 2010). This pattern likely occurs because of competitive interactions between the mule deer and elk, where mule deer are displaced by elk to areas closer to roads (Johnson et al. 2000). In our analysis areas, no or very few elk co-occurred with mule deer on winter range (ODFW, unpublished data), which allowed us to establish clearer inference regarding effects of roads open to motorized vehicle use on mule deer winter habitat use. In other areas, ungulates demonstrated avoidance of roads open to motorized access and open areas (e.g., meadows, non-forest) during the day but used areas closer to both at increased frequencies at night (Ager et al. 2003, Crosmarty et al. 2012, Bonnot et al. 2013, Northrup et al. 2015). Given the associations we documented between use of forest cover and habitat use by mule deer, forest cover may be used by mule deer to minimize the effects of human disturbance in our study areas. Forest cover allows increased concealment and escape-ment from human hunting (Kufeld et al. 1988) and minimization of disturbance from other forms of human recreation (Wisdom et al. 2004), which aligns with our findings that mule deer spent less time in areas close to roads open to motorized vehicle use.

We view our findings of mule deer avoidance of roads open to motorized vehicle use to be linked to human disturbance, and not the physical features of the road. The strong avoidance of roads open to motorized vehicle use, and associated human disturbance, by ungulates observed in our study and others (Rowland et al. 2000, Sawyer et al. 2006, Coe et al. 2011, Webb et al. 2013, Gilbert et al. 2017) suggests a substantial portion of what may be suitable habitat may no longer be used (Rogala et al. 2011). In a meta-analysis of the effects of flight responses of ungulates to human disturbance, it was found that ungulates, including mule deer, had a strong avoidance and increased movement rates in response to human activity, especially for hunted populations (Stankowich 2008) like our study populations in south-central Oregon. Consequently, human disturbance associated with motorized vehicle use on roads may cause mule deer to increase movement rates, leading to a net reduction in their energy budget, which could ultimately have demographic consequences (Robinette et al. 1973, Bishop et al. 2009, Tollefson et al. 2010). Fortunately, given that ungulates likely respond to the disturbance associated with motorized vehicle use of roads and not the road itself, this situation can be rectified through seasonal or permanent road closures. Finally, increased densities of roads open to motorized vehicle use are likely to increase human access and rates of poaching (Cole et al. 1997). In our study areas, poaching represented 3.1% of adult female mule deer

mortality (Mulligan 2015). Population growth rates of ungulates are highly sensitive to changes in adult female survival (Gaillard et al. 1998, 2000) and the rate of poaching observed in our study areas could be contributing to reductions in population growth rates.

At all 3 of our spatio-temporal analysis scales, we observed a strong association of mule deer using areas of moderate (10–30%) slopes and at the herd range scale showed a weak relationship with increased use on northern aspects. Prevailing winter winds in our analysis areas were from the south and deer typically seek shelter from wind when gusts are >40 km/hour and temperatures <−10°C (Loveless 1967, Wood 1988). Topography can effectively serve as thermal cover for deer by providing a windbreak. Most of our analysis areas were relatively flat ($\bar{x}$ slope across the 9 analysis areas was 8.4%) and we contend deer increased use on northern aspects and moderate slopes within our analysis areas as protection from wind, given the scarcity of topographic complexity on the landscape.

Our overarching objective was to assess habitat use patterns of mule deer across multiple analysis areas to document habitat use patterns on a regional scale. Using this approach, our regional models were able to accurately predict habitat use in most analysis areas and we identified several robust patterns of habitat use of mule deer on winter range that are informative to managers. Despite the benefits of our modeling approach, validation results across our 3 spatio-temporal scales and 9 individual analysis areas were not perfect. There are several possible reasons for poor validation results in any particular analysis area: difference in physiographic characteristics, differences in the proportion of shrub or other covariates, or small validation sample sizes. No one reason stands out among these options. The most likely explanation for low correlation between predicted and observed use in any of the analysis areas is that predictor variable(s) important at an individual analysis area scale were not identified prior to our modeling efforts or were not included in the regional model. Given the geographic area and diversity of conditions experienced by mule deer in our analysis areas, this was not unexpected, and it highlights the complexity of modeling habitat use patterns for species across large areas.

MANAGEMENT IMPLICATIONS

We encourage wildlife and land managers to employ predictive models developed here and other areas in a GIS to assess effects of proposed management actions such as timber harvest, juniper removal, or closures of roads open to motorized vehicle use in mule deer winter range. These models and models developed elsewhere for mule deer will allow effective assessment of alternative management practices such as habitat treatments and changes to motorized vehicle access to quantify the degree to which management practices may be beneficial or detrimental.

Our models identified 2 robust patterns of mule deer winter habitat use that are under direct influence of land managers: increased use of areas with forest cover and decreased use of areas with roads open to motorized vehicle access. We

encourage land managers to implement permanent or seasonal road closures on mule deer winter range to minimize disturbance and displacement of mule deer. We also recommend managers attempt to retain forested areas within mule deer winter ranges to increase use by mule deer. Based on our results showing an association between forest cover and winter habitat use by mule deer, habitat management that benefits species such as sage-grouse (e.g., widespread juniper removal) have the potential to reduce use of these areas by mule deer during winter. Consequently, we recommend managers implement projects that consider and integrate the needs of multiple species. For example, where mule deer and sage-grouse co-occur, mitigation of effects of removal of tree cover to benefit sage-grouse could occur through strategic planning to minimize vegetation disturbance in areas that have other attributes associated with increased probability of use by mule deer but not of sage-grouse (e.g., moderate slopes). Consideration of multiple vegetation treatment prescriptions (e.g., thinning vs. complete juniper removal) will also allow managers to identify alternative management practices that mitigate or benefit predicted habitat use by mule deer in conjunction with balancing the needs of other sagebrush-dependent species. Although snow depth is a factor outside the control of wildlife managers, our models could be used to identify areas that have a high probability of use by mule deer during winters with heavy snowfall. During these years, mule deer populations are likely to be nutritionally stressed and have increased risk of overwinter mortality. Our models can be used to identify these areas and assign a high level of protection from future land management changes to ensure the long-term conservation of mule deer winter range.

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LITERATURE CITED

- Adams, D. C., J. Gurevitch, and M. S. Rosenberg. 1997. Resampling tests for meta-analyses of ecological data. *Ecology* 78:1277–1283.
- Ager, A. A., B. K. Johnson, J. W. Kern, and J. G. Kie. 2003. Daily and seasonal movements and habitat use by female Rocky Mountain elk and mule deer. *Journal of Mammalogy* 84:1076–1088.
- Anderson, E. D., R. A. Long, M. P. Atwood, J. G. Kie, T. R. Thomas, P. Zager, and R. T. Bowyer. 2012. Winter resource selection by female mule deer *Odocoileus hemionus*: functional response to spatio-temporal changes in habitat. *Wildlife Biology* 18:153–163.
- Baker, D. L., and N. T. Hobbs. 1985. Emergency feeding of mule deer during winter: tests of a supplemental ration. *Journal of Wildlife Management* 49:934–942.

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Cal Fire burns next to Bald Eagle nest, eaglets die (/stories/2022/4/15/2092201/-Cal-Fire-burns-next-to-Bald-Eagle-nest-eaglets-die)



Defiance Canyon Raptor Rescue (/users/defiance canyon raptor rescue)
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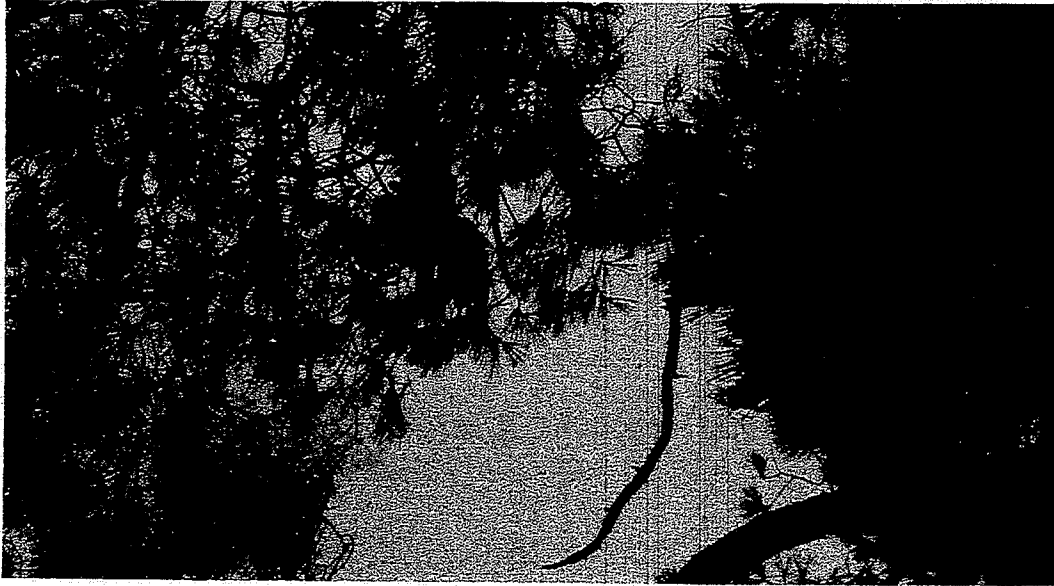
Liz Cheney: The House Jan. 6 committee has uncovered a 'broad,' 'well-organized' conspiracy

by Aldous J Pennyfarthing
★ 262 ● 188

One More Dead Russian General in Ukraine

by GaryNaham
★ 156 ● 92

Tweets of the Week May 29-Jun



Bald eagle chick, dead in nest tree after Cal Fire control burn next to the nest in 2021. Cal Fire has not committed to stop burning by the nest this year. Who would think it would be a problem for public agencies to adhere to laws that protect wildlife?

RSS
(/user/Defiance
Canyon Raptor
Rescue/rss.xml)

PUBLISHED TO

Defiance Canyon Raptor
Rescue
(/blogs/Defiance%20Canyon%20Raptor%20Rescue/)

TAGS

#Birdwatching
(/tags/Birdwatching)

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(/tags/ClimateChange)

#Eagles (/tags/Eagles)

#Environment
(/tags/Environment)

#Fire (/tags/Fire)

#Nature (/tags/Nature)

#Raptors
(/tags/Raptors)

#Wildlife
(/tags/Wildlife)

Climate change impacts have been worsening for years, raising temperatures and exacerbating fire danger in California and the world. In many cases though, trees and other plants are being treated as enemies to be annihilated, rather than as the ecosystems that enable life on earth to exist.

In California, both Cal Fire and PG&E are being given exemptions from any environmental review for their "fuel reduction" or "vegetation management" programs. In this time when thousands of scientists worldwide are screaming and waving red flags about biodiversity and climate catastrophe, the impacts of these projects are being ignored, particularly to wildlife and habitat.

4 2022

by oldhippiedude

★ 44 ● 26



"School lunch isn't cost effective for taxpayers."

by SquireForYou

★ 244 ● 123



And this is freedom? Are they completely insane? Time to lock THEM up.

by Vetwife

★ 155 ● 114



A Dad's Abortion Story...

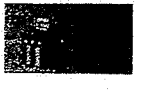
by ExPatDanBKK

★ 218 ● 83

The Voting System WAS Tampered With In Georgia And Raffensperger Covered It Up

by deltopia

★ 344 ● 169



Sekrit Armee Sundai — Nashunol Adopt A Sheltur Kiteh Munf

by FosterMominCA

★ 75 ● 151



Political Christianity has killed biblical Jesus and replaced him with the Fascist Christ.

by TheCriticalMind

★ 218 ● 306



Let's start assigning blame for mass shootings where it really belongs: "A well regulated Militia..."

by integrate

★ 61 ● 44



I think Russia is being enveloped right now in that triangle

by Joe Pac

★ 229 ● 81



PRESIDENT JOE BIDEN—DAY501—SECOND YEAR DAY138—Evening Shade-Sunday

by hpg

★ 18 ● 137



Is the fertilized egg, blastocyst, zygote, embryo a person, a separate self? I argue it cannot be.

by novapsyche

★ 78 ● 128



CRYBABY TRUMP Bashes FOX News, 'Perverts' and 'RINOS' Who 'Didn't Have the Guts' to Impeach Him

by News Corpse

★ 52 ● 32



Ukraine Invasion Day 102: Putin on foreign weapons supplies,



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What has happened over the past several years to a bald eagle nest east of Red Bluff, California illustrates what is occurring because of these exemptions from any oversight. The fear of fire is being exploited to the detriment of the natural world, rather than substantive actions being implemented to reduce the emissions which are causing climate disaster.

(http://www.dailykos.com/story%2F2022/4/15/2092201/-Cal-Fire-burns-next-to-Bald-Eagle-nest-eaglets-die)

Cal-Fire-burns-next-to-Bald-Eagle-nest-eaglets-die



Hwy 36, east of Red Bluff. The eagle nest is to the right (south side). This is the roadside Cal Fire has burned in 2020 and 2021 when the eagle nest was occupied. There is little reason to burn here, and many reasons not to.



The eagles' nest to the south of the highway, circled in red.



Parent eagle with young eaglet in front (little grey head) in nest tree, April 2022.

Local residents have been watching this nest since 2020. A photographer from Red Bluff was going out to the nest every day in 2021. At the end of May, the photographer saw a notice that there was going to be a control burn by the nest in a few days. She contacted a local eagle group, who

"We are breaking them like nuts."

by annieli

★ 145 59

A Ukrainian military expert confirms much of the analysis you've read here and looks to the future

by Charles Jay

★ 294 108

Packard Museum: The 1920s (photo diary)

by Ojibwa

★ 37 11



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The US States People Are...

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called Cal Fire to tell them about the nest which was occupied by two young eaglets. The eagle group left a message and received a message back from Cal Fire saying their biologist said it was fine to be burning near the nest. The eagle group called back to get the biologist's name, but received no answer then or later. It wasn't "fine".

The burn was done on June 1st. This nest is approximately 100 feet down a ravine from the highway. The eaglets were probably only 6-7 weeks old, 4 or 5 weeks from being able to fly.

The photographer was standing next to the nest during the burn and taking photographs. The Cal Fire people were slightly to the east of the nest. The smoke and flames can be seen on the south side of the highway, on the same side as the nest.



Cal Fire burning next to eagle nest, 2021. How much extra CO2 is being emitted by extra equipment use and burning unnecessarily?

The photographer went to check the nest a few days later and saw one adult perched above the nest, but could see no eaglets.

The next morning, the photographer took a photo which shows a dead eaglet hanging from the nest. The photographer contacted me (Marilyn Woodhouse from Defiance Canyon Raptor Rescue). We went to search for the other eaglet, in the hope it was still alive.

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Kirstie Alley Is So Skin...

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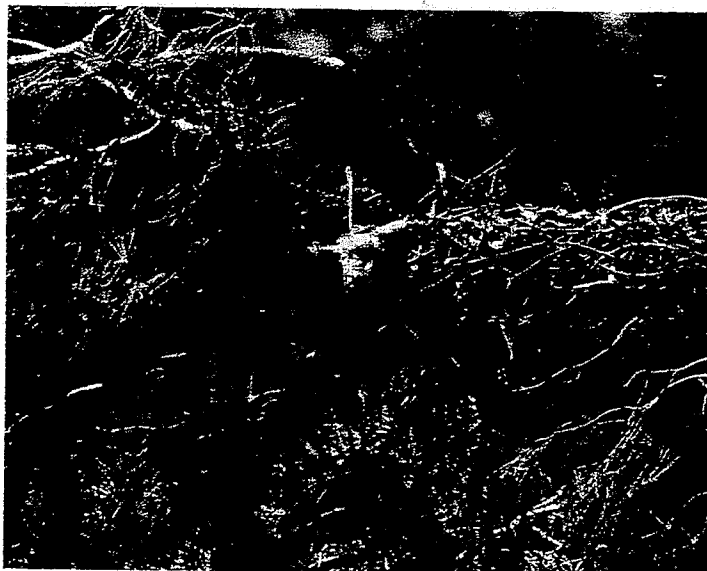
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Doctor Says Slimming Down After 60 Comes Down To This

Dr. Kallyann

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Both the adults were at the top of the tree, above the nest. I went down the ravine to the nest tree to walk around beneath it to search for the second eaglet and the adults stayed in the tree top. I walked to the southeast side of the tree and looked up and saw the other eaglet hanging dead in the tree, below the nest about 10'.



We reported the deaths to US Fish and Wildlife and CA Department of Fish and Wildlife, but never received any notification of any action taken.

A State Wildlife Health Lab biologist wrote to us later that:

"A bird's respiratory system is more sensitive to toxins, including smoke, than a mammal's respiratory system. This is because birds have a higher oxygen demand than mammals and a bird's lungs are 10 times more efficient at capturing oxygen. The rapid efficiency of gas exchange in bird lungs makes them more susceptible to inhaled toxic agents, including smoke. Inhaled toxins, such as smoke, can cause irritation and damage the respiratory system. It also can

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Putin's Greatest Victory

Daily Kos

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Cut for the 'Not-So-Tall' Guy

Peter Manning NYC

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WFP Scaling Up To Reach 3.1 Million In Ukraine

UN World Food Program USA

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compromise the immune system, making the bird more susceptible to infections. This is especially true in young birds in the nest that are unable to escape the smoke. Smoke inhalation toxicity in birds is caused by irritant gases (aldehydes, hydrogen chloride, and sulfur dioxide), particulate matter, and nonirritant gases (carbon monoxide, carbon dioxide, and hydrogen cyanide) released by combustion."

There was a burn done next to the Dales Station nest in 2020 also. I was called upon to rescue an eaglet who got out of the nest before he could fly that year. It was several days before the burn was done that year, so he was away from the nest when the burn occurred. His sister was still in the nest during the burn. I received a call from Dales Station, less than a mile from the nest, in August, 2020 about an eaglet who had been on the ground for 3 days, standing next to a shallow pool of Paynes Creek. My determination was that it was the female from the nest. She was open-mouthed breathing with a raspy noise. She died a few hours after she was caught and transported. The Wildlife Lab report said: "This was a juvenile female in poor nutritional condition with no fat reserves and minimal pectoral muscle development. Internally, there was evidence of an extensive infection. The visible infection resembled avian tuberculosis which is caused by the bacterium *Mycobacterium avium*. It's widespread in the environment in soil and dust and is usually an opportunistic infection. Depending on where the lesions are in the bird, gives an idea of how it entered the body. The lesions in this bird were primarily in the air sacs suggesting it was inhaled."

The male who had been in care was released in 2020. A first year eagle was seen back at the nest in 2021. Judging by his and the adults' behavior, it was the male who was in care away from the nest during the burn in 2020.

I had occasion to contact Cal Fire in February 2022 about another issue. I had just been informed that the Dales Station bald eagle nest was occupied, so mentioned it in the hope of preventing another burn next to the nest. Cal Fire and its employees are public servants. It is their job to uphold state and federal laws, which include protection of wildlife, but the answer from a Cal Fire employee contained only dismissive, condescending remarks, clearly refusing to take steps to ensure any protections were implemented.



2020 bald eaglet being released. He was away from the nest in rehab care during Cal Fire's control burn in 2020, which probably saved his life.

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Do's And Don'ts For Pain-Free Knees

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Yes we can get gun control passed in the Senate

Daily Kos
(https://www.dailykos.com/story/2022/6/5/2102278/-Yes-we-can-get-gun-control-passed-in-the-Senate)
(https://www.dailykos.com/story/2022/6/5/2102278/-Yes-we-can-get-gun-control-passed-in-the-Senate)

Let's start assigning blame for mass shootings where it real...

Daily Kos
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(https://www.dailykos.com/story/2022/6/5/2102394/-Let's-start-assigning-blame-for-mass-shootings-where-it-really-belongs-A-well-regulated-Militia)

The Ferrari of Kitchen Knives Now 50% Off

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Many letters, calls, and emails have ensued since February (most unanswered). I made maps from Cal Fire's own fire database showing how rarely the area around the nest has burned. The ravine area there is extremely rocky and is grazed by cattle. And then there are the State and Federal laws that protect nesting birds. Still, Cal Fire will not commit to refrain from burning by the nest again this year.

Last week a biologist from a PG&E contractor company working in Greenville (a town that burned in the Dixie fire last year) called Raptor Rescue because they wanted us to take eggs from a nest in a tree they wanted to cut down. I explained the multitude of reasons that was a bad idea, along with it being illegal for them to do. The man said "We have an exemption". How many nesting birds are being destroyed in California due to these stupid, thoughtless exemptions and the complete lack of oversight which is occurring?

There have got to be protections enforced. Apparently that won't happen without widespread public outrage.

Here are some state employees to contact if you will help tell them there is a problem with their practices:

George Morris, Cal Fire Northern Region Unit Chief (530) 224-2445 (They would not give out his email address)

Dave Russell, Cal Fire Tehama/Glenn Unit Chief (530) 528-5199 dave.russell@fire.ca.gov

Tina Bartlett, Regional Manager CDFW, (530) 225-2300 tina.bartlett@wildlife.ca.gov

People often focus on individual species, but we believe every species is important, whether it is on a man-made list or not. Habitat fragmentation and loss have significant impacts on wildlife. Defiance Canyon Raptor Rescue works to rescue, rehabilitate, and return raptors to their wild lives, along with our work to protect watersheds and forests of California.

www.thebattlecreekalliance.org (<http://www.thebattlecreekalliance.org/>)

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Tweets of the Week May 29-Jun 4 2022

Daily Kos

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Explaining Things to the Families, Calmly and Rationally

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(<https://www.dailykos.com/story/2022/6/5/2101391/-Explaining-Things-to-the-Families-Calmly-and-Rationally>)

Americans Are Replacing AC's With This Tiny Cooler

NowTech

(https://ac.2022gadgets.com/?p=2&site=dailykos&site_id=1946&title=Americans+Are+ReHfzYdIXD-xXRU0dKoPgxdLW7JlFxs5hf5nSCtFgon8SL_au80cCSAQ&tblci=HfzYdIXD-xXRU0dKoPgxdLW7JlFxs5hf5nSCtFgon8SL_au80cCSAQ#tblci=HfzYdIXD-xXRU0dKoPgxdLW7JlFxs5hf5nSCtFgon8SL_au80cCSAQ)
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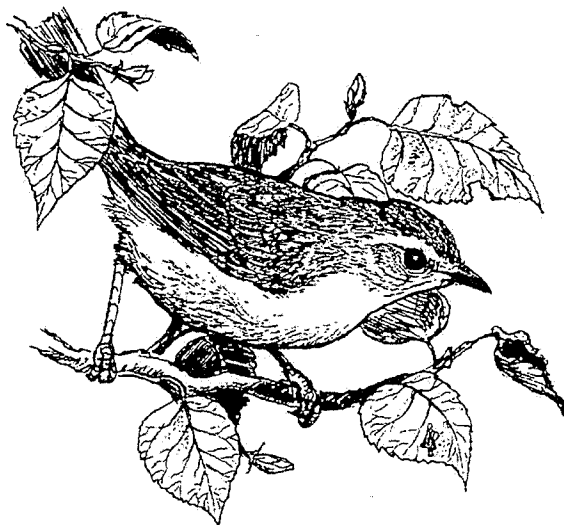
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The Legacy Report

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(<https://popularsearches.net/index.php?>

Neotropical Migrant Landbirds in the Northern Rockies and Great Plains



United States
Department of Agriculture

Forest
Service

Northern Region



92

Cor-B-53

A Handbook for
Conservation
and Management

by

David S. Dobkin

The High Desert Museum
Bend, Oregon

Cal Base-Sook.
Souso-D-19.
Salvage-A-14!!!

CASSIN'S FINCH

Carpodacus cassinii
Fringillidae

Summer, Permanent, or Winter Resident

WINTERING AREA: 5

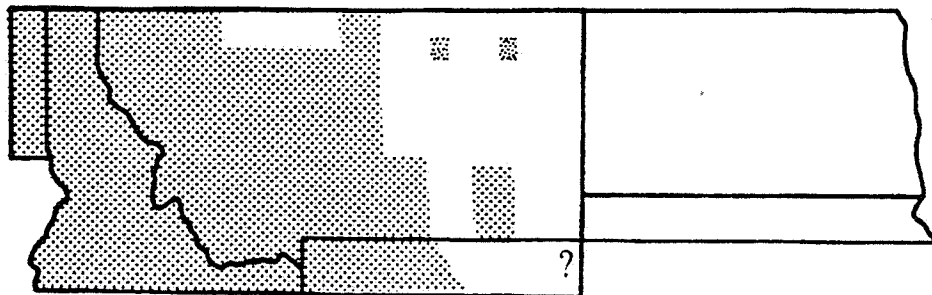
HABITAT REQUIREMENTS: Drier montane coniferous forests and woodlands, especially of ponderosa pine. Nests in coniferous trees.

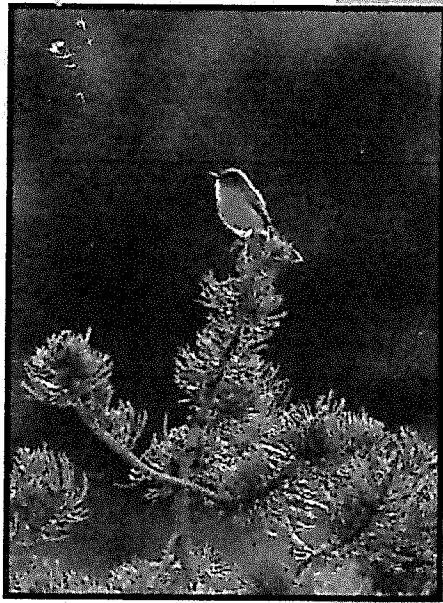
FEEDING: Dines primarily on seeds of conifer trees, also takes insects, buds and berries. Forages on the ground and by gleaning from foliage in trees and shrubs.

STATUS AND MANAGEMENT: Numbers have been highly erratic in Idaho but appear to be increasing

there; numbers have been more stable in Montana but appear to be declining slightly. In the West as a whole, numbers show a small but significant increasing trend. Prefers older rotation-age stands (Mannan and Maslow, 1984) and harvest units (Moore, 1992) over old growth. Cassin's Finch is a nomadic, semi-colonial breeder with resultant fluctuations in local population numbers.

FURTHER READING: Hejl et al., 1988; Mewaldt and King, 1985; Samson, 1976.





Sharing the Land with Pinyon-Juniper Birds

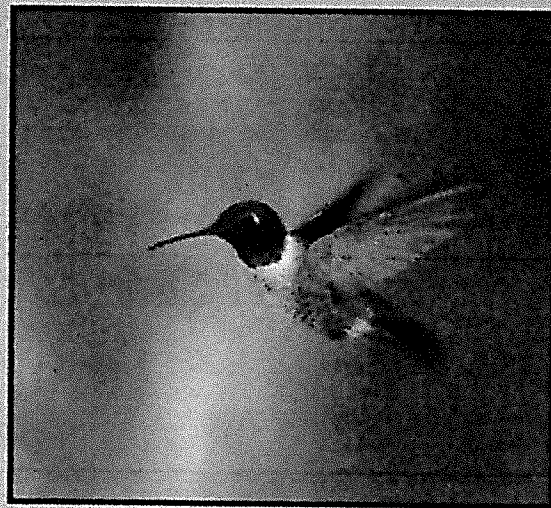


State of Utah
Department of Natural Resources
Division of Wildlife Resources



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2006

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Sharing the Land with Pinyon-Juniper Birds

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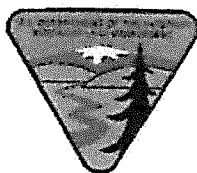
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Human History in Pinyon and Juniper Woodlands

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 metropoli-

tan 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 Rottler, 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 km²) 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 km²) (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).

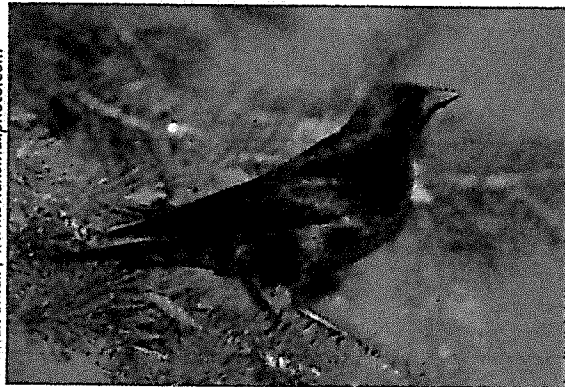
Brown-headed Cowbirds and Brood Parasitism

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

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.

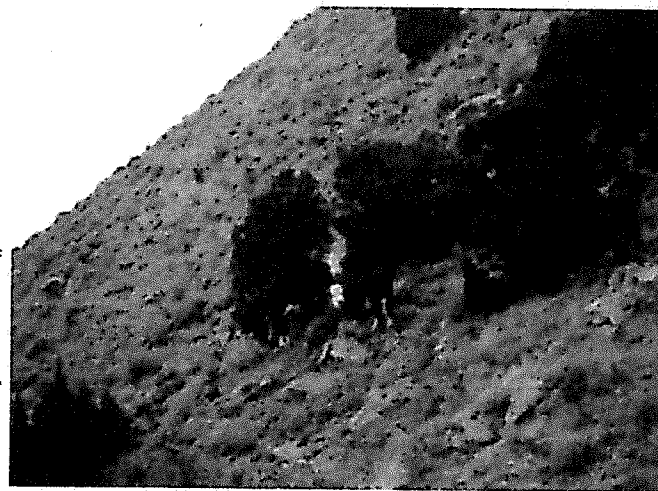
Management objectives and local conditions can support removal of dense stands of pinyon-juniper to release the herbaceous understory for livestock forage. A given site should have the potential to be highly productive and include a source of understory seeds, either in the soil seed bank (which is not 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.

BLM-Grand Junction Field Office



graze

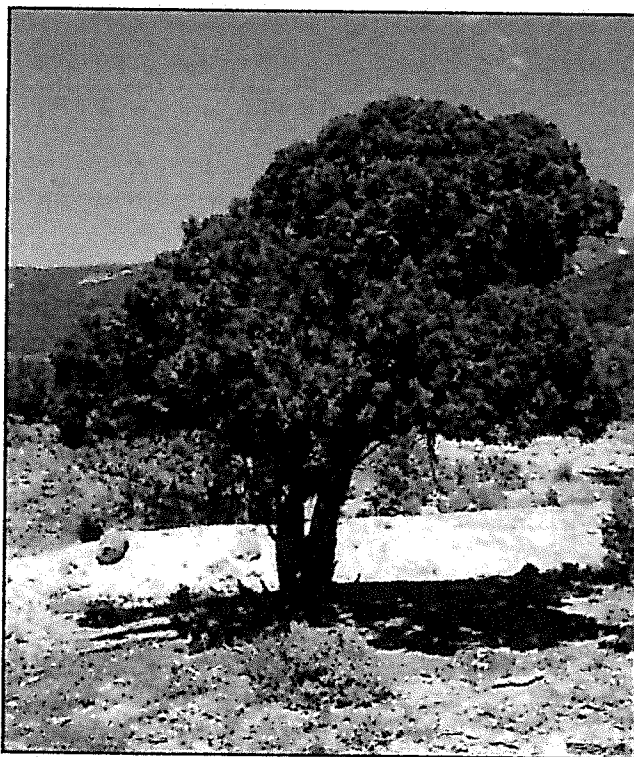
- Where biological soil crusts occur, protect them from damage by stocking at light to moderate levels during spring and by removing livestock before the hot and dry conditions of summer set in, to allow the crusts to recover while moisture is still available. Other strategies include employing a rest-rotation 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.

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).



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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.

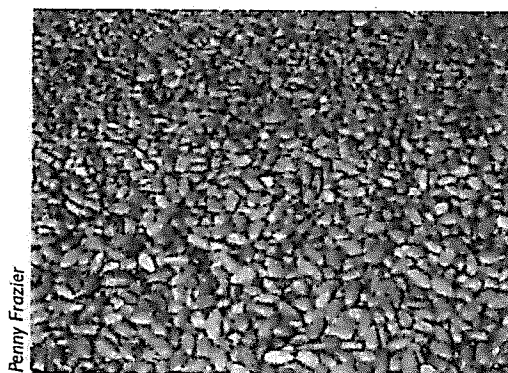
- Rehabilitate areas used for mineral exploration and extraction. Rehabilitation of such sites should include returning the land to its original contours and replanting with a mix of native species, particularly with local cultivars. Where native species are not available or where an exotic weed problem 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.

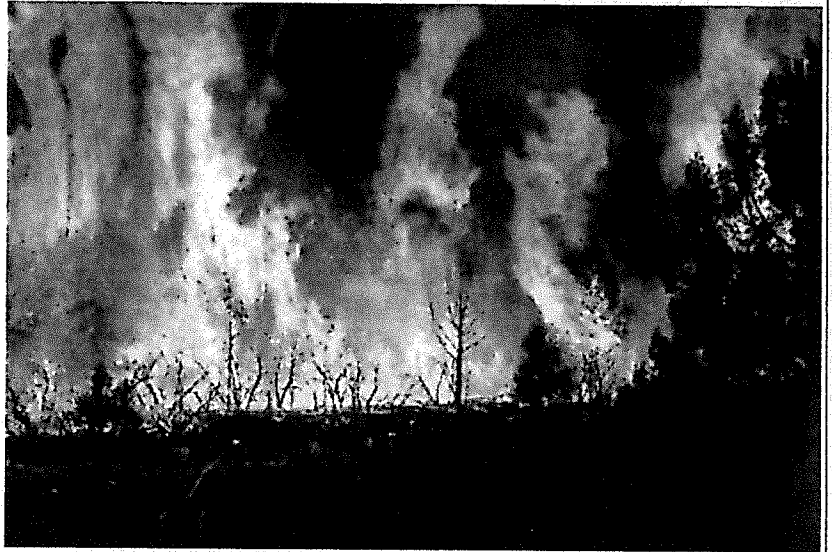


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Wildfire management

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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fire

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 whenever 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



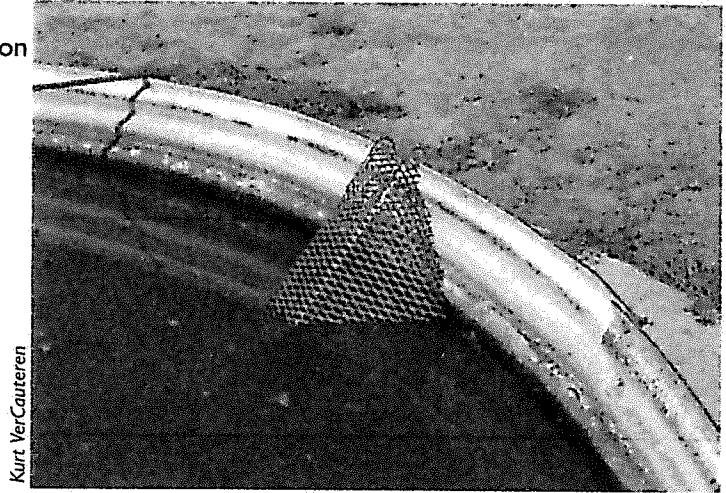
Where juniper or pinyon-juniper has encroached on sagebrush communities, acceptable removal methods include prescribed burns (used with caution), mechanical removal, and chemical treatment. The amount of disruption to the sagebrush stand should be a factor in selecting the tree removal method (Connelly 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.



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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:

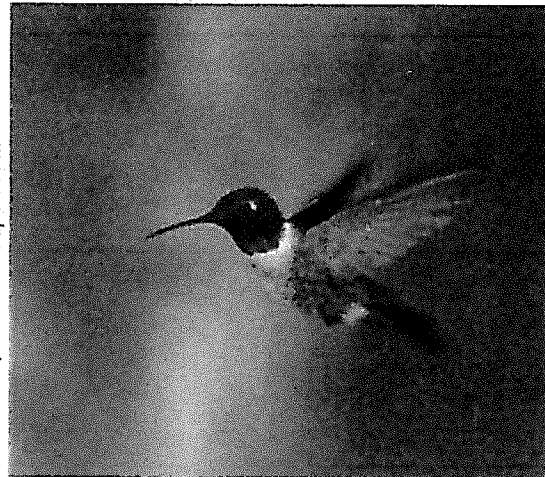
This species consumes nectar from flowers, also spiders and insects that it picks from vegetation. Dependent young are mostly fed invertebrates.

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.

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 native 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.

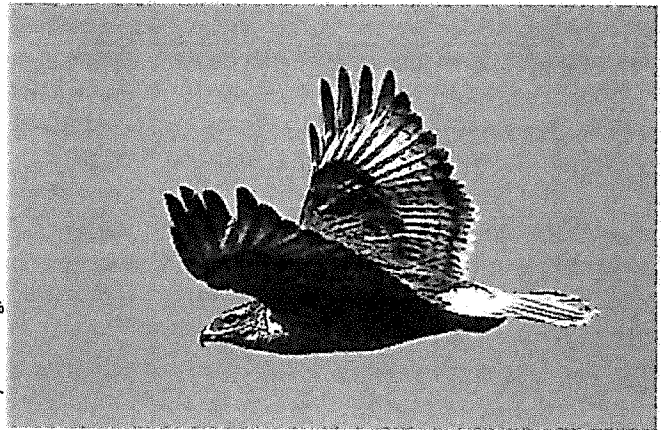
Feeding:

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 et 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,

Tony Leukering, RMBO



the population trend is a positive 2.2% per year (Sauer et al. 2006).

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

CN

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.

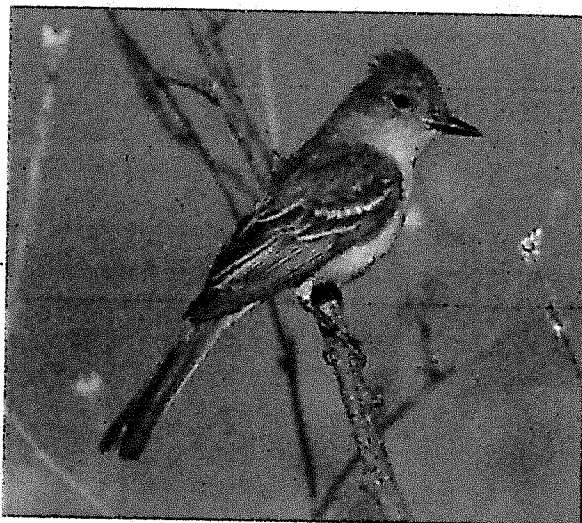
Status:

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:

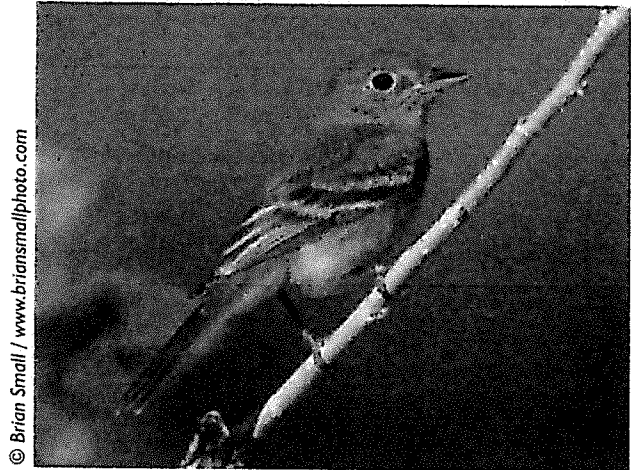
This species winters in western and central Mexico in open habitat with scattered trees and shrubs (Sterling 1999).

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).



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).

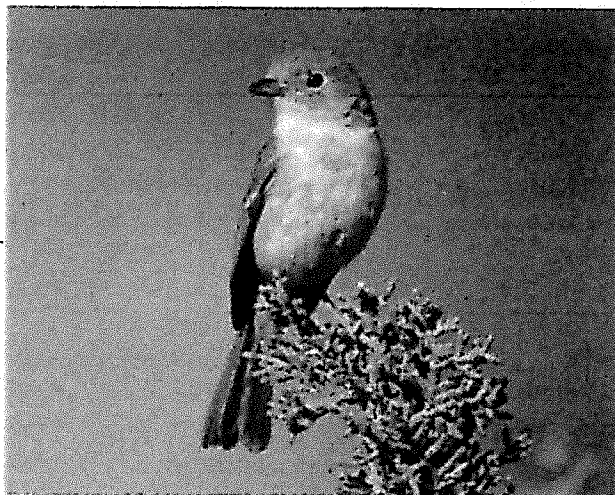
Feeding:

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 km²), 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:

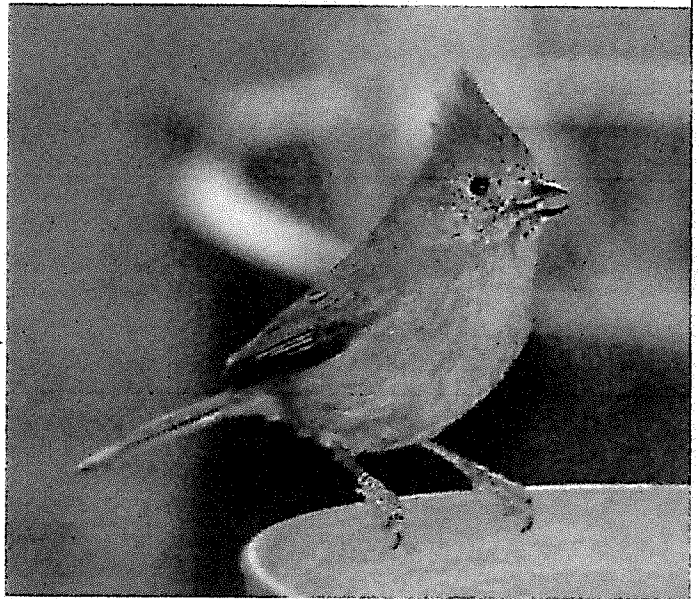
The Juniper Titmouse is nonmigratory, and pairs defend their territories year-round, although some birds may move upslope into ponderosa pine forests during winter.

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:

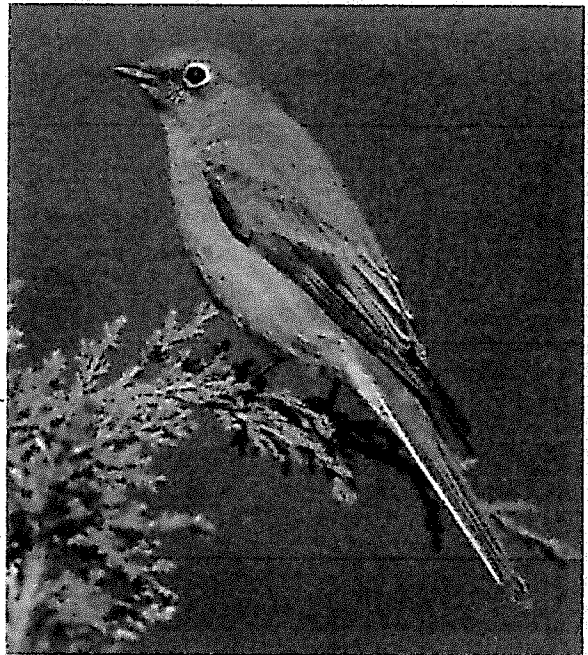
During winter, the Townsend's Solitaire moves into juniper or pinyon-juniper woodlands where it establishes and defends a feeding territory. The size of the territory is linked to the availability of juniper berries --- smaller territories where juniper berries are plentiful, larger territories where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

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:

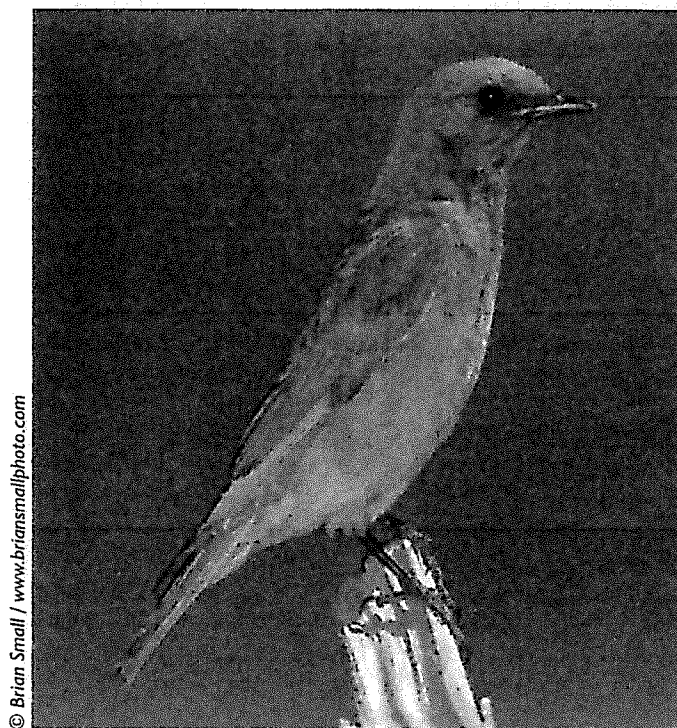
The summer diet is primarily invertebrates while the winter diet includes small berries such as mistletoe and juniper. It frequently captures flying insects by sallying out from an exposed perch, and collects invertebrates and small berries from foliage or on the ground.

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:

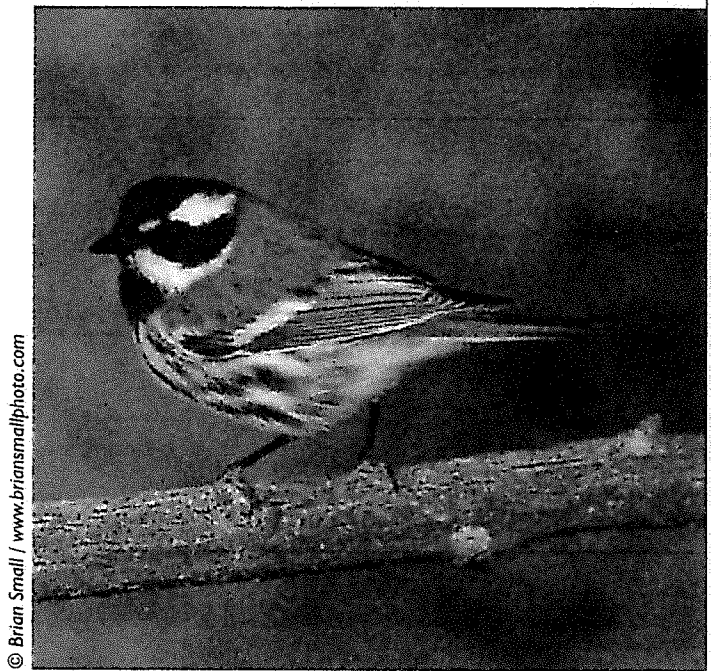
This species is insectivorous, and gleans insects from the foliage of trees and shrubs (Guzy and Lowther 1997).

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).



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).

15%
AC

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:

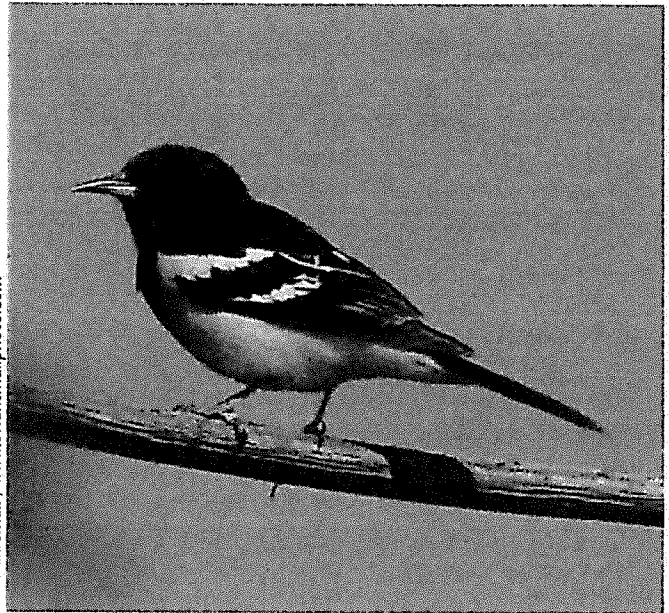
This species is insectivorous, collecting prey on the ground or low in vegetation. It also consumes berries, cactus fruits, and nectar.

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).

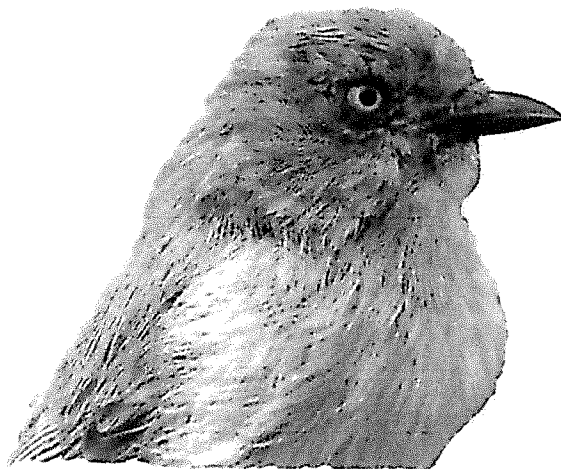
What you can do: Preserve trees with cavities, especially at forest or woodland edges or in open woodlands. Preserve standing dead trees as foraging perches. Reduce or eliminate the use of insecticides. Retain fruiting shrubs such as currants or elderberries. Install nest boxes to encourage nesting (see 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

Why Share?

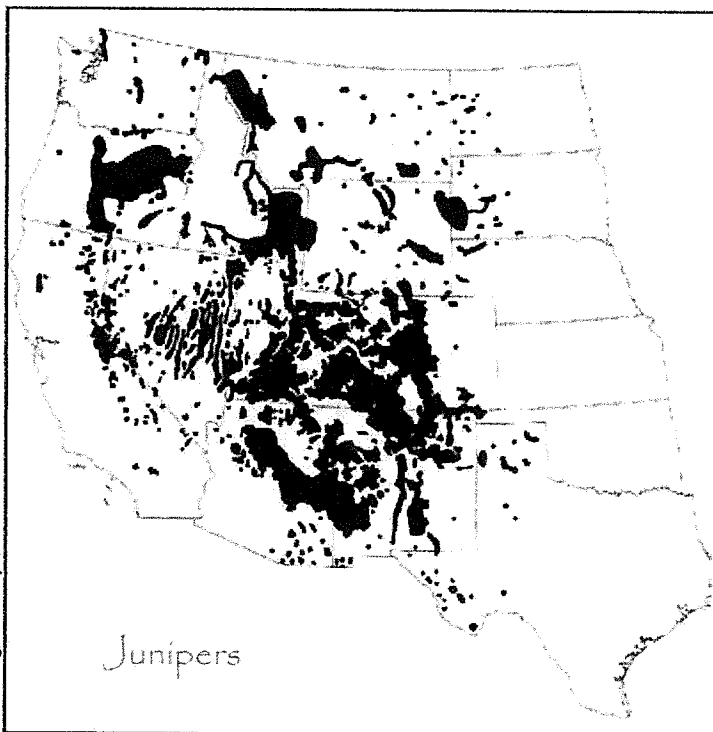
The pinyon-juniper woodland is a widespread ecosystem of the North American West. Estimates of its current extent vary widely, depending on how the habitat is defined and delineated. A recent estimate is 55.6 million acres (22.5 million ha; Mitchell and Roberts 1999). It is widely regarded that the extent 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.

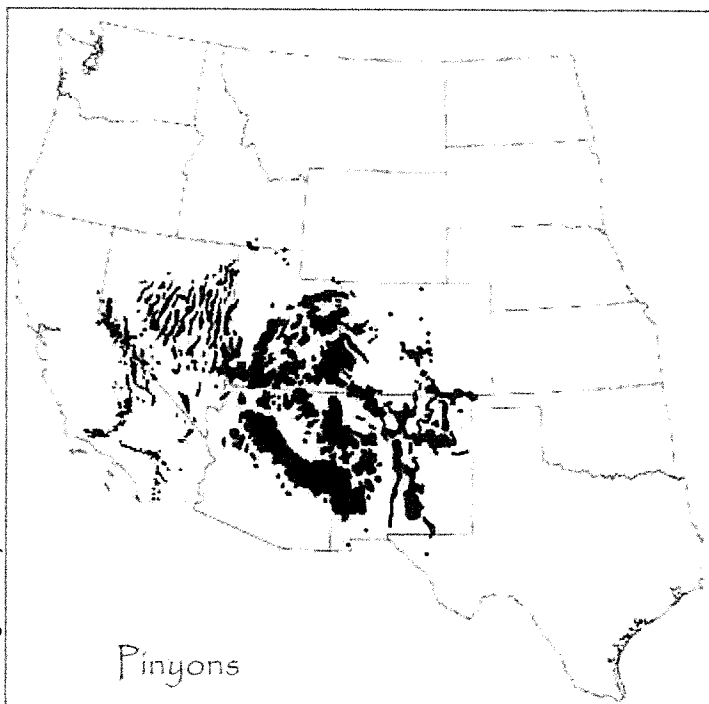
While the body of knowledge regarding pinyon-juniper woodlands grows steadily, some synthesis of the existing knowledge is in order so that landowners and land managers can go about their business of caring for the land. One area where such a synthesis is needed, where an information vacuum exists, is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



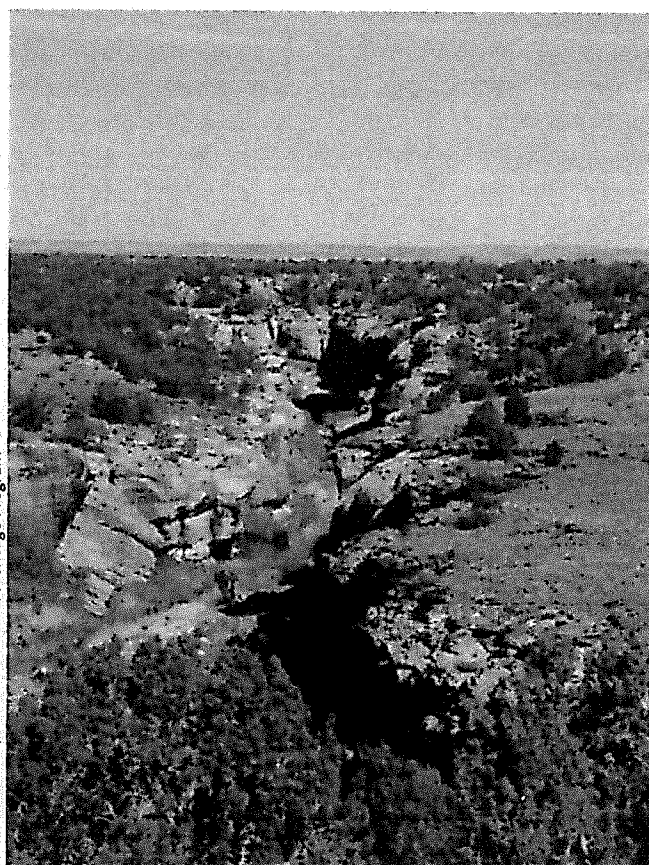


Pinyons and junipers rely heavily on animals for seed distribution, a dependence that makes the pinyon-juniper woodland unique. Other forest types may require animals to disperse some seeds of some plant species, but in pinyon-juniper, animals are critical to the dispersal of the seeds of the dominant 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.

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.



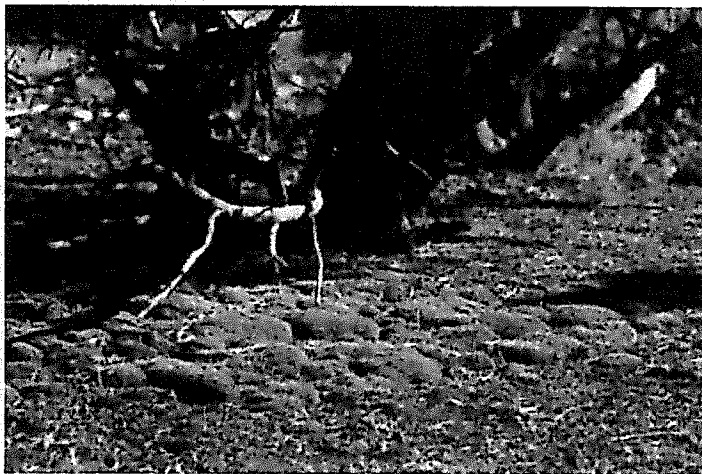
Renee Rordeau, Colorado Natural Heritage Program

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

BLM-Grand Junction Field Office



Moss and biological soil crust in a pinyon-juniper woodland

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)

(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).

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).

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-laden 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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CHARACTERISTICS OF OLD-GROWTH FORESTS
IN THE INTERMOUNTAIN REGION

COMPILED BY
RONALD C. HAMILTON
REGIONAL GENETICIST

APRIL 1993

U.S.D.A. - FOREST SERVICE

SAF COVER TYPE PINYON-JUNIPER Code 239

Species: *Pinus monophylla* - Singleleaf pinyon
Juniperus osteosperma - Utah juniper

Description:

Pinyon-juniper woodlands consist of relatively few tree species, but stands exhibit considerable diversity in appearance and composition. Some stands have closed canopies with one or both species present, and little or no understory vegetation. Other stands, in contrast, are open with widely scattered junipers and/or pinyons and a wide variety of shrub and herbaceous species in a well distributed understory. Stands may consist of all ages or one age, and may have sprawling multi-stemmed or tall, single-stemmed trees.

Historically there has been a great deal of use by man in pinyon-juniper stands. This use has had a profound influence on current stand structure and character of the understory. Most of the historical and some current use has centered around grazing and mining activities. Fire suppression has also influenced stands. Most of the negative impacts on the stands have occurred within the last 150 years. Few areas were avoided because the low elevations where it occurs were usually near settlements. Because of past grazing and deforestation, for mining and heating, a great proportion of the existing plant communities is neither climax or near climax. This cover type is, in a real sense, the result of much past human activity more than natural ecological processes.

The woodlands in the Intermountain Regions western area pinyon-juniper are either pure singleleaf pinyon, pure Utah juniper, or a combination of the two. Pinyon often is predominant in the mixed-species stands. Pure juniper stands are found only at the lowest elevations on ranges below where pinyon occurs. Juniper is generally absent from upper elevation areas of the range. These woodlands at upper elevations border the mountain brush zone. In some upper elevation areas singleleaf pinyon is mixed with curlleaf mahogany or locally with limber pine, Jeffrey pine, ponderosa pine, white fir, or Rocky Mountain juniper. Pure stands of singleleaf pinyon occur on all elevations along the western side of the Great Basin in western Nevada and eastern California. On more productive sites pinyon can grow to large size. Juniper is generally small in size and sparsely distributed on the lower drier portions of the woodlands, but larger juniper will grow on more productive sites. Junipers are also found in pure stands at all elevations across the northern Great Basin and into southern Idaho, northern Utah, and western Wyoming.

Area of Application

Pinyon-juniper woodlands in the Intermountain Region occur in two broad ecological areas. The boundary between these two areas generally coincides with the boundary between Colorado pinyon and singleleaf pinyon (Betancourt, J.L., Proceedings, 1987 pinyon-juniper conference. GTR INT-215. Ogden, Utah, USDA Forest Service page 133). Areas of hybridization between the two species are included in the Colorado pinyon region. Geographically the areas are separated by a boundary that runs through and connects the lowest elevations of the Bonneville Basin, Sevier Desert, and Escalante Desert in western Utah. The entire Toiyabe and Humboldt National Forests, the Wellsville mountains and Cache Valley portions of the Wasatch-Cache National Forest, and the Goose and Grouse Creek Mountains, Raft River Range, Black Pine Mountains, and the Cassia areas of the Sawtooth National Forest are included in this description of old-growth criteria.

For the remainder of Utah National Forests, the eastern sites influenced by Colorado pinyon and the zone of hybridization, the description and old-growth criteria developed by the Southwest Region (Region 3) are applicable.

Standard Summary of Old-Growth Characteristics

Vegetative Series: Singleleaf Pinyon - Utah Juniper
 SAF Cover Type : Pinyon - Juniper
 Applicable Area: Humbolt and Toiyabe NF, Sawtooth National Forest south
 the Snake River, the Wasatch-Cache NF portions
 encompassing the Wellsville Mountains and Cache
 Valley drainage.
 Site Productivity: See description of attributes

Live Trees

Main canopy			Variation in tree diameter	Tree decadence	Tree canopy layers
$\frac{1}{\text{DRC}}^*$	TPA*	Age*	6-in Classes	TPA	Number

Low

>12	≥ 12	>200	≥ 1	N/A	N/A
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High

>18	≥ 30	≥ 250	≥ 1	N/A	N/A
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Dead Trees

Standing		Down	
$\frac{1}{\text{DRC/ht ft}}$	TPA	Diameter (in)	Pieces/acre length in ft (min. length)

Low

12-5	$\geq .05^*$	≥ 10	$\geq 2-5$
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High

15-8	≥ 1	≥ 12	$> 2-8$
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*Dead limbs help make up the deficit for dead material.

**Some allowance for firewood and burning activity may be allowed.

1/ Diameter root crown.

Description of Attributes:

The following attributes are the minimum acceptable criteria for threshold old-growth in the singleleaf pinyon and Utah juniper portion of the pinyon-juniper cover type.

There are two stand potential production descriptions that should be used to segregate the stand situations encountered. Low production potential stands are usually found at lower elevation, drier portions of the type. Trees are short, with diffuse, sprawling crowns, often multiple stems, and low density per acre. Juniper-dominated areas have a well developed shrub-herbaceous understory. Increased pinyon presence diminishes understory to low and sparse levels.

High production potential sites are usually the upper elevation, moister regions of the type, where trees are taller and tend to be single stemmed with less diffuse crown area. Stands are usually dense; often pinyon predominates with little understory vegetation.

Live Trees

On low production potential sites, rather open stand types have 12 trees per acre greater than 12 inches in diameter (DRC, diameter root crown), and at least 200 years of age that produce at least 8 square feet of basal area per acre average. The total canopy coverage for all live trees on this site is 15 percent or more.

On high production potential sites, total canopy coverage exceeds 35 percent for all the live trees. These largely single-stemmed stands have 30 or more trees per acre that exceed 18 inches in diameter (DRC) producing at least 30 square feet of basal area. The trees are 250 or more years of age.

Dead trees

Low production potential, open growing stands, have few standing trees that are dead. They are widely scattered with about one per 20 acres that is 12 inches in diameter (DRC) and at least 5 feet in height. Stands unaffected by firewood removals should have two pieces longer than 5 feet in length and at least 10 inches in diameter at the small end as down woody debris.

High production, denser stands have more snags per acre, with at least one 15 inches or more in diameter (DRC) and 8 feet in height per acre. The down logs on these sites occur at about two per acre greater than 8 feet in length and 12 inches in diameter.

Stand Size

Ten acres or more. Past inventories have classified stands as 10 acres or more for ease in mapping and inventory purposes only. Minimum old-growth stand size and configuration have not been determined at this point. Surrounding stand conditions and management objectives should be considered when determining stand size.

Some stands to be evaluated for old-growth attributes may not be undisturbed. Minor tree removals, grazing and other disturbances may have altered the stands. Judgement must be used in evaluating old-growth conditions.

Habitat Types Where It Occurs

Use of climax vegetation to classify sites by habitat types is unsatisfactory in the pinyon-juniper type, therefore, no classification is provided.

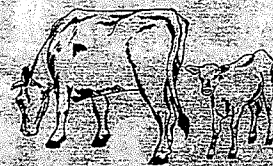
arming potential (GWP) of methane over a 20-year interval, meaning it is more potent than carbon dioxide in the near term.

drops to about this amount once in the atmosphere 1-year interval, after methane slowly breaks down in dioxide and water.

A single cow-calf pair emits **233 pounds** of methane annually.

Animal Unit Month (AUM)

Forage required to feed one 1,000-pound cow-calf pair grazing on public land for one month.



31.3 million acres

Minimum amount of land in the Western U.S. dominated by cheatgrass, a noxious, fire-prone weed spread by grazing, as of 2000.

123.5 million

Tons of carbon lost to the atmosphere as of 2000 due to the conversion of native rangelands to cheatgrass in the Wyoming big sagebrush biome.

Percentage of a cow's body weight the animal will eat in one month. This can increase in desert environments where cows must walk farther to reach forage.



Colorado River Basin

10-2 million of water needed to irrigate an acre, depending on soil and climate.

32%

Water from the Colorado River Basin that goes toward irrigating alfalfa and other livestock feed.

90%

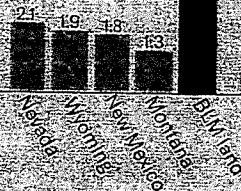
Water consumed by irrigated agriculture in the upper Colorado River Basin that goes toward cattle feed crops.

Lower Basin

Number of active AUMs (in millions)

Bureau of Land Management land as of February 2023, for cattle and other livestock.

155 million Acres of BLM land allotted for grazing.



\$5.49 million

Amount that industry, including livestock lobbying groups, donated to Frank Mitloehner, a UC Davis animal science professor who downplays cattle's contribution to climate change.

\$105.9 million

Amount budgeted to the Interior Department for rangeland management in 2020, meaning taxpayers are subsidizing grazing operations to the tune of \$90 million per year.

\$15.9 million

Revenue the BLM received from grazing fees for all livestock categories in 2020.

\$36

Social cost of greenhouse gas—the estimated cost of damage done to the climate—for one AUM on Western public lands.

\$2.5 billion

Total amount of federal conservation disaster commodity and crop insurance subsidies paid to ranchers and farmers in the 11 Western states between 1995 and 2020.

SOURCES: U.S. Department of Agriculture; Bureau of Land Management; Bureau of Reclamation; Environmental Working Group; Environmental Protection Agency; "Water Scarcity and Fish Imperilment Driven by Beef Production," by Brian Richter, et al.; "The animal agriculture industry, US universities, and the obstruction of climate understanding and policy," by Viveca Morris and Jennifer Jacquet; "Livestock Use on Public Lands in the Western USA Exacerbates Climate Change: Implications for Climate Change Mitigation and Adaptation," by J. Boone Kauffman, et al.

 University of Colorado **Boulder**

College of Arts and Sciences

Colorado Arts and Sciences Magazine

Temperature changes wreak havoc in deforested areas

By Trent Knoss • Feb. 22, 2016



A clear-cut forest area near Eugene, Oregon. Photo by Calibas / Wikipedia.

The newly exposed edges of deforested areas are highly susceptible to drastic temperature changes, leading to hotter, drier and more variable conditions for the forest that remains, according to new research from the University of Colorado Boulder.

The findings suggest that thermal biology—an emerging discipline that examines the effects of temperature on biological and ecological processes—could be an effective tool for understanding

how temperature changes in fragmented habitats can potentially wreak havoc on species activity and other critical ecosystem functions.

A study outlining a framework for applying thermal biology to deforestation research was recently published in the journal *Ecology Letters*.

Previous research has shown that widespread deforestation is a threat to global biodiversity, but scientists are only just now beginning to examine the role that temperature may play when trees are removed from an ecosystem—especially near the newly-cut edges of forests.

“When you chop down trees, you create hot spots in the landscape that are just scorched by the sun,” said Kika Tuff, a PhD candidate in the Department of Ecology and Evolutionary Biology at CU-Boulder and the lead author of the new paper. “These hot spots can change the way that heat moves through the landscape.”

In some cases, this creates a phenomenon known as the ‘vegetation breeze,’ where low air pressure in the cleared areas pulls the cool, moist air out of the forest and feeds hot, dry air back in.

“So now the cleared areas get all the rain and the forests gets sucked dry,” said Tuff.

The warming effect is most pronounced between 50 and 100 meters of a forest edge, the study reports, where temperatures can be anywhere from 4 to 18 degrees Fahrenheit warmer than in the forest interior.

“This is like climate change on steroids,” Tuff said, “and it happens over much more rapid time scales.”

Biologists estimate that 20 percent of the world’s remaining forests lie within 100 meters of an edge, while more than 70 percent lie within a kilometer of one. This means that much of the world’s forests may be experiencing the vegetation breeze and other warming effects.

Increased temperature variation near forest edges could affect species’ ability to regulate their body temperatures, resulting in behavioral changes that could alter the local ecosystem.

One such example, Tuff said, could be the feeding patterns of animals living at the forest edge. Animals are very temperature sensitive, so they hunt for food when they have sufficiently warmed up in the morning and stop hunting for food when it is too hot in the afternoon. If temperatures are



Kika Tuff

higher at the forest edge, species may respond by retreating to hunt in the cooler, deeper forest, where they become dependent on new types of food, sparking a domino effect in the food chain.

Another example might be the timing and duration of species activity. If temperatures were to increase due to tree loss, predators may start foraging later in the day to avoid the heat. Such a change could increase how frequently predators come across their prey, intensifying predation events and resulting in localized prey population crashes in some cases.

Such effects should also apply in instances of natural treefall, Tuff said. In Colorado, for example, high winds, wildfires and beetle kill can create edges in the treeline where greater sunlight exposure would subsequently increase the solar radiation and temperature in localized areas.

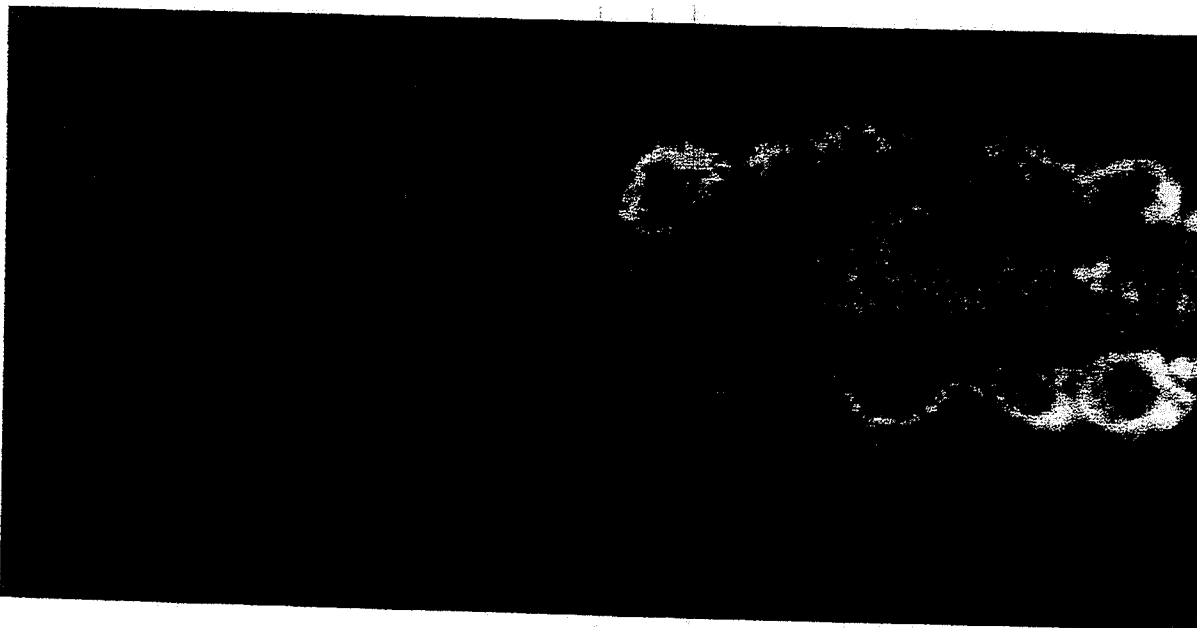
The sensitivity of animals and plants to temperature could have implications for future conservation strategies as deforestation and habitat fragmentation continue worldwide.

"Applying thermal biology on the scale of landscapes is a fairly new idea," Tuff said. "Thermal biology presents a new imperative for forest conservation and makes the value of forests all the greater because of what they do for thermal regulation. Trees aren't just habitat for animals, they are the world's insurance for a thermally stable and habitable planet."

The study was co-authored by Assistant Professor Kendi Davies and graduate student Ty Tuff, both of the Department of Ecology and Evolutionary Biology (EBIO) at CU-Boulder.

Trent Knoss is a science editor at the CU Office of News Services.

Related Articles



Gene controlling skin stem-cell self-renewal is found



The Unseen Effects of Deforestation: Biophysical Effects on Climate

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Climate policy has thus far focused solely on carbon stocks and sequestration to evaluate the potential of forests to mitigate global warming. These factors are used to assess the impacts of different drivers of deforestation and forest degradation as well as alternative forest management. However, when forest cover, structure and composition change, shifts in biophysical processes (the water and energy balances) may enhance or diminish the climate effects of carbon released from forest aboveground biomass. The net climate impact of carbon effects and biophysical effects determines outcomes for forest and agricultural species as well as the humans who depend on them. Evaluating the net impact is complicated by the disparate spatio-temporal scales at which they operate. Here we review the biophysical mechanisms by which forests influence climate and synthesize recent work on the biophysical climate forcing of forests across latitudes. We then combine published data on the biophysical effects of deforestation on climate by latitude with a new analysis of the climate impact of the CO₂ in forest aboveground biomass by latitude to quantitatively assess how these processes combine to shape local and global climate. We find that tropical deforestation leads to strong net global warming as a result of both CO₂ and biophysical effects. From the tropics to a point between 30°N and 40°N, biophysical cooling by standing forests is both local and global, adding to the global cooling effect of CO₂ sequestered by forests. In the mid-latitudes up to 50°N, deforestation leads to modest net global warming as warming from released forest carbon outweighs a small opposing biophysical cooling. Beyond 50°N large scale deforestation leads to a net global cooling due to the dominance of biophysical processes (particularly increased albedo) over warming from CO₂ released. Locally at all latitudes, forest biophysical impacts far outweigh CO₂ effects, promoting local climate stability by reducing extreme temperatures in all seasons and times of day. The importance of forests for both global climate change mitigation and local adaptation by human and non-human species is not adequately captured by current carbon-centric metrics, particularly in the context of future climate warming.

Keywords: forest, biophysical effects, temperature, climate policy, deforestation/afforestation

deforestation and all emitted CO₂ would have had an effect in a given band, but the point of the analysis was to isolate the temperature change caused by forests in a given latitude. We determined the latitudinal sensitivity to warming in response to added CO₂ from a re-analysis of global 2 m temperature data (CERA-20C) obtained from the European Centre for Medium-Range Weather <https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/cera-20c>. We compared average temperatures from 1901 to 1910 and 2001–2010, by latitude on land only (inadequate land only data for 50–60S and 80–90N; for those, we do not report a locally felt CO₂ effect). Then we divided the temperature change for each latitude band by the change in global temperature over the same period. We scaled the effect of CO₂ emitted by a given 10° latitude band by this sensitivity to represent the influence of non-linear responses such as polar amplification (see **Supplementary Information 1** and **Supplementary Table 2**).

RESULTS

Biophysical Effects of Deforestation on Local Climate: A Broader Context

Our analysis is the first to compare regional scale biophysical and CO₂ impacts from regional scale deforestation but the literature is replete with data on local biophysical impacts. The results for local biophysical effects (100s of m to 100s of km) agree with our results at the regional scale (below). **Figures 2, 3** synthesize local biophysically-driven temperature responses to deforestation, as indicated by forest/no-forest comparisons or forest change over time, from the scientific literature. Satellite and flux tower data indicate that surface temperatures in tropical forests are significantly lower than in cleared areas nearby. On an annual basis, local surface cooling of 0.2–2.4°C has been observed (mean 0.96°C, **Figure 2** and **Supplementary Information 2**). In the temperate zone, satellite studies of land surface temperature (which is more sensitive than the temperature of the air at 2 m) have shown biophysical cooling from forest cover, or biophysical warming from deforestation (0.02–1.0°C, mean of 0.4°C; see **Figure 2** and **Supplementary Information 2**). Both *in situ* and satellite data generally indicate an average annual cooling of under 1°C from boreal deforestation (**Figure 2**). Across latitudinal zones, warming from deforestation is generally greater during the day, and during the dry (hot) season (**Figure 3**).

CO₂-Induced Warming Versus Biophysical Effects on Regional (Local) Temperature From Deforestation by 10° Latitude Band

As expected, the regionally felt effect of regionally (10° band) produced CO₂ is very small compared to any individual biophysical effect or the sum of all non-CO₂ effects (**Figure 4**). These results indicate that the net impact of all non-CO₂ effects is negligible between 20 and 30N. Beyond 30N the local biophysical response to deforestation is cooling. In the broader literature,

this latitude of net zero biophysical effect on local temperature is generally between 30 and 40N (**Figure 1**).

Biophysical Effects on Global Temperature From Deforestation by 10° Latitude Band

For most latitudinal bands, the strongest biophysical effect of deforestation is cooling from albedo changes. In the tropics, however, the warming effect of lost roughness is comparable to or greater than the albedo effect (**Figure 5A**). Adding the warming from lost evapotranspiration, the net biophysical effect from tropical deforestation is global warming, as much as 0.1°C contributed each by latitudes 0°–10°S and 0°–10°N. The net biophysical effect of intact tropical forest, therefore, is global cooling; slightly more cooling if BVOCs are also considered (see **Figure 5B**). Roughness effects are generally greater than evapotranspiration effects across latitudes providing a strong counterbalance to albedo effects (Davin and de Noblet-Ducoudré, 2010; Burakowski et al., 2018; Winckler et al., 2019b; **Figure 5A**). Albedo almost balances the combined effect of roughness, evapotranspiration, BVOC and non-linear effects between 20 and 30°N resulting in close to zero net biophysical effect on global temperature (**Figure 5B**). From 30–40°N and northward, albedo dominates, and the net biophysical effect of deforestation is cooling.

CO₂-Induced Warming Versus Biophysical Effects on Global Temperature From Deforestation by 10° Latitude Band

From 30°S to 30°N, the biophysical effect of deforesting a given 10° latitudinal band is about half as great and in the same direction as the CO₂ effect: global warming. Biophysical warming is around 60% as great as warming from released CO₂ in the outer tropics (20°S–10°S and 10°N–20°N) and about 35% as great in the heart of the tropics (10°S–10°N). Biophysical cooling due to deforestation from 30°N to 40°N offsets about 40% of the warming associated with carbon loss from deforestation; from 40°N to 50°N biophysical effects offset 85% of CO₂ effects (**Figure 5B**). Above 50°N, biophysical global cooling is 3–6 times as great as CO₂ induced global warming. The net impact of deforestation (effects of CO₂, biophysical processes and BVOC combined) is warming at all latitudes up to 50N (**Figure 5C**). Thus, from 50S to 50N, an area that encompasses approximately 65% of global forests (FAO, 2020), deforestation results in global warming (**Figure 5C**).

DISCUSSION

All Forests Provide Local Climate Benefits Through Biophysical Effects

Ignoring biophysical effects on local climate means casting aside a powerful inducement to promote global climate goals and advance forest conservation: local self-interest. The

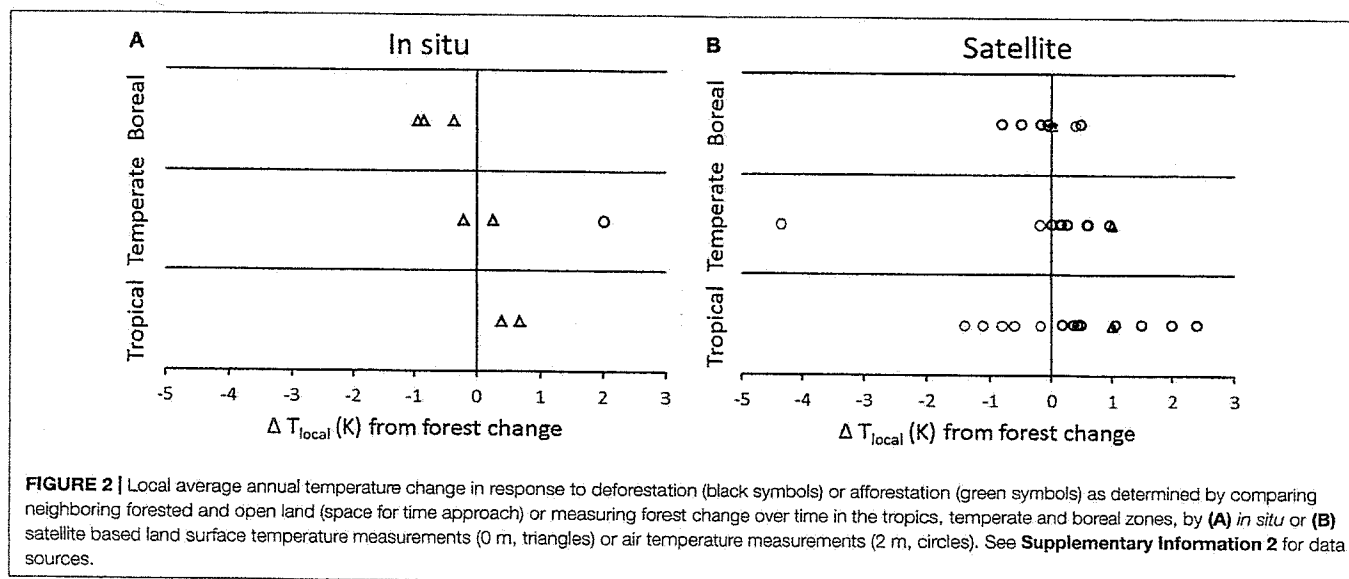


FIGURE 2 | Local average annual temperature change in response to deforestation (black symbols) or afforestation (green symbols) as determined by comparing neighboring forested and open land (space for time approach) or measuring forest change over time in the tropics, temperate and boreal zones, by (A) *in situ* or (B) satellite based land surface temperature measurements (0 m, triangles) or air temperature measurements (2 m, circles). See **Supplementary Information 2** for data sources.

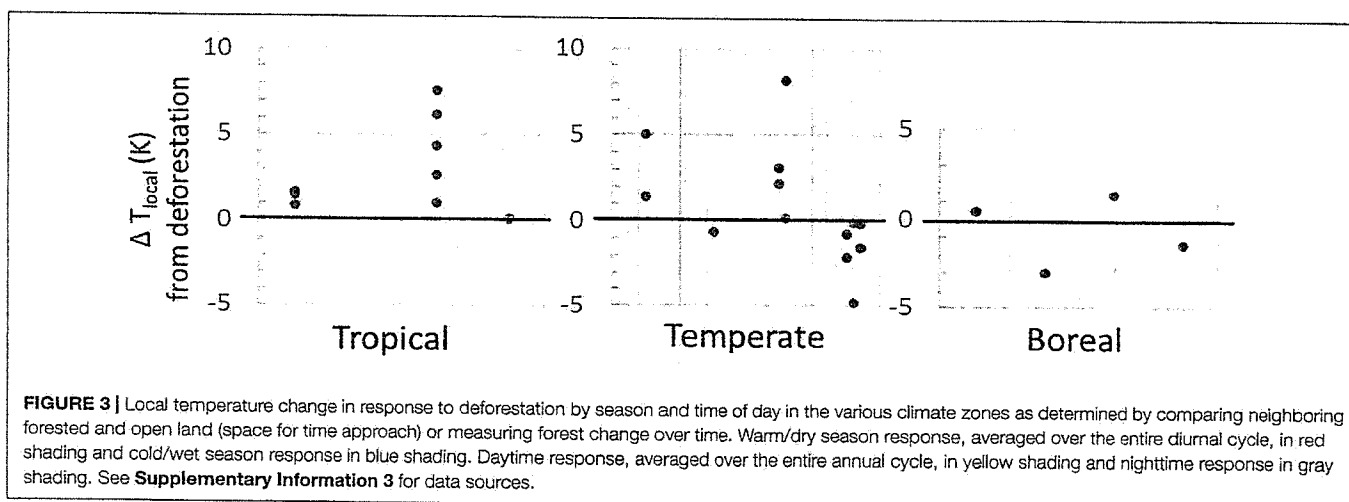


FIGURE 3 | Local temperature change in response to deforestation by season and time of day in the various climate zones as determined by comparing neighboring forested and open land (space for time approach) or measuring forest change over time. Warm/dry season response, averaged over the entire diurnal cycle, in red shading and cold/wet season response in blue shading. Daytime response, averaged over the entire annual cycle, in yellow shading and nighttime response in gray shading. See **Supplementary Information 3** for data sources.

biogeochemical effect of forests tends to dominate the biophysical effect at the global scale because physical effects in one region can cancel out effects in another. Nevertheless, biophysical effects are very important, and can be very large, at the local scale (e.g., Anderson-Teixeira et al., 2012; Bright et al., 2015; Jiao et al., 2017; **Figures 2–4**). The role of forests in maintaining critical habitat for biodiversity is well known, but new research on extinction confirms the role of forests in maintaining critical climates to support biodiversity. Changes in maximum temperature are driving extinction, not changes in average temperature (Román-Palacios and Wiens, 2020). Deforestation is associated with an increase in the maximum daily temperature throughout the year in the tropics and during the summer in higher latitudes (Lee et al., 2011; Zhang et al., 2014). Of course deforestation also increases average daytime temperatures in boreal, mid-latitude and tropical forests (**Figure 3**). The biophysical effects of forests also moderate local and regional temperature extremes such that extremely hot days are significantly more common following deforestation even in the mid- and high latitudes

(Vogel et al., 2017; Stoy, 2018). Historical deforestation explains $\sim 1/3$ of the present day increase in the intensity of the hottest days of the year at a given location (Lejeune et al., 2018). It has also increased the frequency and intensity of hot dry summers two to four fold (Findell et al., 2017). Local increases in extreme temperatures due to forest loss are of comparable magnitude to changes caused by 0.5°C of global warming (Seneviratne et al., 2018). Forests provide local cooling during the hottest times of the year anywhere on the planet, improving the resilience of cities, agriculture, and conservation areas. Forests are critical for adapting to a warmer world.

Forests also minimize risks due to drought associated with heat extremes. Deep roots, high water use efficiency, and high surface roughness allow trees to continue transpiring during drought conditions and thus to dissipate heat and convey moisture to the atmosphere. In addition to this direct cooling, forest ET can influence cloud formation (Stoy, 2018), enhancing albedo and potentially promoting rainfall. The production of BVOCs and organic aerosols by forests accelerates with

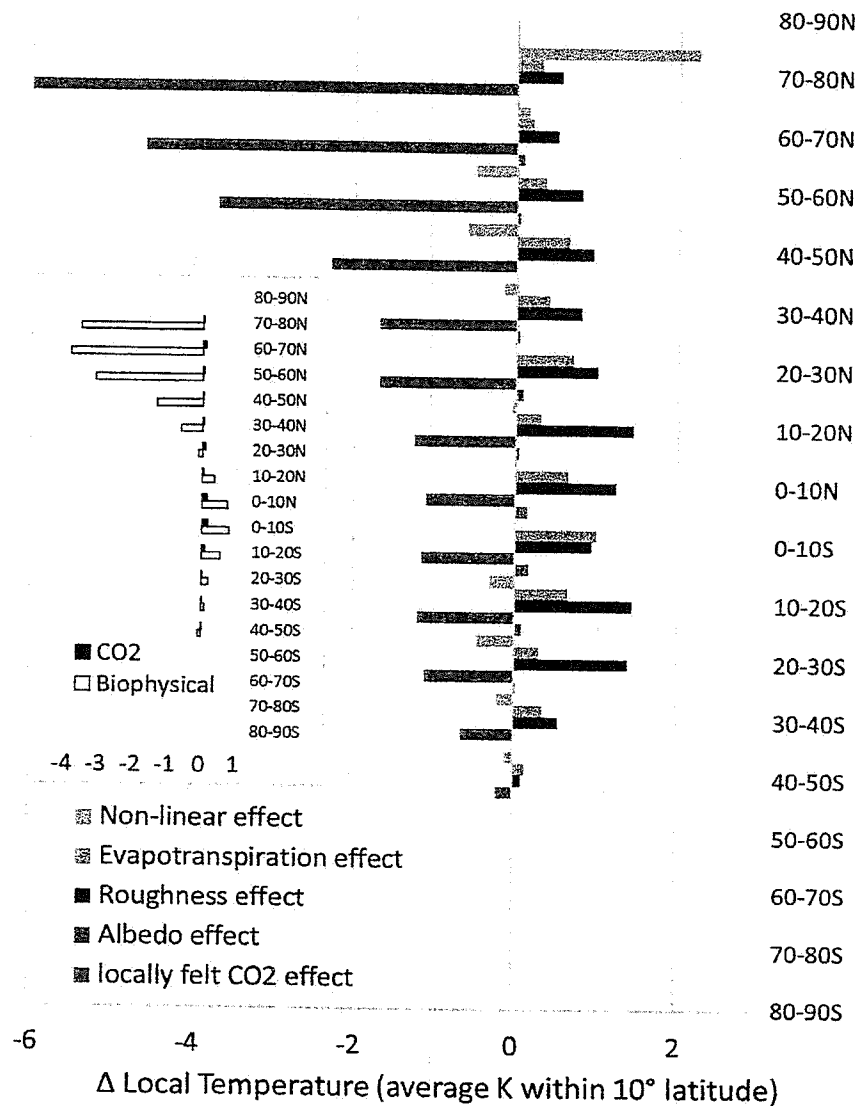


FIGURE 4 | Effect of complete deforestation on local annual temperature by climate factor, averaged across the land surface within a 10° latitudinal band. Complete deforestation was implemented globally and analyzed by 10° latitudinal bands (Davin and de Noblet-Ducoudré, 2010). The CO₂ effect was determined from total aboveground biomass in each 10° band after Walker et al. (2020) and scaled by CERA-derived sensitivity by latitude. Inset distinguishes the sum of all local biophysical effects from local CO₂ effects.

increasing temperatures, enhancing direct or indirect (cloud formation) albedo effects. This negative feedback on temperature has been observed to counter anomalous heat events in the mid-latitudes (Paasonen et al., 2013).

Some Forests Provide Global Climate Benefits Through Biophysical Effects

Disregarding the biophysical effects of specific forests on global climate means under-selling some forest actions and over-selling others. The response to local forest change is not equivalent for similar sized areas in different latitudes. According to Arora and Montenegro (2011) warming reductions per unit reforested area

are three times greater in the tropics than in the boreal and northern temperate zone due to a faster carbon sequestration rate magnified by year-round biophysical cooling. Thus, considering biophysical effects significantly enhances both the local and global climate benefits of land-based mitigation projects in the tropics (see Figures 4, 5).

Constraints on Forest Climate Benefits in the Future

Climate change is likely to alter the biophysical effect of forests in a variety of ways. Deforestation in a future (warmer) climate could warm the tropical surface 25% more than deforestation

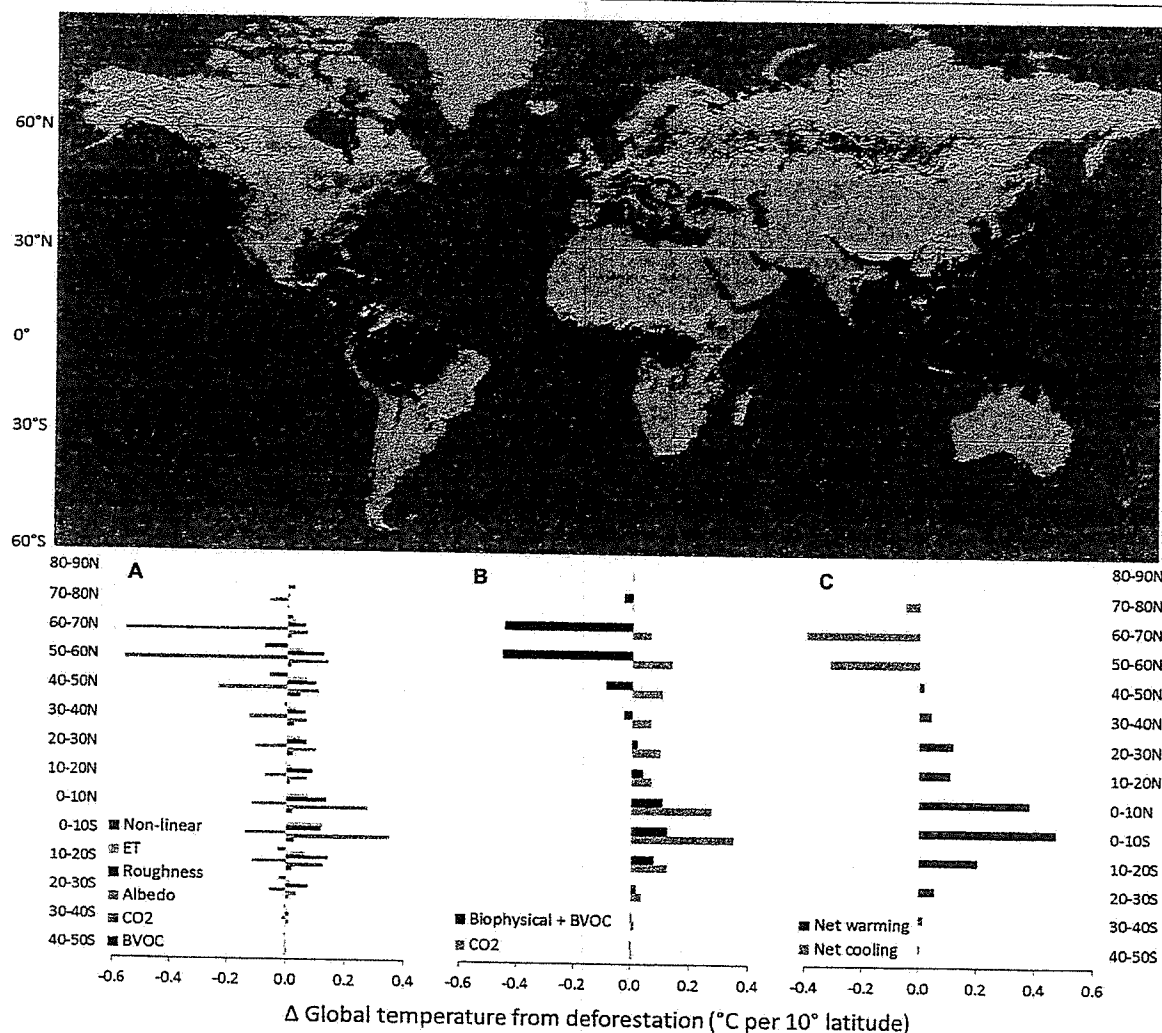


FIGURE 5 | Effect of complete deforestation on global temperature by 10° band of latitude. **(A)** Contribution to global temperature change by climate forcing factor. Biophysical factors are from Davin and de Noblet-Ducoudré, 2010, area-weighted. BVOC effects are estimated relative to albedo effects based on Scott et al., 2018. CO₂ effect is based on aboveground live biomass for each 10° latitudinal band following Baccini et al., 2017 and Walker et al., 2020. **(B)** Net biophysical and BVOC effect versus CO₂ effect. **(C)** Cooling or warming effects of deforestation by 10° latitudinal band (BVOC included). "Forests as mountains" map of aboveground biomass carbon in woody vegetation ca. 2016 courtesy of Woodwell Climate Research Center and shaded to indicate where deforestation results in net global warming. See **Supplementary Information 1** for details.

in a present-day climate due to stronger decreases in turbulent heat fluxes (Winckler et al., 2017b). In a warmer climate, reduced snow cover in the temperate and boreal regions will lead to a smaller albedo effect and thus less biophysical cooling with high latitude deforestation. In addition to snow cover change, future rainfall regimes will affect the response of climate to changes in forest cover (Pitman et al., 2011) as rainfall limits the supply of moisture available for evaporative cooling. Increases in water use efficiency due to increasing atmospheric CO₂ may reduce evapotranspiration (Keenan et al., 2013), potentially reducing the local cooling effect of forests and altering atmospheric moisture content and dynamics at local to global scales. Future BVOC production may increase due to warming and simultaneously decline due to CO₂ suppression

(Lathière et al., 2010; Unger, 2014; Hantson et al., 2017). The physiological and ecological responses of forests to warming, rising atmospheric CO₂ and changing precipitation contribute to uncertainty in the biophysical effect of future forests on climate.

Forest persistence is essential for maintaining the global benefits of carbon removals from the atmosphere and the local and global benefits of the physical processes described above. Changing disturbance regimes may limit forest growth and regrowth in many parts of the world. Dynamic global vegetation models currently show an increasing terrestrial carbon sink in the future. This sink is thought to be due to the effects of fertilization by rising atmospheric CO₂ and N deposition on plant growth as well as the effects of climate change lengthening the growing season in northern temperate and boreal areas (Le Quéré et al.,

2018). Free-air carbon dioxide enrichment (FACE) experiments often show increases in biomass accumulation under high CO₂ but results are highly variable due to nutrient limitations and climatic factors (Feng et al., 2015; Paschalis et al., 2017; Terrer et al., 2018). Climate change effects on the frequency and intensity of pest outbreaks are poorly studied, but are likely to be significant, particularly at the margins of host ranges. Warmer springs and winters are already increasing insect-related tree mortality in boreal forests through increased stress on the tree hosts and direct effects on insect populations (Volney and Fleming, 2000; Price et al., 2013).

Climate also affects fire regimes. In the tropics, fire regimes often follow El Niño cycles (van der Werf et al., 2017). As temperatures increase, however, fire and rainfall are decoupled as the flammability of forests increases even in normal rainfall years (Fernandes et al., 2017; Brando et al., 2019). Fire frequency is also increasing in some temperate and boreal forests, with a discernable climate change signal (Abatzoglou and Williams, 2016). Modeling exercises indicate that this trend is expected to continue with increasing damage to forests as temperatures rise and fire intensity increases (De Groot et al., 2013).

In addition to changes induced by warming, continued deforestation could severely stress remaining forests by warming and drying local and regional climates (Lawrence and Vandecar, 2015; Costa et al., 2019; Gatti et al., 2021). In the tropics, a tipping point may occur, potentially resulting in a shift to shorter, more savannah-like vegetation and altering the impact of vast, previously forested areas on global climate (Nobre et al., 2016; Brando et al., 2019). Some of these processes are included in climate models and some are not. The gaps leave considerable uncertainty. Nevertheless, a combination of observations, models, and theory gives us a solid understanding of the biophysical effects of forests on climate at local, regional and global scales. We can use that knowledge to plan forest-based climate mitigation and adaptation.

Mitigation Potential of Forests: Beyond the Carbon/Biophysical Divide

If instead of focusing on the contrast between biophysical and biochemical impacts of forests and forest loss, we focus on the potential of forests to cool the planet through both pathways, another picture emerges. By our conservative estimate, through the combined effects on CO₂, BVOC, roughness and evapotranspiration, forests up to 50°N provide a net global cooling that is enough to offset warming associated with their low albedo. Given the most realistic pathways of forest change in the future (not complete deforestation of a 10° latitudinal band, or an entire biome), global climate stabilization benefits likely extend beyond 50°N. For the 29% of the global land surface that lies beyond 50°N, forests may warm the planet, but only as inferred from assessing the effects of complete zonal deforestation with all the associated, and powerful, land-ocean feedbacks spawned by largescale forest change in the boreal zone. Forests above 50°N, like forests everywhere, provide essential local climate stabilization benefits by reducing surface temperatures during

the warm season as well as periods of extreme heat or drought. Indeed, they also reduce extreme cold.

Creating a fair and effective global arena for market-based solutions to climate change requires attention to all the ways that forests affect climate, including the biophysical effects. Future metrics of forest climate impacts should consider the effects of deforestation beyond CO₂. Only recently have modelers begun to include BVOC. Doing so means that the albedo of intact forests (or the atmosphere above them) is higher due to the creation of SOA and subsequent cloud formation. Modeled deforestation thus results in less of a change in albedo, reducing the biophysical cooling effect. Similarly, accounting for the ozone and methane effects of BVOC reduces the biogeochemical warming from deforestation (Scott et al., 2018). In addition, especially in the tropics, deforestation reduces the strength of the soil CH₄ sink (Dutaur and Verchot, 2007). While a small change relative to the atmospheric pool of CH₄ (the second most important greenhouse gas), the loss of this sink is equivalent to approximately 13% of the current rate of increase in atmospheric CH₄ (Saunois et al., 2016). We already have the data (Figure 5) to begin conceptualizing measures to coarsely scale CO₂ impacts of forest change by latitude. Finer resolution of latitude, background climate (current and future) and forest type would improve any such new, qualifying metric for the climate mitigation value of forests.

The role of forests in addressing climate change extends beyond the traditional concept of CO₂ mitigation which neglects the local climate regulation services they provide. The biophysical effects of forest cover can contribute significantly to solving local adaptation challenges, such as extreme heat and flooding, at any latitude. The carbon benefits of forests at any latitude contribute meaningfully to global climate mitigation. In the tropics, however, where forest carbon stocks and sequestration rates are highest, the biophysical effects of forests amplify the carbon benefits, thus underscoring the critical importance of protecting, expanding, and improving the management of tropical forests. Perhaps it is time to think more broadly about what constitutes global climate mitigation. If climate mitigation means limiting global warming, then clearly the biophysical effects of deforestation must be considered in addition to its effects on atmospheric CO₂. We may further consider whether mitigation is too narrow a scope for considering the climate benefits provided by forests. Climate policy often separates mitigation from adaptation, but the benefits of forests clearly extend into both realms.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

AUTHOR CONTRIBUTIONS

DL conceived the presented idea. All authors helped perform the computations, discussed the results, and contributed to the final manuscript.

Trees and forests

Very cool: trees stalling effects of global heating in eastern US, study finds

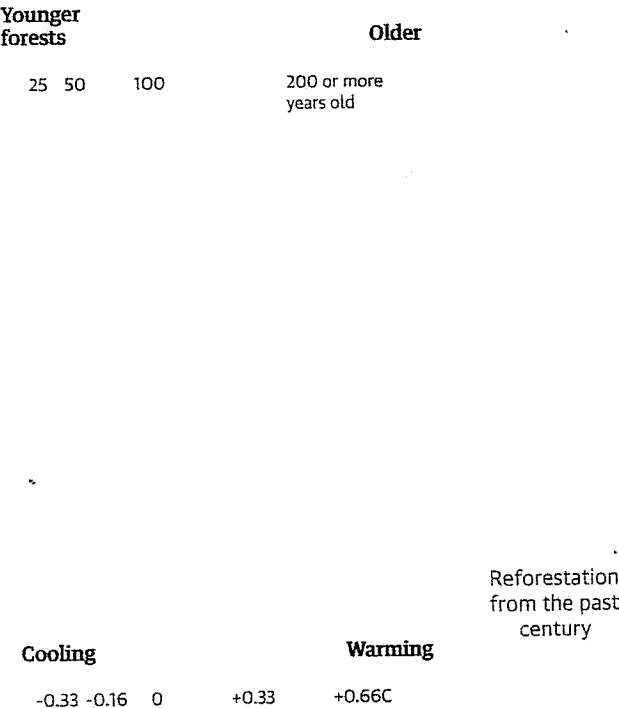
Vast reforestation a major reason for 'warming hole' across parts of US where temperatures have flatlined or cooled

Oliver Milman

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Sat 17 Feb 2024 05.00 EST

Trees provide innumerable benefits to the world, from food to shelter to oxygen, but researchers have now found their dramatic rebound in the eastern US has delivered a further, stunning feat - the curtailing of the soaring temperatures caused by the climate crisis.

While the US, like the rest of the world, has heated up since industrial times due to the burning of fossil fuels, scientists have long been puzzled by a so-called "warming hole" over parts of the US south-east where temperatures have flatlined, or even cooled, despite the unmistakable broader warming trend.



A major reason for this anomaly, the new study finds, is the vast reforestation of much of the eastern US following the initial loss of large numbers of trees in the wake of European settlement in America. Such large expanses have been reforested in the past century - with enough trees sprouting back to cover an area larger than England - that it has

to reverse from around the 1920s as more people began to move into cities, leaving marginal land to become populated again with trees. The US government, meanwhile, embarked upon an aggressive tree-planting program, with these factors leading to about 15m hectares of reforested area in the past century in the eastern US.



People work to reforest Allegheny National Forest in Pennsylvania circa 1934. Photograph: Universal History Archive/Universal Images Group via Getty Images

The recovery of the US's eastern forests has blunted global heating mainly through the trees' transpiration, in which water is drawn up through the roots to the leaves and then released into the air as vapor, slightly cooling the surrounding area.

By poring over data from satellites and weather stations located across the eastern US from 1900 to 2000, Barnes and her colleagues found reforested areas have provided this cooling impact on a grand scale, with most of this effect occurring within 400 meters of the trees.

In all, the replenished forests today cool the eastern US by 1C to 2C (1.8F to 3.6F) each year. The cooling effect is strongest on the hottest days in summer, when trees lower temperatures by 2C to 5C (3.6F to 9F), the researchers found.

The researchers cautioned that bringing back trees hasn't been the sole cause of the stalled warming, with factors such as airborne pollutants, which block incoming sunlight, and agricultural irrigation also potential causes. But Barnes said that the findings should further bolster efforts to provide thoughtful reforestation, particularly near urban communities that suffer particularly scorching temperatures due to a lack of shady trees.

"Trees have a really beneficial impact upon surface temperatures through transpiration, which is similar to human sweating, and they have really cooled things off a lot," said Barnes.



📷 Civilian Conservation Corps workers plant 15,000,000 trees across the wastelands of southern Mississippi on 11 April 1940. They are part of the United Forest Service which will re-establish forests destroyed by logging and lumbering operations decades ago. Photograph: AP

“Moving forward, we need to think about tree planting not just as a way to absorb carbon dioxide but also the cooling effects in adapting for climate change, to help cities be resilient against these very hot temperatures.”

Patrick Gonzalez, a University of California, Berkeley, climate change scientist and forest ecologist who wasn't involved in the new study, said the work provides “strong support” to the theory of cooling trees.

“Cutting carbon pollution from cars, power plants and other human sources that burn coal, oil and methane remains the essential solution to halt climate change,” he said. “Natural regeneration of trees and reforestation, where ecologically appropriate, can contribute substantially.”

Barnes, too, stressed that reforestation was no substitute for the need to drastically cut planet-heating emissions, which hit a new global high last year.

“Nature-based climate solutions like tree planting won't get us out of this climate change problem,” she said. “If anyone thinks we can just plant a few trees and be OK, they are wrong - we need a massive reduction in fossil fuel emissions to hit our targets. Reforestation is something that needs to happen in addition to, not instead of, cutting emissions.”

I hope you appreciated this article. Before you move on, I wanted to ask if you would consider supporting the Guardian's journalism as we enter one of the most consequential news cycles of our lifetimes in 2024.

With the potential of another Trump presidency looming, there are countless angles to cover around this year's election - and we'll be there to shed light on each new development, with explainers, key takeaways and analysis of what it means for America, democracy and the world.

From Elon Musk to the Murdochs, a small number of billionaire owners have a powerful hold on so much of the information that reaches the public about what's happening in the world. The Guardian is different. We have no billionaire owner or shareholders to consider. Our journalism is produced to serve the public interest - not profit motives.

And we avoid the trap that befalls much US media: the tendency, born of a desire to please all sides, to engage in false equivalence in the name of neutrality. We always strive to be fair. But sometimes that means calling out the lies of powerful people and institutions - and making clear how misinformation and demagoguery can damage democracy.

State of the Birds Report

United States of America

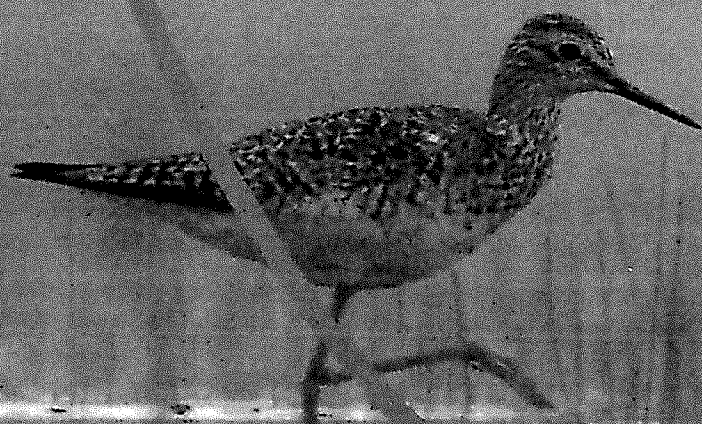
2022

North American Bird
Conservation Initiative 2022
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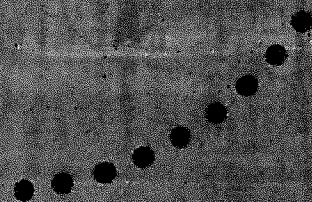


We Can Bend the Curve to Bring Birds Back

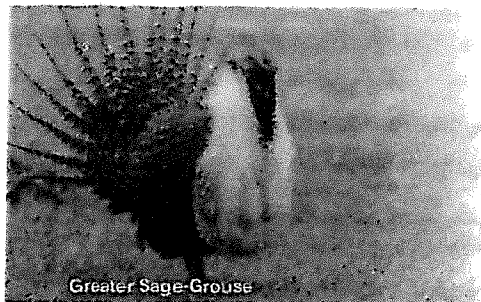
The United States and Canada have lost 3 billion breeding birds since 1970—a loss of 1 in 4 birds, according to research published in *Science* in 2019. This steep decline in abundance can be reversed with new scales of conservation actions that benefit not only birds but also wildlife and people.



Lesser Yellowlegs



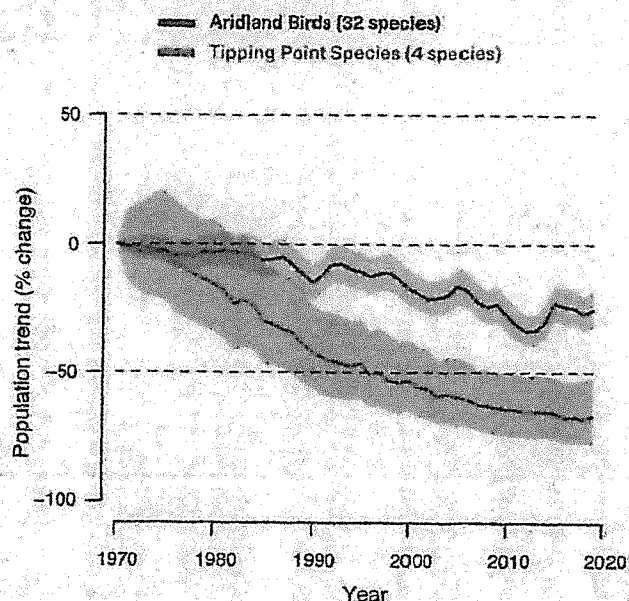
When Birds Thrive, We All Win



Greater Sage-Grouse

ARIDLAND BIRDS A Key Role for Public Lands

Status: Long-term declines with unrelenting habitat threats

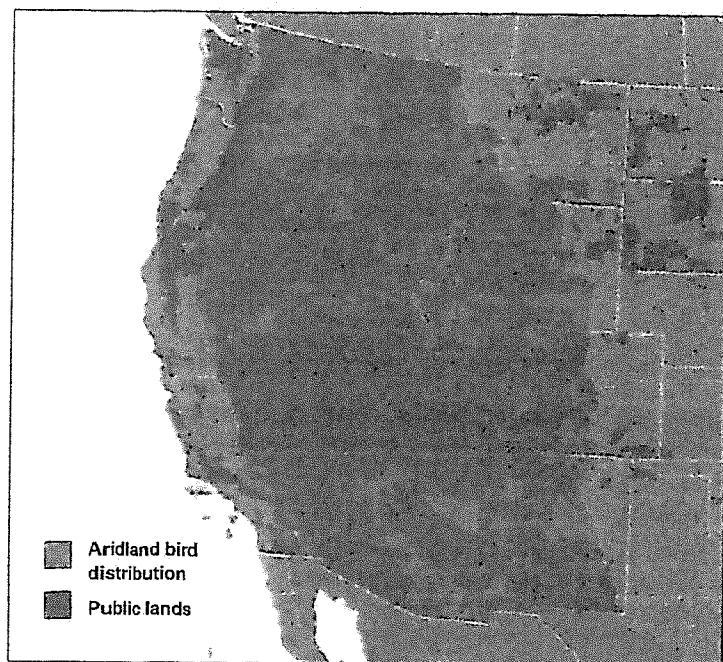


Aridland birds have been in a long-term decline, with a slight improvement since 2012. Fires, drought, invasive plants, development, unsustainable grazing, and energy extraction pressures on habitat are all driving aridland bird declines.

- Several aridland birds (such as Chihuahuan Raven, Sage Thrasher, and Pyrrhuloxia) exhibit accelerated rates of decline since 2010.
- Bendire's and LeConte's Thrasher have experienced long-term declines, but the Bendire's Thrasher population has stabilized in the past decade.
- Greater Sage-Grouse shows a continued steep decline that warrants increased voluntary habitat conservation incentives and renewed strong federal and state protections.

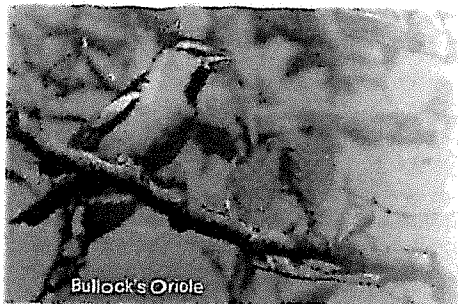
Public Lands Are Essential for Aridland Bird Conservation

The federal government and state agencies have a vital role to play in turning around bird declines in sagebrush and desert habitats. According to the 2011 State of the Birds report, public lands in the American West support more than half of the breeding distribution of aridland birds. Bureau of Land Management lands are particularly important, supporting almost a quarter of the distribution of all aridland birds and more than two-thirds of the U.S. distributions of Sage Thrasher and Sagebrush Sparrow, both species with declining populations. U.S. Forest Service lands in coastal chaparral habitats are important for the declining Wrentit. National Park Service lands are important for some desert bird species, such as the Bendire's Thrasher (a Tipping Point species). The 2011 State of the Birds Report found that about 80% of publicly owned aridlands were vulnerable to activities that could potentially degrade bird habitat—including energy development, off-road vehicle traffic, grazing, mining, and logging. Aridland bird habitat conservation can be compatible with multiple land uses, but management plans for these landscapes need to include measures to ensure long-term healthy populations of aridland birds.



WESTERN PUBLIC LANDS ARE HABITAT FOR ARIDLAND BIRDS

This map shows the cumulative range for 30 aridland bird species in North America, with the vast majority of that range falling within the boundaries of federal and state public lands. Source: Aridland bird data from Bird Conservation Regions, Bird Studies Canada and NABCI, Public lands map from GISGeography.com.



Bullock's Oriole

WESTERN FOREST BIRDS

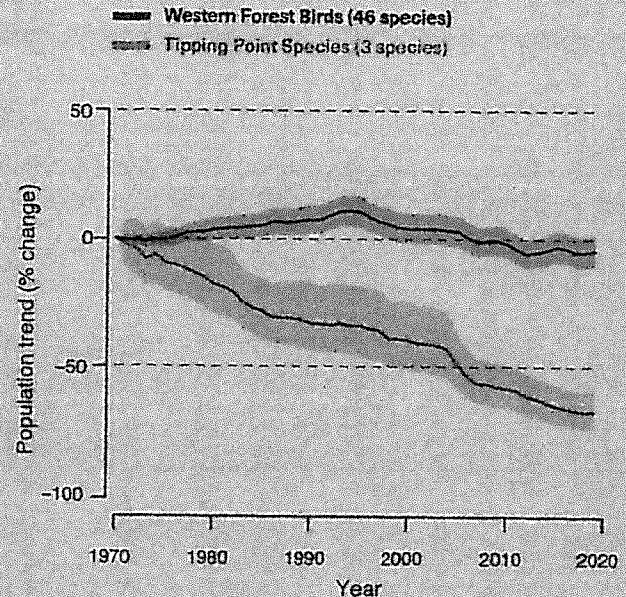
Restoring Natural Cycles for Forest Health

STATUS: Stable overall, but with warning signs

HL

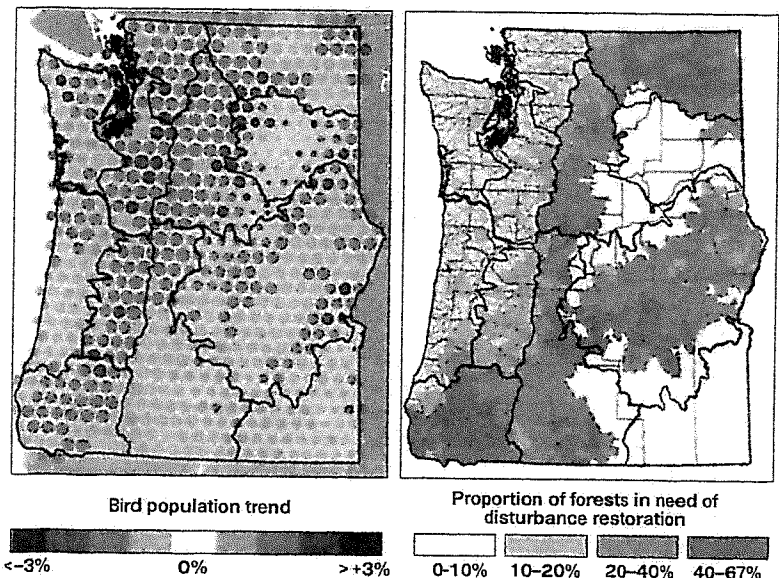
The overall population for the western forest birds group is much the same as it was 50 years ago, aided by protected habitats. But since reaching recent highs in the early 1990s, western forest birds have declined by nearly 20%.

- Almost half of this group (19 species) currently have declining population trends.
- Five species have lost more than half of their population since 1970, including Tipping Point species such as Pinyon Jay and Rufous Hummingbird with poorly understood life cycles. More science is needed to identify the drivers of their declines.
- Recent declining trends among Oak Titmouse, Williamson's Sapsucker, and other birds appear to be associated with the disruption of natural disturbance patterns such as fire cycles.



Birds Are Declining Where Western Forests Are Stressed

For most of the past 100 years, western forests have been managed to encourage conifer tree dominance and discourage fires. But for many centuries before the 1900s, fires were common on this landscape, both natural wildfires and intentional burns by Indigenous peoples. Today those historic disturbance patterns that created a mosaic of conifer and broadleaf forest cover and successional stages have been disrupted, and large swaths of western forest landscapes have departed from their natural range of tree species and structural diversity. These areas of forest departure from natural patterns are also hotspots for western forest bird declines. Furthermore, these compromised forests have very little resilience to the forces of wildfire and climate change, which puts greater forest landscape health and forest resources (such as water reservoirs) at risk of disaster. Investments in forest restoration can turn around this dim outlook for western forests and western forest birds.



BIRD DECLINES IN FORESTS THAT HAVE DEPARTED FROM HISTORIC CYCLES

According to population trends generated by eBird data, bird numbers tend to be declining in forests that have departed from historic conditions and are most in need of disturbance restoration. Sources: Cornell Lab | eBird data 2007–2019 (left map); DeMeo et al, "Expanding Our Understanding of Forest Structural Restoration Needs in the Pacific Northwest," *Northwest Science*, Winter 2018 (right map).

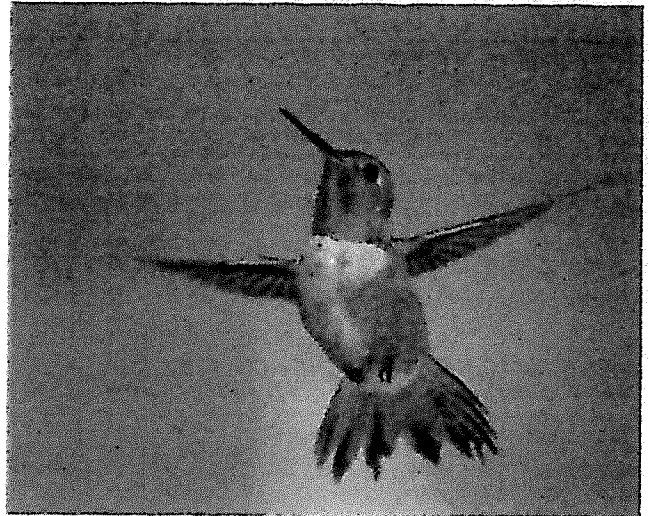
Bird Declines Are Reaching a Tipping Point

Sounding an Alarm About Steep Population Losses

In 2019, a study of 529 bird species with adequate long-term data for analysis (*Science*, Rosenberg et al.) found that 303 species in North America were declining—more than half of the bird species studied.

Now scientists with the Road to Recovery initiative have issued an alert for 90 declining bird species—birds that are not yet federally listed as threatened or endangered, but that have lost half or more of their breeding population since 1970. The scientists further identified a subset of 70 Tipping Point species that could lose another half or more of their populations in the next 50 years, based on recent trajectories and expert assessments.

These Tipping Point species are high priorities for science and conservation because of their high vulnerability to extinction, high urgency, and steep population declines where known. All are included on the Birds of Conservation Concern List of the U.S. Fish and Wildlife Service and/or state lists of Species of Greatest Conservation Need.



Two-thirds of Rufous Hummingbirds have been lost in the past 50 years.

On Alert: All of these bird species have lost half of their populations in the past 50 years

Baird's Sparrow	Allen's Hummingbird	Buff-breasted Sandpiper	King Rail	Rufous Hummingbird ✓
Black-billed Cuckoo	American Golden-Plover	Cassia Crossbill*	Kittlitz's Murrelet*	Saltmarsh Sparrow*
Black Skimmer	Ashy Storm-Petrel*	Chestnut-collared Longspur	Laysan Albatross*	Scripps's Murrelet*
Black Swift	Audubon's Shearwater*	Chimney Swift	Least Tern	Seaside Sparrow*
Canada Warbler	Bachman's Sparrow	Craveri's Murrelet*	LeConte's Sparrow	Semipalmated Sandpiper
Cerulean Warbler	Band-rumped Storm-Petrel*	Elegant Tern*	LeConte's Thrasher	Short-billed Dowitcher
Clark's Grebe	Bendire's Thrasher	Evening Grosbeak ✓	Lesser Prairie-Chicken*	Sprague's Pipit
Eastern Whip-poor-will	Bicknell's Thrush*	Fea's Petrel*	Lesser Yellowlegs	Stilt Sandpiper
Grace's Warbler ✓	Black-capped Petrel*	Golden-winged Warbler	Mottled Duck	Townsend's Storm-Petrel*
Long-billed Dowitcher	Black-chinned Sparrow	Great Black-backed Gull	Mountain Plover	Tricolored Blackbird*
Mourning Warbler	Black-footed Albatross*	Greater Sage-Grouse ✓	Murphy's Petrel*	Wandering Tattler
Olive-sided Flycatcher ✓	Black-vented Shearwater*	Guadalupe Murrelet*	Parkinson's Petrel*	Whimbrel
Red-headed Woodpecker ✓	Black Rail*	Harris's Sparrow	Pectoral Sandpiper	Whiskered Auklet*
Rock Sandpiper	Black Rosy-Finch*	Heermann's Gull*	Pinyon Jay ✓	Yellow-billed Loon
Snowy Owl	Black Scoter	Henslow's Sparrow	Prairie Warbler	Yellow-billed Magpie
Surfbird	Bobolink	Hudsonian Godwit	Red-faced Cormorant	Yellow Rail*
Thick-billed Longspur	Bristle-thighed Curlew*	Ivory Gull*	Red-legged Kittiwake*	
Western Grebe	Brown-capped Rosy-Finch*	King Eider	Ruddy Turnstone	
Wilson's Plover				
Wood Thrush				

These Tipping Point species are on a trajectory to lose another 50% of their remnant populations in the next 50 years if nothing changes.

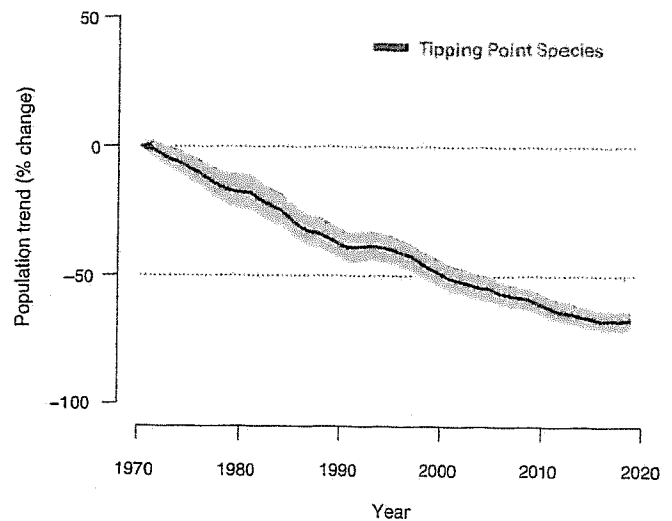
These 90 bird species lost 50% or more of their populations during 1970–2019. The Tipping Point species are on a trajectory to lose another 50% of their populations in the next 50 years (39 species), or already have perilously small populations and continue to face high threats, but lack sufficient monitoring data (31 species, indicated with an asterisk). For the USFWS Birds of Conservation Concern list, visit [fws.gov/media/birds-conservation-concern-2021.pdf](https://www.fws.gov/media/birds-conservation-concern-2021.pdf).

The Next Set of Species Plummeting Toward Endangered Status

Of the 1,093 bird species protected under the Migratory Bird Treaty Act, 89 birds have received additional protections as either threatened or endangered under the U.S. Endangered Species Act to prevent their extinction.

The Tipping Point species represent another 70 birds that could be next to face threatened or endangered status. Cumulatively, the Tipping Point species that have sufficient data for monitoring have lost more than two-thirds of their populations in the past 50 years.

Tipping Point species come from varied habitats, but they all have the same urgency—immediate science and conservation actions are needed to turn around declines.



70 Tipping Point Species

Urgent action is needed to help these birds before they become endangered.

GRASSLAND BIRDS

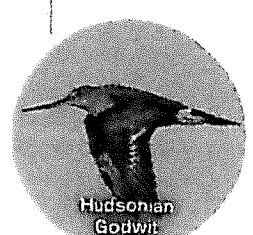
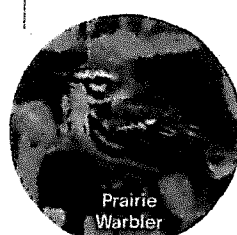
Prairie specialists such as Mountain Plover, Sprague's Pipit, and Chestnut-collared Longspur have lost more than 75% of their populations since 1970.

FOREST BIRDS

The steepest declines among forest birds include species that specialize on tree seeds (e.g., Pinyon Jay), long-distance migrants (e.g., Bicknell's Thrush), and aerial insect-eating specialists (e.g., Chimney Swift).

ARCTIC & ALPINE TUNDRA

Shrinking habitats due to changing climate and resource extraction threaten Arctic-breeding shorebirds (e.g., Hudsonian Godwit and Whimbrel) and alpine birds (e.g., Black Rosy-Finch).



COASTAL & OCEANIC

Nearly a quarter of seabirds found in U.S. waters are at risk of an Endangered listing, including murrelets, albatrosses, petrels, and shearwaters.

ARIDLAND BIRDS

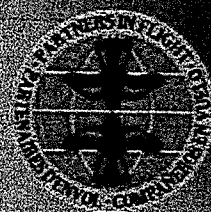
Aridland birds are experiencing long-term declines, including Allen's Hummingbird, Bendire's Thrasher, and Greater Sage-Grouse.

WETLAND BIRDS

Though many waterbirds benefited from decades of wetland conservation, steep bird declines are still occurring in coastal saltmarshes (e.g., Saltmarsh Sparrow), freshwater marshes (e.g., Yellow Rail), and beaches (e.g., Least Tern).

*North Am. Bird Cons Initiative
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4.3
PARTNERS IN FLIGHT LANDBIRD CONSERVATION PLAN



2016 Revision for Canada and Continental United States

SPECIES OF CONTINENTAL CONCERN

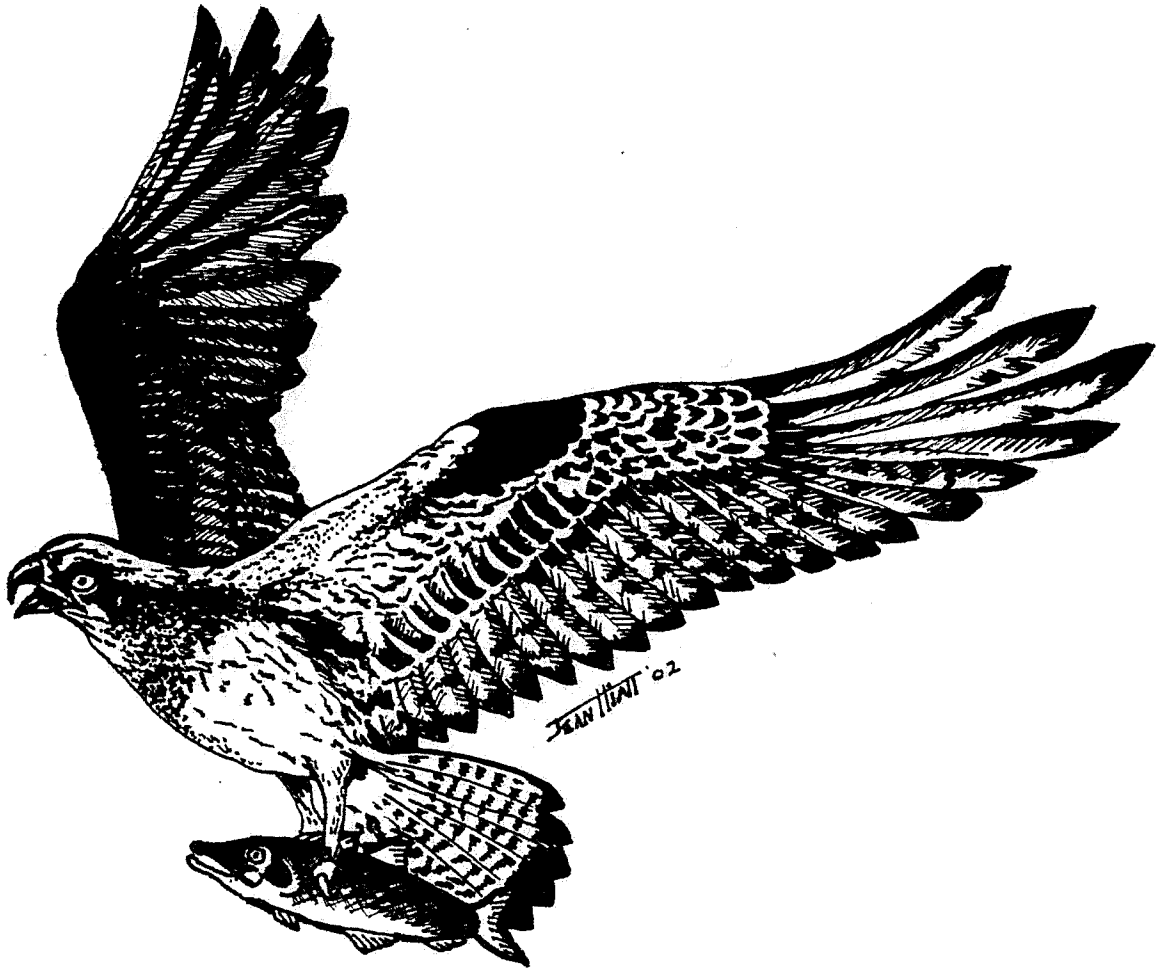
Table 1. PIF WATCH LIST FOR CONTINENTAL UNITED STATES AND CANADA

Species	Vulnerability Factors						Loss	Urgency/ Half-Life (years)	Continental Threat	Regions of Highest Importance		Primary Breeding Habitat
	PS	Distribution		Threats		PT				Breeding	Wintering	
		BD	ND	TB	TN							
RECOVER: Red Watch List - Species with extremely high vulnerability due to small population and range, high threats, and rangewide declines (19 species)												
Gunnison Sage-Grouse							> 50%		R, E, CI, U, D	16	16	Sagebrush
Lesser Prairie-Chicken							> 50%		A, R, E, CI	18, 19	18, 19	Grassland
California Condor							> 50%		Co, D, E	32, 16	32, 16	Chaparral
Red-cockaded Woodpecker							79%	38*	F	27, 25	27, 25	Eastern Forest
Ivory-billed Woodpecker							uncertain		F, U	27, 25, 26, 31	27, 25, 26, 31	Eastern Forest
Red-crowned Parrot							> 50%		H, T	36	36	Tropical Dry Forest
Black-capped Vireo							15-50%		R, U	35, 20	MX-P	Desert Scrub
Florida Scrub-Jay							> 50%		U, A, D	31	31	Eastern Forest
Bicknell's Thrush							15-50%		T, F, CI	14	Hisp	Boreal Forest
Bendire's Thrasher							86%	18	R, A, U, E, CI	33, 16	33	Desert Scrub
Le Conte's Thrasher							67%	27	R, A, U, E, CI	33	33	Desert Scrub
Bachman's Warbler							uncertain		F	27, 25, 26	CU	Eastern Forest
Golden-winged Warbler							60%	34*	F, T, U	12, 23, 28	CR, PA, HN, NI	Eastern Forest
Golden-cheeked Warbler							> 50%		T, F, U	20	NI, HN, MX-H	Western Forest
Bachman's Sparrow							72%	24	F	27, 31	27, 31	Eastern Forest
Saltmarsh Sparrow							94%		CI, U	30	27, 30	Coastal Saltmarsh
Tricolored Blackbird							> 50%	> 50	A	32	32	Wetland
Black Rosy-Finch							95%		CI	10, 9	16	Alpine Tundra
Brown-capped Rosy-Finch							95%		CI	16	16	Alpine Tundra
PREVENT DECLINE: "R" Yellow Watch List - Species not declining but vulnerable due to small range or population and moderate threats (12 species)												
Flammulated Owl							uncertain		F, CI, U	34, 16, 10		Western Forest
Lucifer Hummingbird							uncertain		CI	35	MX-H; MX-P	Desert Scrub
Gray Vireo							none	> 50	T, F, D	16, 34	MX-B	Western Forest
Island Scrub-Jay							uncertain		F, D	32	32	Western Forest
California Gnatcatcher							uncertain		U	32	32	Chaparral
McKay's Bunting							uncertain		CI	1	1	Arctic Tundra
Colima Warbler							uncertain		F	35	Mx-H	Mexican Pine Oak
Kirtland's Warbler							none		T, F	12	BS	Eastern Forest
Henslow's Sparrow							uncertain	> 50	A, U	24, 22	25, 26, 27	Grassland
Nelson's Sparrow							uncertain	> 50	CI, A, U	7, 11, 6, (14)	37, 27	Wetland
Seaside Sparrow							none	> 50	CI, U	37, 30, 27	37, 27	Coastal Saltmarsh
Audubon's Oriole							uncertain		F	36	36	Tropical Dry Forest
REVERSE DECLINE: "D" Yellow Watch List - Species with population declines and moderate to high threats (55 species)												
Mountain Quail							19%	> 50	CI, F	32, 15, 5	32, 15, 5	Western Forest
Scaled Quail							67%	8	R, A, CI	35, 18	35, 18	Desert Scrub
Greater Sage-Grouse							67%	> 50	E, R, D, A, CI, I	10, 17, 9	10, 17, 9	Sagebrush
Sooty Grouse							52%	> 50	F	5	5	Western Forest
Greater Prairie-Chicken							> 50%	> 50	A, E, R, I, H	19	19	Grassland
White-crowned Pigeon							15-50%		T, H	31	31	Mangrove
Band-tailed Pigeon							60%	> 50	F, T	5, 32, 34	CO	Western Forest
Mangrove Cuckoo							15-50%		U, T	31		Mangrove
Black-billed Cuckoo							66%	37*	T, F, U	12, 13, 23, 28	VE, MX-P, EC	Eastern Forest
Whiskered Screech-Owl							15-50%		F, U, CI	34	34	Mexican Pine Oak

SEE WATCH LIST TABLE AT A GLANCE FOR DEFINITIONS (page 5)

Species	Vulnerability Factors						Loss	Urgency/ Half-Life (years)	Continental Threat	Regions of Highest Importance		Primary Breeding Habitat
	PS	Distribution		Threats		PT				Breeding	Wintering	
		BD	ND	TB	TN							
Snowy Owl							64%		CI	3	11	Arctic Tundra
Spotted Owl							15-50%		F, CI	34, 5, 32, 15	34, 5, 32, 15	Western Forest
Long-eared Owl							91%		F, U	(widespread)	22, 35, 33, 18, 9, 34, 15	Forest Generalist
Eastern Whip-poor-will							67%		F, T, Co, U, CI	24, 29, 27, 25	31, NI	Eastern Forest
Mexican Whip-poor-will							15-50%		T, F, Co, CI	34	MX-H; GT	Mexican Pine Oak
Black Swift							94%	16	CI	5, 10	BR	Western Forest
Rufous Hummingbird							60%	34	CI, F	5	26, 37, 36	Western Forest
Allen's Hummingbird							83%	17	CI, U	32, 5	32	Chaparral
Elegant Trogon							15-50%		T, F	34	MX-P; MX-H	Mexican Pine Oak
Lewis's Woodpecker							67%	> 50	F, CI	9, 16	32, 15, 16, 34	Western Forest
Red-headed Woodpecker							68%	> 50	F, U	22, 19, 27, 26, 24	26, 27, 25, 24	Eastern Forest
Arizona Woodpecker							15-50%		T, F, CI	34	34	Mexican Pine Oak
Gilded Flicker							58%	33	R, U	33	33	Desert Scrub
Green Parakeet							15-50%		T, H	36	36	Tropical Dry Forest
Olive-sided Flycatcher							78%	24	T, F, CI	4, 10, 5	CO, EC, VE	Boreal Forest
Pinyon Jay							84%	19	F, R	16, 9	16, 9	Western Forest
Yellow-billed Magpie							49%	11	D	32	32	Western Forest
Chestnut-backed Chickadee							51%	46	F, U	5	5	Western Forest
Mexican Chickadee							15-50%		F	34		Mexican Pine Oak
Oak Titmouse							53%	40	F, U	32	32	Western Forest
Black-capped Gnatcatcher							15-50%		A, R, U	34	34	Desert Scrub
Wrentit							24%	> 50	U	32, 15	32, 15	Chaparral
Wood Thrush							59%	31	F, T, U, E, I	28, 29, 27, 24, 13	BZ, GT, HN, MX-C	Eastern Forest
California Thrasher							58%	34	U	32	32	Chaparral
Sprague's Pipit							73%	27	A, R, E, I	11	36, 37, 35, 21, 34	Grassland
Chestnut-collared Longspur							85%	21	A, R, E, I	11, 17	35, 34	Grassland
McCown's Longspur							86%	> 50	A, R, E, I	11, 18, 17, 10	35, 21, 18, 34, 19	Grassland
Prothonotary Warbler							34%	> 50	T, U, F	26, 27	PA, CR	Eastern Forest
Virginia's Warbler							38%	> 50	T, F, U	16, 34	Mx-P	Western Forest
Connecticut Warbler							51%	> 50	T, F	6, 8, 12	CO	Boreal Forest
Kentucky Warbler							25%	> 50	T, F, U	24, 25, 27, 28	BZ, GT, HN, MX-C	Eastern Forest
Cape May Warbler							79%	> 50	T, F	8, 6, 12, 7	Hisp, BS, CU	Boreal Forest
Cerulean Warbler							73%	26	T, F, E, U	28	CO	Eastern Forest
Prairie Warbler							54%	> 50	T, F, U	27, 29, 28, 24, 25	BS, CU, Hisp	Eastern Forest
Grace's Warbler							52%	> 50	T, F, CI	34, 16	BZ, GT, HN, MX-H	Mexican Pine Oak
Canada Warbler							63%	> 50	T, F	8, 12, 14	CO	Boreal Forest
Rufous-winged Sparrow							15-50%		R, A, U	33, 34	33, 34	Desert Scrub
Black-chinned Sparrow							61%	> 50	R, U	35, 32, 34	34, 35	Chaparral
Five-striped Sparrow							15-50%		R	34	MX-P	Tropical Dry Forest
Baird's Sparrow							72%	> 50	A, R, E	11	34	Grassland
Le Conte's Sparrow							61%	43	A, U, CI	6, 7, 11	25, 21, 20, 37	Grassland
Harris's Sparrow							63%		A, U	3, 7	19, 21	Arctic Tundra
Bobolink							59%	48*	A, U	11, 13, 12, 17, 14, 23	BO	Grassland
Cassin's Finch							68%	> 50	F	10, 9, 15	16	Western Forest
Evening Grosbeak							92%	38*	F	14, 12, 9, 10, 5	6, 8	Boreal Forest

UTAH FIELD OFFICE GUIDELINES FOR RAPTOR PROTECTION FROM HUMAN AND LAND USE DISTURBANCES



U.S. Fish and Wildlife Service, Utah Field Office
Salt Lake City
January 2002 update

Prepared by Laura A. Romin and James A. Muck

to minimize disturbance to raptors and raptor nest sites.

STEP 3

Apply the information attained in Steps 1 and 2 to the following guidelines for occupied and unoccupied nest sites to avoid or minimize effects of proposed land use activities to nesting raptors:

- Occupied raptor nests: Activities should not occur within the spatial/seasonal buffer of any nest (occupied or unoccupied) when raptors are in the process of courtship and nest site selection. Egg laying, incubation, fledging, brooding, and post-fledging dependency periods are protected by varying seasonal and spatial buffers (Tables 2 and 3).

Short term land use and human use activities should only proceed within the spatial buffer of an occupied nest outside the seasonal buffer, after coordination with appropriate Service, UDWR, and/or land management agency biologists. Mitigation for habitat loss or degradation should be planned. Long term land use activities and human use activities should not occur within the species-specific spatial buffer zone of occupied nests.

- Unoccupied raptor nests: If a nest site within a territory is deemed unoccupied after sufficient time has elapsed in a specified breeding season and prior to the beginning of the next year's breeding season, human activity could be allowed within the nesting area. This period varies dependent on raptor species. However, as a general rule, even renesting will usually not occur later than May 30 (C. White, BYU, 1998, pers. comm.).

Short term land use and human activities may progress near a nest or nest territory designated as unoccupied. For long term land use activities, unoccupied nests should be protected for 7 years, or the period a known preferred prey species fluctuates from population highs to lows. At the end of the 7-year period, each nest should be evaluated by a qualified wildlife biologist as to its potential future use. Criteria could include the raptor species current population trend in the local area, the corresponding prey species population levels and trends, as well as past, current, and future impacts of the proposed action. Nests could also be considered permanently abandoned if the nest has been physically damaged past the point of repair by raptors.

Long-term land use activities and human use activities should not occur proximally to unoccupied nests unless it is determined that mitigation is appropriate and can be accomplished prior to initiation of the long-term disturbance. Coordination with Service, UDWR, and/or land management agency

Monitoring and documentation of results is recommended following any of the aforementioned techniques to maximize success of efforts. Publishing data and results should also be considered to widely circulate information regarding success of raptor mitigation techniques.

CONCLUSION

It has been the intent of these guidelines to provide land use planners with the tools to develop successful raptor management and mitigation strategies proximal to disturbances from land use activities. Raptor survey information attained through implementation of these guidelines will also provide a means to track raptor population trends and document population responses to human use of their environments.

The guidelines have presented recommendations for protection of raptor life stages (i.e., nesting and wintering) as well as raptor habitats. The recommendations are hardly exhaustive of available protective strategies, nor are all recommendations intended to be incorporated on every proposed project. Coordination with appropriate Service, UDWR, and/or land management agency biologists is important during the analysis of project impacts and selection of protective measures.

Project proponents should seek first to avoid or minimize impacts. Where there are inevitable losses or degradations of habitat or disturbance to individual birds, mitigation can be incorporated to lessen the impact. Overall, these guidelines have been designed to maintain viable raptor populations amid continued human use of the environment.

Table 2. Nesting periods and recommended buffers for raptors in Utah

Species	Spatial Buffer (miles)	Seasonal Buffer	Incubation, # Days	Brooding, # Days Post-Hatch	Fledging, # Days Post-Hatch	Post-fledge Dependency to Nest, # Days ¹
Bald eagle	1.0	1/1-8/31	34-36	21-28	70-80	14-20
Golden eagle	0.5	1/1-8/31	43-45	30-40	66-75	14-20
N. Goshawk	0.5	3/1-8/15	36-38	20-22	34-41	20-22
N. Harrier	0.5	4/1-8/15	32-38	21-28	42	7
Cooper's hawk	0.5	3/15-8/31	32-36	14	27-34	10
Ferruginous hawk	0.5	3/1-8/1	32-33	21	38-48	7-10
Red-tailed hawk	0.5	3/15-8/15	30-35	35	45-46	14-18
Sharp-shinned hawk	0.5	3/15-8/31	32-35	15	24-27	12-16
Swainson's hawk	0.5	3/1-8/31	33-36	20	36-40	14
Turkey vulture	0.5	5/1-8/15	38-41	14	63-88	10-12
California condor	1.0	NN yet	56-58	5-8 weeks	5-6 months	2 months
Peregrine falcon	1.0	2/1-8/31	33-35	14-21	35-49	21
Prairie falcon	0.25	4/1-8/31	29-33	28	35-42	7-14
Merlin	0.5	4/1-8/31	28-32	7	30-35	7-19
American kestrel	NN ²	4/1-8/15	26-32	8-10	27-30	12
Osprey	0.5	4/1-8/31	37-38	30-35	48-59	45-50
Boreal owl	0.25	2/1-7/31	25-32	20-24	28-36	12-14
Burrowing owl	0.25	3/1-8/31	27-30	20-22	40-45	21-28
Flammulated owl	0.25	4/1-9/30	21-22	12	22-25	7-14
Great horned owl	0.25	12/1-9/31	30-35	21-28	40-50	7-14
Long-eared owl	0.25	2/1-8/15	26-28	20-26	30-40	7-14
N. saw-whet owl	0.25	3/1-8/31	26-28	20-22	27-34	7-14
Short-eared owl	0.25	3/1-8/1	24-29	12-18	24-27	7-14
Mex. Spotted owl	0.5	3/1-8/31	28-32	14-21	34-36	10-12
N. Pygmy owl	0.25	4/1-8/1	27-31	10-14	28-30	7-14
W. Screech owl	0.25	3/1-8/15	21-30	10-14	30-32	7-14
Common Barn-owl	NN ²	2/1-9/15	30-34	20-22	56-62	7-14

¹ Length of post-fledge dependency period to parents is longer than reported in this table. Reported dependency periods reflect the amount of time the young are still dependent on the nest site; i.e. they return to the nest for feeding.

² Due to apparent high population densities and ability to adapt to human activity, a spatial buffer is not currently considered necessary for maintenance of American kestrel or Common barn-owl populations. Actions resulting in direct mortality of individual birds or take of known nest sites is unlawful.

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SUMMARY

Proponents of land-use activities are responsible for determining potential impacts to raptors of those activities. Appropriate management strategies for conservation and restoration of raptor populations and their habitats associated with the proposed actions should be devised. The following steps should become routine during initial project planning:

1. Coordinate with appropriate U.S. Fish and Wildlife Service (Service), Utah Division of Wildlife Resources (UDWR), and/or land management agency wildlife biologists at the onset of project planning.
2. Identify species and distribution of raptors occurring within the project area by evaluating existing data and/or conducting on-site surveys.
3. Determine location and distribution of important raptor habitat, raptor nests, and available prey base associated with proposed developments and activities.
4. Ascertain the type, extent, timing, and duration of development or human activities proposed to occur.
5. Consider cumulative effects to raptors of proposed projects when added to past, present, and reasonably foreseeable actions.
6. Minimize, to the extent feasible, loss of raptor habitats and avoid long-term habitat degradation. Mitigate for unavoidable losses of high-valued raptor habitats, including (but not limited to) nesting, winter roosting, and foraging areas.
7. Plan and schedule short-term and long-term project disturbances and human-related activities to avoid raptor nesting and roosting areas, particularly during crucial breeding and wintering periods.
8. Post-project and post-mitigation monitoring are necessary to document stability of raptor populations and their prey base, and to evaluate success of mitigation efforts.

PREFACE

The following raptor protection guidelines were prepared by the Service in coordination with various federal, state, tribal, and private entities with an interest in raptor protection. These guidelines are intended to provide an advisory framework for consistent raptor management approaches statewide.

Table 3. Recommended proportion (None, Half, or Full) of the species-specific spatial buffer zones for level and duration of activities during raptor nesting

NESTING PHENOLOGY (Risk Level)				
	Courtship and Nesting (High)	Incubation, and Brooding (High)	Post-Brooding Nestling Period (Moderate)	Post Fledging Dependency (Moderate)
In-Vehicle, Recreational^a Activity: Any recreational vehicle driving off-road, or on dirt roads, and not part of a routinely used transportation corridor.				
less than 1 hour ^b	NONE	NONE	NONE	NONE
less than 1 hour ^c	HALF	HALF	NONE	NONE
greater than 1 hour	FULL	FULL	HALF	HALF
Out-of-Vehicle, Recreational Activity: including, but not limited to hiking, dispersed camping, rock climbing, birdwatching, fishing, hunting, biological surveys.				
less than 1 hour ^b	HALF	HALF	NONE	NONE
less than 1 hour ^c	FULL	FULL	HALF	HALF
greater than 1 hour	FULL	FULL	FULL	FULL
Developed Recreation: including, but not limited to ski resorts, snowmobile and off-road vehicle courses, developed campground sites, and group tour operations.				
	FULL	FULL	FULL	FULL
Industrial, Municipal, and Transportation Disturbance: including, but not limited to urbanization; mining; oil and gas development; logging; power line construction; road construction & maintenance; use of explosives; agricultural operations; fixed wing and helicopter overflights.				
less than 1 hour ^b	FULL	FULL	HALF	HALF
less than 1 hour ^c	FULL	FULL	FULL	HALF
greater than 1 hour	FULL	FULL	FULL	FULL

^aRecreational activities are defined as those providing outdoor recreation, entertainment, or adventure.

^bNo more than 1 repetition in a 24 hour period for a duration of less than 1 hour is allowable.

^cMore than one repetition per 24 hours, spaced no less than 2 hours apart, occurs during daylight hours. Full buffer zone is required for any activities occurring during nighttime hours

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Decline of the North American avifauna

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Species extinctions have defined the global biodiversity crisis, but extinction begins with loss in abundance of individuals that can result in compositional and functional changes of ecosystems. Using multiple and independent monitoring networks, we report population losses across much of the North American avifauna over 48 years, including once common species and from most biomes. Integration of range-wide population trajectories and size estimates indicates a net loss approaching 3 billion birds, or 29% of 1970 abundance. A continent-wide weather radar network also reveals a similarly steep decline in biomass passage of migrating birds over a recent 10-year period. This loss of bird abundance signals an urgent need to address threats to avert future avifaunal collapse and associated loss of ecosystem integrity, function and services.

Slowing the loss of biodiversity is one of the defining environmental challenges of the 21st century (1–5). Habitat loss, climate change, unregulated harvest, and other forms of human-caused mortality (6, 7) have contributed to a thousand-fold increase in global extinctions in the Anthropocene compared to the presumed prehuman background rate, with profound effects on ecosystem functioning and services (8). The overwhelming focus on species extinctions, however, has underestimated the extent and consequences of biotic change, by ignoring the loss of abundance within still-common species and in aggregate across large species assemblages (2, 9). Declines in abundance can degrade ecosystem integrity, reducing vital ecological, evolutionary, economic, and social services that organisms provide to their environment (8, 10–15). Given the current pace of global environmental change, quantifying change in species abundances is essential to assess ecosystem impacts. Evaluating the magnitude of declines requires effective long-term monitoring of population sizes and trends, data which are rarely available for most taxa.

Birds are excellent indicators of environmental health and ecosystem integrity (16, 17), and our ability to monitor many species over vast spatial scales far exceeds that of any other animal group. We evaluated population change for 529 species of birds in the continental United States and Canada (76% of breeding species), drawing from multiple standardized bird-monitoring datasets, some of which provide close to fifty years of population data. We integrated range-wide estimates of population size and 48-year population trajectories,

along with their associated uncertainty, to quantify net change in numbers of birds across the avifauna over recent decades (18). We also used a network 143 weather radars (NEXRAD) across the contiguous U.S. to estimate long-term changes in nocturnal migratory passage of avian biomass through the airspace in spring from 2007 to 2017. The continuous operation and broad coverage of NEXRAD provide an automated and standardised monitoring tool with unrivaled temporal and spatial extent (19). Radar measures cumulative passage across all nocturnally migrating species, many of which breed in areas north of the contiguous U.S. that are poorly monitored by avian surveys. Radar thus expands the area and the proportion of the migratory avifauna that is sampled relative to ground surveys.

Results from long-term surveys, accounting for both increasing and declining species, reveal a net loss in total abundance of 2.9 billion (95% CI = 2.7–3.1 billion) birds across almost all biomes, a reduction of 29% (95% CI = 27–30%) since 1970 (Fig. 1 and Table 1). Analysis of NEXRAD data indicate a similarly steep decline in nocturnal passage of migratory biomass, a reduction of $13.6 \pm 9.1\%$ since 2007 (Fig. 2A). Reduction in biomass passage occurred across the eastern U.S. (Fig. 2, C and D), where migration is dominated by large numbers of temperate- and boreal-breeding songbirds; we observed no consistent trend in the Central or Pacific flyway regions (Fig. 2, B to D, and table S5). Two completely different and independent monitoring techniques thus signal major population loss across the continental avifauna.

Species exhibiting declines (57%, 303/529) based on long-

term survey data span diverse ecological and taxonomic groups. Across breeding biomes, grassland birds showed the largest magnitude of total population loss since 1970—more than 700 million breeding individuals across 31 species—and the largest proportional loss (53%); 74% of grassland species are declining. (Fig. 1 and Table 1). All forest biomes experienced large avian loss, with a cumulative reduction of more than 1 billion birds. Wetland birds represent the only biome to show an overall net gain in numbers (13%), led by a 56% increase in waterfowl populations (Fig. 3 and Table 1). Surprisingly, we also found a large net loss (63%) across 10 introduced species (Fig. 3, D and E, and Table 1).

A total of 419 native migratory species experienced a net loss of 2.5 billion individuals, whereas 100 native resident species showed a small net increase (26 million). Species overwintering in temperate regions experienced the largest net reduction in abundance (1.4 billion), but proportional loss was greatest among species overwintering in coastal regions (42%), southwestern aridlands (42%), and South America (40%) (Table 1 and fig. S1). Shorebirds, most of which migrate long distances to winter along coasts throughout the hemisphere, are experiencing consistent, steep population loss (37%).

More than 90% of the total cumulative loss can be attributed to 12 bird families (Fig. 3A), including sparrows, warblers, blackbirds, and finches. Of 67 bird families surveyed, 38 showed a net loss in total abundance, whereas 29 showed gains (Fig. 3B), indicating recent changes in avifaunal composition (table S2). While not optimized for species-level analysis, our model indicates 19 widespread and abundant landbirds (including 2 introduced species) each experienced population reductions of >50 million birds (data S1). Abundant species also contribute strongly to the migratory passage detected by radar (19), and radar-derived trends provide a fully independent estimate of widespread declines of migratory birds.

Our study documents a long-developing but overlooked biodiversity crisis in North America—the cumulative loss of nearly 3 billion birds across the avifauna. Population loss is not restricted to rare and threatened species, but includes many widespread and common species that may be disproportionately influential components of food webs and ecosystem function. Furthermore, losses among habitat generalists and even introduced species indicate that declining species are not replaced by species that fare well in human-altered landscapes. Increases among waterfowl and a few other groups (e.g., raptors recovering after the banning of DDT) are insufficient to offset large losses among abundant species (Fig. 3). Importantly, our population loss estimates are conservative since we estimated loss only in breeding populations. The total loss and impact on communities and ecosystems could be even higher outside the breeding season

if we consider the amplifying effect of “missing” reproductive output from these lost breeders.

Extinction of the Passenger Pigeon (*Ectopistes migratorius*), once likely the most numerous bird on the planet, provides a poignant reminder that even abundant species can go extinct rapidly. Systematic monitoring and attention paid to population declines could have alerted society to its pending extinction (20). Today, monitoring data suggest that avian declines will likely continue without targeted conservation action, triggering additional endangered species listings at tremendous financial and social cost. Moreover, because birds provide numerous benefits to ecosystems (e.g., seed dispersal, pollination, pest control) and economies (47 million people spend 9.3 billion U.S. dollars per year through bird-related activities in the U.S. (21)), their population reductions and possible extinctions will have severe direct and indirect consequences (10, 22). Population declines can be reversed, as evidenced by the remarkable recovery of waterfowl populations under adaptive harvest management (23) and the associated allocation of billions of dollars devoted to wetland protection and restoration, providing a model for proactive conservation in other widespread native habitats such as grasslands.

Steep declines in North American birds parallel patterns of avian declines emerging globally (14, 15, 22, 24). In particular, depletion of native grassland bird populations in North America, driven by habitat loss and more toxic pesticide use in both breeding and wintering areas (25), mirrors loss of farmland birds throughout Europe and elsewhere (15). Even declines among introduced species match similar declines within these same species' native ranges (26). Agricultural intensification and urbanization have been similarly linked to declines in insect diversity and biomass (27), with cascading impacts on birds and other consumers (24, 28, 29). Given that birds are one of the best monitored animal groups, birds may also represent the tip of the iceberg, indicating similar or greater losses in other taxonomic groups (28, 30).

Pervasiveness of avian loss across biomes and bird families suggests multiple and interacting threats. Isolating spatio-temporal limiting factors for individual species and populations will require additional study, however, since migratory species with complex life histories are in contact with many threats throughout their annual cycles. A focus on breeding season biology hampers our ability to understand how seasonal interactions drive population change (31), although recent continent-wide analyses affirm the importance of events during the non-breeding season (19, 32). Targeted research to identify limiting factors must be coupled with effective policies and societal change that emphasize reducing threats to breeding and non-breeding habitats and minimizing avoidable anthropogenic mortality year-round. Endangered species legislation and international treaties, such as

the 1916 Migratory Bird Treaty between Canada and the United States, have prevented extinctions and promoted recovery of once-depleted bird species. History shows that conservation action and legislation works. Our results signal an urgent need to address the ongoing threats of habitat loss, agricultural intensification, coastal disturbance, and direct anthropogenic mortality, all exacerbated by climate change, to avert continued biodiversity loss and potential collapse of the continental avifauna.

REFERENCES AND NOTES

1. M. C. Urban, Climate change. Accelerating extinction risk from climate change. *Science* **348**, 571–573 (2015). doi:10.1126/science.aaa4984 Medline
2. R. Dirzo, H. S. Young, M. Galetti, G. Ceballos, N. J. B. Isaac, B. Collen, Defaunation in the Anthropocene. *Science* **345**, 401–406 (2014). doi:10.1126/science.1251817 Medline
3. S. L. Pimm, C. N. Jenkins, R. Abell, T. M. Brooks, J. L. Gittleman, L. N. Joppa, P. H. Raven, C. M. Roberts, J. O. Sexton, The biodiversity of species and their rates of extinction, distribution, and protection. *Science* **344**, 1246752 (2014). doi:10.1126/science.1246752 Medline
4. A. D. Barnosky, N. Matzke, S. Tomiya, G. O. U. Wogan, B. Swartz, T. B. Quental, C. Marshall, J. L. McGuire, E. L. Lindsey, K. C. Maguire, B. Mersey, E. A. Ferrer, Has the Earth's sixth mass extinction already arrived? *Nature* **471**, 51–57 (2011). doi:10.1038/nature09678 Medline
5. W. Steffen, J. Crutzen, J. R. McNeill, The Anthropocene: Are humans now overwhelming the great forces of Nature? *Ambio* **36**, 614–621 (2007). doi:10.1579/0044-7447(2007)36[614:TAHNO]2.0.CO;2 Medline
6. S. R. Loss, T. Will, P. P. Marra, Direct Mortality of Birds from Anthropogenic Causes. *Annu. Rev. Ecol. Evol. Syst.* **46**, 99–120 (2015). doi:10.1146/annurev-ecolsys-112414-054133
7. A. M. Calvert, C. A. Bishop, R. D. Elliot, E. A. Krebs, T. M. Kydd, C. S. Machtans, G. J. Robertson, A Synthesis of Human-related Avian Mortality in Canada. *Avian Conserv. Ecol.* **8**, art11 (2013). doi:10.5751/ACE-00581-080211
8. D. U. Hooper, E. C. Adair, B. J. Cardinale, J. E. K. Byrnes, B. A. Hungate, K. L. Matulich, A. Gonzalez, J. E. Duffy, L. Gamfeldt, M. I. O'Connor, A global synthesis reveals biodiversity loss as a major driver of ecosystem change. *Nature* **486**, 105–108 (2012). doi:10.1038/nature11118 Medline
9. G. Ceballos, P. R. Ehrlich, R. Dirzo, Biological annihilation via the ongoing sixth mass extinction signaled by vertebrate population losses and declines. *Proc. Natl. Acad. Sci. U.S.A.* **114**, E6089–E6096 (2017). doi:10.1073/pnas.1704949114 Medline
10. C. J. Whelan, Ç. H. Şekerciöğlu, D. G. Wenny, Why birds matter: From economic ornithology to ecosystem services. *J. Ornithol.* **156** (S1), 227–238 (2015). doi:10.1007/s10336-015-1229-y
11. M. Galetti, R. Guevara, M. C. Côrtes, R. Fadini, S. Von Matter, A. B. Leite, F. Labecca, T. Ribeiro, C. S. Carvalho, R. G. Collevatti, M. M. Pires, P. R. Guimarães Jr., P. H. Brancalion, M. C. Ribeiro, P. Jordano, Functional extinction of birds drives rapid evolutionary changes in seed size. *Science* **340**, 1086–1090 (2013). doi:10.1126/science.1233774 Medline
12. G. C. Daily, Ed., *Nature's Services: Societal Dependence on Natural Ecosystems* (Island Press, Washington, DC, 1997).
13. S. Bauer, B. J. Hoyer, Migratory animals couple biodiversity and ecosystem functioning worldwide. *Science* **344**, 1242552 (2014). doi:10.1126/science.1242552 Medline
14. K. J. Gaston, R. A. Fuller, Commonness, population depletion and conservation biology. *Trends Ecol. Evol.* **23**, 14–19 (2008). doi:10.1016/j.tree.2007.11.001 Medline
15. R. Inger, R. Gregory, J. P. Duffy, I. Stott, P. Voříšek, K. J. Gaston, Common European birds are declining rapidly while less abundant species' numbers are rising. *Ecol. Lett.* **18**, 28–36 (2015). doi:10.1111/ele.12387 Medline
16. M. L. Morrison, in *Current Ornithology*, R. F. Johnston, Ed. (Springer US, Boston, MA, 1986; https://link.springer.com/10.1007/978-1-4615-6784-4_10), pp. 429–451.
17. J. Burger, M. Gochfeld, Marine birds as sentinels of environmental pollution. *EcoHealth* **1**, 263–274 (2004). doi:10.1007/s10393-004-0096-4
18. See supplementary materials.
19. A. M. Dokter, A. Farnsworth, D. Fink, V. Ruiz-Gutierrez, W. M. Hochachka, F. A. La Sorte, O. J. Robinson, K. V. Rosenberg, S. Kelling, Seasonal abundance and survival of North America's migratory avifauna determined by weather radar. *Nat. Ecol. Evol.* **2**, 1603–1609 (2018). doi:10.1038/s41559-018-0666-4 Medline
20. J. C. Stanton, Present-day risk assessment would have predicted the extinction of the passenger pigeon (*Ectopistes migratorius*). *Biol. Conserv.* **180**, 11–20 (2014). doi:10.1016/j.biocon.2014.09.023
21. U.S. Department of the Interior, U.S. Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau, "National Survey of Fishing, Hunting, and Wildlife-Associated Recreation" (2016).
22. C. H. Sekerciöğlu, G. C. Daily, P. R. Ehrlich, Ecosystem consequences of bird declines. *Proc. Natl. Acad. Sci. U.S.A.* **101**, 18042–18047 (2004). doi:10.1073/pnas.0408049101 Medline
23. J. D. Nichols, M. C. Runge, F. A. Johnson, B. K. Williams, Adaptive harvest management of North American waterfowl populations: A brief history and future prospects. *J. Ornithol.* **148** (S2), 343–349 (2007). doi:10.1007/s10336-007-0256-8
24. C. A. Hallmann, R. P. B. Foppen, C. A. M. van Turnhout, H. de Kroon, E. Jongejans, Declines in insectivorous birds are associated with high neonicotinoid concentrations. *Nature* **511**, 341–343 (2014). doi:10.1038/nature13531 Medline
25. R. L. Stanton, C. A. Morrissey, R. G. Clark, Analysis of trends and agricultural drivers of farmland bird declines in North America: A review. *Agric. Ecosyst. Environ.* **254**, 244–254 (2018). doi:10.1016/j.agee.2017.11.028
26. J. De Laet, J. D. Summers-Smith, The status of the urban house sparrow *Passer domesticus* in north-western Europe: A review. *J. Ornithol.* **148** (S2), 275–278 (2007). doi:10.1007/s10336-007-0154-0
27. F. Sánchez-Bayo, K. A. G. Wyckhuys, Worldwide decline of the entomofauna: A review of its drivers. *Biol. Conserv.* **232**, 8–27 (2019). doi:10.1016/j.biocon.2019.01.020
28. B. C. Lister, A. Garcia, Climate-driven declines in arthropod abundance restructure a rainforest food web. *Proc. Natl. Acad. Sci. U.S.A.* **115**, E10397–E10406 (2018). doi:10.1073/pnas.1722477115 Medline
29. D. L. Narango, D. W. Tallamy, P. P. Marra, Nonnative plants reduce population growth of an insectivorous bird. *Proc. Natl. Acad. Sci. U.S.A.* **115**, 11549–11554 (2018). doi:10.1073/pnas.1809259115 Medline
30. R. E. A. Almond, M. Grooten, "Living Planet Report - 2018: Aiming Higher" (WWF, Gland, Switzerland, 2018).
31. P. P. Marra, E. B. Cohen, S. R. Loss, J. E. Rutter, C. M. Tonra, A call for full annual cycle research in animal ecology. *Biol. Lett.* **11**, 20150552 (2015). doi:10.1098/rsbl.2015.0552 Medline
32. F. A. La Sorte, D. Fink, P. J. Blancher, A. D. Rodewald, V. Ruiz-Gutierrez, K. V. Rosenberg, W. M. Hochachka, P. H. Verburg, S. Kelling, Global change and the distributional dynamics of migratory bird populations wintering in Central America. *Glob. Change Biol.* **23**, 5284–5296 (2017). doi:10.1111/gcb.13794 Medline
33. A. C. Smith, AdamCSmithCWS/Estimating_Change_in_NorthAmerican_Birds, Zenodo, (2019); <https://doi.org/10.5281/zenodo.3218403>
34. A. M. Dokter, L. Veen, J. H. Spaaks, adokter/vol2bird: vol2bird, Version 0.4.0, Zenodo (2019); <https://doi.org/10.5281/zenodo.3369999>
35. A. M. Dokter, S. Van Hoey, P. Desmet, adokter/bioRad: bioRad, Version 0.4.0, Zenodo (2019); <https://doi.org/10.5281/zenodo.3370005>
36. J. R. Sauer, W. A. Link, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski Jr., The North American Breeding Bird Survey 1966–2011: Summary Analysis and Species Accounts. *North American Fauna* **79**, 1–32 (2013). doi:10.3996/nafa.79.0001
37. K. V. Rosenberg, P. J. Blancher, J. C. Stanton, A. O. Panjabi, Use of North American Breeding Bird Survey data in avian conservation assessments. *Condor* **119**, 594–606 (2017). doi:10.1650/CONDOR-17-57.1
38. J. C. Stanton, P. J. Blancher, K. V. Rosenberg, A. O. Panjabi, W. E. Thogmartin, Estimating uncertainty of North American landbird population sizes. *Avian Conserv. Ecol.* **14**, art4 (2019). doi:10.5751/ACE-01331-140104
39. North American Bird Conservation Initiative, The state of Canada's birds, 2012. *Environment Canada, Ottawa, ON* (2012); <http://www.stateofcanadasbirds.org/>.
40. North American Bird Conservation Initiative, U.S. Committee, "The State of the

Table 1. Net change in abundance across the North American avifauna, 1970-2017. Species are grouped into native and introduced species, management groups (landbirds, shorebirds, waterbirds, waterfowl), major breeding biomes, and nonbreeding biomes (see data S1 in (18) for assignments and definitions of groups and biomes). Net change in abundance is expressed in millions of breeding individuals, with upper and lower 95% credible intervals (CI) shown. Percentage of species in each group with negative trend trajectories are also noted. Values in bold indicate declines and loss; those in italics indicate gains.

Species Group	Number of Species	Net Abundance Change (Millions) & 95% CI			Percent Change & 95% CIs			Proportion Species in Decline
		Change	LC95	UC95	Change	LC95	UC95	
Species Summary								
All N. Am. Species	529	-2,911.9	-3,097.5	-2,732.9	-28.8%	-30.2%	-27.3%	57.3%
All Native Species	519	-2,521.0	-2,698.5	-2,347.6	-26.5%	-28.0%	-24.9%	57.4%
Introduced Species	10	-391.6	-442.3	-336.6	-62.9%	-66.5%	-56.4%	50.0%
Native Migratory Species	419	-2,547.7	-2,723.7	-2,374.5	-28.3%	-29.8%	-26.7%	58.2%
Native Resident Species	100	26.3	7.3	46.9	5.3%	1.4%	9.6%	54.0%
Landbirds	357	-2,516.5	-2,692.2	-2,346.0	-27.1%	-28.6%	-25.5%	58.8%
Shorebirds	44	-17.1	-21.8	-12.6	-37.4%	-45.0%	-28.8%	68.2%
Waterbirds	77	-22.5	-37.8	-6.3	-21.5%	-33.1%	-6.2%	51.9%
Waterfowl	41	34.8	24.5	48.3	56.0%	37.9%	79.4%	43.9%
Aerial Insectivores	26	-156.8	-183.8	-127.0	-31.8%	-36.4%	-26.1%	73.1%
Breeding Biome								
Grassland	31	-717.5	-763.9	-673.3	-53.3%	-55.1%	-51.5%	74.2%
Boreal forest	34	-500.7	-627.1	-381.0	-33.1%	-38.9%	-26.9%	50.0%
Forest Generalist	40	-482.2	-552.5	-413.4	-18.1%	-20.4%	-15.8%	40.0%
Habitat Generalist	38	-417.3	-462.1	-371.3	-23.1%	-25.4%	-20.7%	60.5%
Eastern Forest	63	-166.7	-185.8	-147.7	-17.4%	-19.2%	-15.6%	63.5%
Western forest	67	-139.7	-163.8	-116.1	-29.5%	-32.8%	-26.0%	64.2%
Arctic Tundra	51	-79.9	-131.2	-0.7	-23.4%	-37.5%	-0.2%	56.5%
Aridlands	62	-35.6	-49.7	-17.0	-17.0%	-23.0%	-8.1%	56.5%
Coasts	38	-6.1	-18.9	8.5	-15.0%	-39.4%	21.9%	50.0%
Wetlands	95	20.6	8.3	35.3	13.0%	5.1%	23.0%	47.4%
Nonbreeding Biome								
Temperate North America	192	-1,413.0	-1,521.5	-1,292.3	-27.4%	-29.3%	-25.3%	55.2%
South America	41	-537.4	-651.1	-432.6	-40.1%	-45.2%	-34.6%	75.6%
Southwestern Aridlands	50	-238.1	-261.2	-215.6	-41.9%	-44.5%	-39.2%	74.0%
Mexico-Central America	76	-155.3	-187.8	-122.0	-15.5%	-18.3%	-12.6%	52.6%
Widespread Neotropical	22	-126.0	-171.2	-86.1	-26.8%	-33.4%	-19.3%	45.5%
Widespread	60	-31.6	-63.1	1.6	-3.7%	-7.4%	0.2%	43.3%
Marine	26	-16.3	-29.7	-1.2	-30.8%	-49.1%	-2.5%	61.5%
Coastal	44	-11.0	-14.9	-6.7	-42.0%	-51.8%	-26.7%	68.2%
Caribbean	8	-6.0	1.4	-15.7	12.1%	-2.8%	31.7%	25.0%



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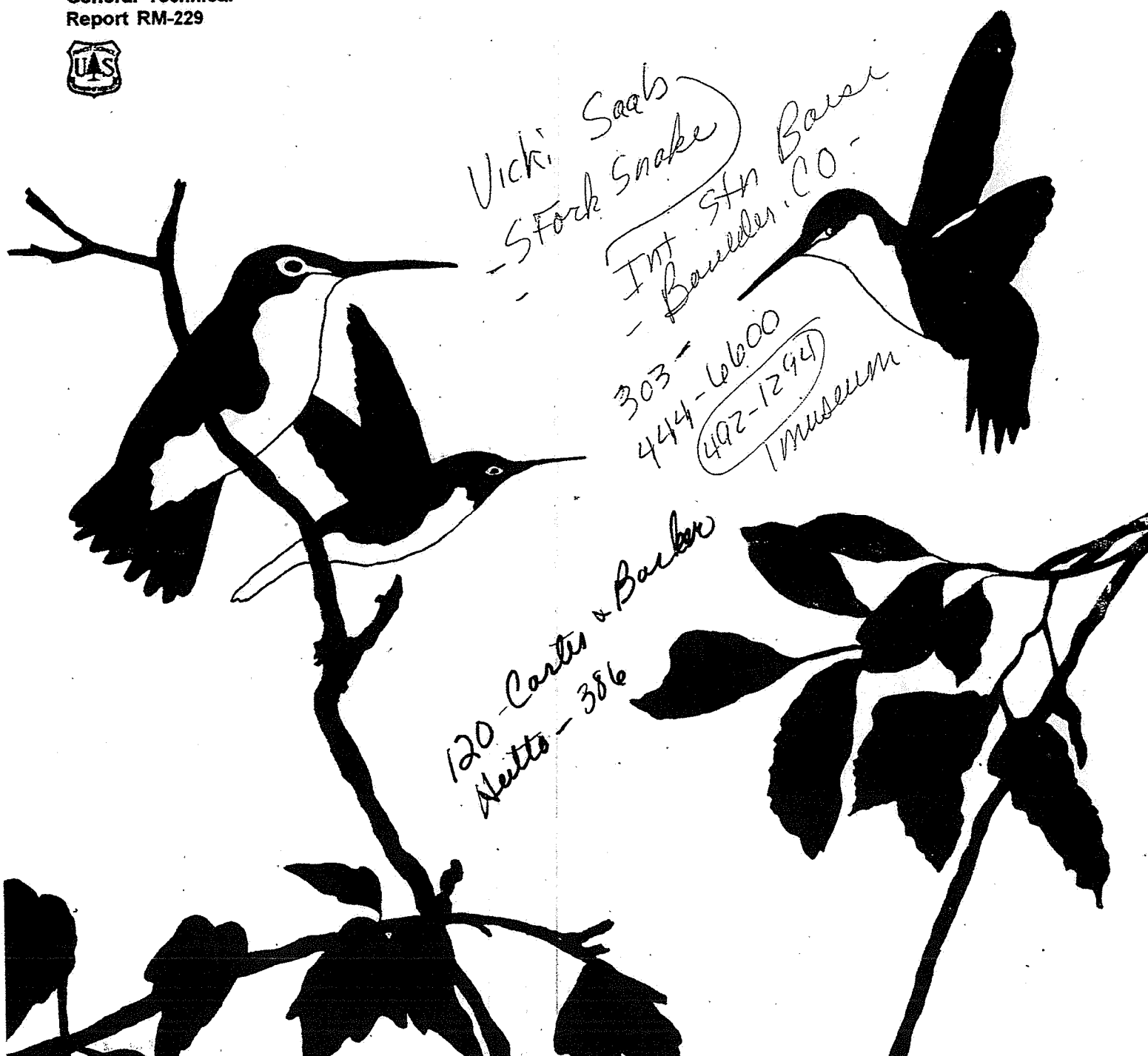
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Cowbird mgmt

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Management Implications of Cowbird Parasitism on Neotropical Migrant Songbirds

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*- feed on
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Abstract — Populations of brood parasitic Brown-headed Cowbirds (*Molothrus ater*) have increased to the point where they pose a potential threat to populations of many neotropical migrant songbirds. Because cowbirds mostly feed in short grass (e.g., pastures and lawns) or on bare ground (e.g., row crops), they benefit directly from human activities. Cowbirds commute up to 7 km between feeding areas and habitats where they search for host nests, often favoring forest edge or secondary growth. Several neotropical migrants with restricted geographical ranges are endangered, at least partly as a result of cowbird parasitism (e.g., Kirtland's warbler *Dendroica kirtlandii*, Black-capped Vireo *Vireo atricapillus*). Cowbird control using baited decoy traps has reduced the percent of nests parasitized, increased nesting success, and may be essential for the continued survival of these endangered species. It is not clear, however, whether cowbird trapping would be effective at a broader scale in reducing parasitism in extensively fragmented landscapes such as in the Midwest where many neotropical migrants are experiencing very high levels of parasitism. Cowbird trapping should be viewed as a stop-gap measure to protect specific endangered populations. We recommend instead the development of broader-scale approaches, perhaps in combination with local trapping. One approach to controlling cowbirds is landscape-level management such as consolidation of ownership to preserve large tracts, eliminating potential cowbird feeding areas within large tracts, and minimizing edge habitat. A second possible approach is large-scale cowbird eradication at winter roosts, but this approach may be too diffuse to help specific sensitive species or areas with high parasitism levels. Any management plan should be preceded by cowbird monitoring and preliminary data on levels of parasitism.

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BACKGROUND

Parasitism by the Brown-headed Cowbird (*Molothrus ater*) has become one of the major threats to populations of neotropical migrants on the breeding grounds (Mayfield 1977, Brittingham and Temple 1983). The Brown-headed Cowbird is a generalist brood parasite that lays its eggs in the nests of over 240 known host species (Friedmann and Kiff 1985), the majority of which are neotropical migrants. Historically, cowbirds were largely confined to the mid-continental prairies where they presumably followed herds of nomadic bison. Cowbirds mainly search for seeds and insects in short grass and on bare ground and may have depended upon grazing by large ungulates to create suitable feeding conditions. Since the clearing of forests for agriculture and the widespread introduction of livestock, however, cowbirds have expanded their geographical range eastward and westward as new feeding areas became available (Mayfield 1965). Similarly, cowbird populations have increased within their range as a result of increasing winter food supply (primarily waste grain in agricultural fields) and higher reproductive rates as cowbirds have come in contact with new hosts that lack defenses against parasitism (Mayfield 1965, Brittingham and Temple 1983). Cowbird populations have continued to increase in most sections of the United States (with the notable exception of the northeast: Robbins et al. 1986).

Increasing cowbird populations pose a potential threat to many hosts because of the cowbird's extraordinary fecundity and the extent to which cowbird parasitism reduces host productivity. Female cowbirds lay at least 30-40 eggs per season on average (Rothstein et al. 1986). Dan Roby (pers. comm.) found that individuals in captivity can lay up to 77 eggs in a season. Relatively small numbers of cowbirds can therefore parasitize many nests. Cowbird parasitism reduces host productivity for the following reasons: (1) female cowbirds remove host eggs (usually one) from 33% to 90% of all parasitized nests (Friedmann 1963, Weatherhead 1989, Sealy 1992); (2) cowbird eggs are unusually thick and, when laid, often break those of the host (Spaw and Rohwer 1987, Roskaft et al. 1990); (3) cowbird eggs have a short incubation period of 11 days compared with 12-14 days for most hosts (Nice 1953, Friedmann 1963), which gives nestling cowbirds a head start; (4) cowbirds usually parasitize hosts smaller than themselves, which gives cowbird nestlings a further advantage in competition with host young; and (5) cowbird nestlings grow faster, beg more loudly and have larger gapes than host nestlings (Friedmann 1929, Ortega and Cruz 1991). As a result of these factors, small hosts with long incubation periods usually fail to produce any of their own young if a single cowbird egg hatches (Rothstein 1975, May and Robinson 1985). For larger hosts and those with shorter incubation periods, cowbird parasitism is less costly (Smith 1981, Roskaft et al. 1990, Friedmann et al. 1977), except when the nests are multiply parasitized (i.e., two or more cowbird eggs are laid).

Neotropical migrants are especially vulnerable to cowbird parasitism. Most neotropical migrants build open-cup nests, which are the most frequent target of cowbirds (Friedmann 1929). The cowbird egg-laying period generally extends from mid-April until mid-July (Friedmann 1929, Scott 1963, Robinson, unpubl. data), which also coincides with the major period of egg-laying in most neotropical migrants (Whitcomb et al. 1981). Resident and short-distance migrants generally have longer breeding seasons that only partially overlap that of the cowbird.

Cowbird hosts with restricted geographical ranges can be particularly vulnerable to parasitism. Cowbird parasitism is considered one major cause (along with habitat loss) of population declines and the endangered status of the Kirtland's Warbler (*Dendroica kirtlandii*) (Walkinshaw 1983), Least Bel's Vireo (*Vireo belli pusillus*) (Franzreb 1989), Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (Unitt 1987, Brown 1988), and Black-capped Vireo (*Vireo atricapillus*) (Grzybowski et al. 1986). Cowbird hosts with larger ranges may be less vulnerable because heavily parasitized populations can be "rescued" by immigrants produced from populations in areas where parasitism levels are lower. Local extinctions of wide-ranging species, however, have occurred in Oklahoma (Orchard Oriole, *Icterus spurius*) (J. Grzybowski, pers. obs.) and in the lower Rio Grande Valley (J. Arvin, pers. comm.) and may be linked to heavy parasitism.

The parasitic life history of cowbirds enables them to occupy a wider range of habitats than any other North American passerine. Because cowbirds do not tend their own offspring, their two main activities during the breeding season, feeding and searching for hosts, can be uncoupled and carried out in different locations. Cowbirds can therefore occupy habitats that fulfill only one of these needs (Rothstein et al. 1984) and regularly commute up to 7 km between feeding and nest-searching sites (fig. 1, see also Rothstein et al. 1984). In southern Illinois and central Missouri, for example, cowbirds that searched for nests in forests fed 0.1-4.0 km away in pastures, feedlots for livestock (pigs, horses, and cattle), mowed roadsides, lawns, recently plowed and planted row crop fields, campgrounds, gravel roadsides, bird feeders, and logging roads (fig. 1). In the Sierra Nevada of California, recently arrived cowbirds commuted on average once a day between horse corrals and feeding areas. Rothstein et al. (1984) estimated that this single corral made it possible for cowbirds to parasitize hosts over an area of 154 km² that contained no other suitable feeding sites.

In southern Illinois, where there are many potential feeding sites, cowbirds fed throughout the day (fig. 2). Perhaps because of the proximity of feeding and nest-searching areas, cowbirds tend to be most abundant in heterogeneous "fragmented" landscapes in which grassy areas are intermixed with shrubby old fields and/or forests. Cowbird control may be much more difficult in landscapes where human activities have created many potential feeding areas (Rothstein et al. 1987; see below).

away from these animals (Grzybowski 1990a). However, if livestock are dispersed, effectiveness is compromised (Rothstein et al. 1987, Tazik and Cornelius unpubl. data).

A modification of this approach has been used with rotational grazing systems, a system where cattle are moved from pasture to pasture on a rotational basis. At the Kerr WMA in Texas, cattle were placed immediately adjacent to Black-capped Vireo nesting areas (containing traps) at the beginning of the nesting season. Capture rates of females improved dramatically for the trap closest to the cattle, observed parasitism was the lowest recorded, and vireo reproductive success the highest (Grzybowski 1990b).

Capture rates at traps are often high at the beginning of the trapping effort, and drop substantially after an initial capture period of two to four weeks. Most of the cowbirds are normally removed in this initial period, although traps operated near cowbird feeding sites continue catching cowbirds for most of the season.

Cowbird Shooting

Female cowbirds can be attracted to taped calls and removed by shooting. Shooting has been used in conjunction with trapping on Fort Hood (Hayden and Tazik unpubl. data), but the specific effects of shooting were not isolated from those of trapping. About 247 female cowbirds were removed, some of which may have been later trapped if not shot. Nonetheless, the technique can be used to remove a substantial number of cowbirds, and may be useful and more cost-effective in some areas with small or scattered groupings of sensitive species. Cowbirds, however, are sensitive to activity near the traps, including extended human visitation. Thus, shooting should not be conducted at the trap locations themselves.

Control at Roosts

Because cowbirds gather in large roosts during the nonbreeding season, they are potentially vulnerable to large-scale control efforts (e.g., Johnson et al. 1980). Such control efforts, however, should be considered carefully before they are implemented. Previous eradication programs have had little apparent effect on national populations of cowbirds, possibly because birds from many regions gather in the same roosts. The effects of control at winter roosts are therefore likely to be diffuse and may not protect any specific endangered population. Control efforts may also work only for a few years if they select for cowbirds that avoid large roosts. Nevertheless, control at winter roosts may offer the most practical way to reduce cowbird populations in fragmented landscapes where local trapping is too expensive. Even if many of the cowbirds killed would be from areas where they pose little threat, the enhanced productivity of host species throughout their range might increase the pool of immigrants available to recolonize

areas with heavier rates of parasitism. Martin (1992), however, has argued that in most areas the effects of nest predation on host population dynamics far outweigh the consequences of brood parasitism. Landscape management that reduces both cowbird and nest predator populations (Temple and Cary 1988) may therefore still be the best long-term solution to preserving populations of neotropical migrants (see below). The ethical implications of large-scale eradication of a native songbird also need to be considered before such a program is considered. Even among the authors of this paper, opinions are divided about the value of control at winter roosts.

Landscape and Habitat Management

Perhaps the best and most permanent way to reduce the impact of cowbirds on neotropical migrants is through landscape-level management, which can be effective at a much larger scale than trapping. Because cowbirds are frequently associated with agriculture, human settlements, and internal and external edges, the best management strategy is to maintain large areas of contiguous habitat. Unfortunately, we cannot provide one specific guideline for minimum area requirements for reducing cowbird impacts because edge effects vary among landscapes and cowbirds can commute long distances when searching for nests (fig. 1). *As a general rule, however, bigger tracts are preferable to small ones, wider riparian strips are better than narrow ones, and compact shapes are preferable to complex shapes with high ratios of edge to interior.*

Managers must also keep in mind the landscape surrounding the area being managed. Landscapes with few feeding opportunities for cowbirds may not have problems with cowbird parasitism even along edges and small openings. Landscapes with abundant cowbird feeding habitat may have cowbird populations that saturate breeding habitat regardless of proximity to edge. Ultimate solutions to the increasing threat of cowbird parasitism to neotropical migrants must involve changing land-use practices and configurations that reduce cowbird feeding areas. Below we provide more specific guidelines.

Forest Habitat

1. Where possible, managers should seek to maintain and establish large areas of contiguous forest cover that include core areas of forest interior. Estimates of areas necessary to sustain populations of neotropical migrants vary regionally. Robbins et al. (1989), for example, suggest maintaining at least 3000 ha of contiguous forest as the minimum required to retain local populations of forest songbirds in the mid-Atlantic states. Data from moderately fragmented areas of the Midwest suggest that areas of 20,000-50,000 ha may be necessary because the landscape supports very high cowbird populations and parasitism rates remain high even two km from feeding areas (Robinson, unpubl. data). The Biological Advisory Team (1990)

The Influence of Mammals and Birds in Retarding Artificial and Natural Reseeding of Coniferous Forests in the United States

Clarence F. Smith and Shaler E. Aldous¹

FORESTERS have long been searching for an economical method of re-establishing trees on deforested lands. Three methods have been used, namely: the planting of nursery-raised stock and natural seedlings, direct seeding, and the encouragement of natural reproduction. To date the planting program has been given the most attention but the other two methods are older and considerable hope for their satisfactory use is always being expressed. Chief among the factors that have pushed reproduction by seeding into the background is the depredation of seed-eating rodents and birds.

This does not mean, however, that animals are the chief factors in preventing reforestation. Among the many other important factors are: availability of seed source, soil type and condition, prevalence of destructive insects and diseases, moisture supply, temperature, slope, and many others. So it should not be inferred that if rodent and bird pressures could be removed reforestation would always be successful. The role of mammals and birds in aiding reforestation is not discussed in this paper. Although actual consumption of coniferous seeds implies destruction, it must be recalled that in the process of feeding, mammals through caching, and birds by transportation and dropping of seeds may function as seed distributors.

The first known effort at direct seeding on a national forest in the United States was in 1901 (11) on the San Bernardino National Forest, California. This and several other trials (12, 38) failed due to a combination of factors, one of which was the activity of seed-eating animals. Periodic attempts at direct seeding were continued with little or no success through about 1912 (6, 20, 27, 39, 59, 62). In the early twenties an interest was again shown in this work (30, 41, 42, 50), but still one of the main obstacles to success was the animal factor. During the late thirties and up until the present time, a renewed interest has again been extended to this

method of reforestation (1, 2, 8, 10, 16, 25, 26, 32, 33, 34, 35, 36, 37, 40, 45, 46, 47, 48, 49, 58, 61, 63).

It has been during this latter period that the authors and other workers in the Fish and Wildlife Service have been making extensive investigations of the relation of animals to the forest. Reproduction by seed and the animal pressure thereon has received considerable attention. It is the purpose of this paper to point out the degree and type of pressure exerted by birds and mammals on forest seeds, the tree species affected, and to describe methods of reducing or eliminating these losses.

MANY ANIMAL AND BIRD SEED EATERS

A large number of different mammals and birds feed on the seeds of coniferous trees, both when supplied naturally and when provided by planting procedures. From the literature and the authors' studies, a total of 44 mammals and 37 birds have been found to eat coniferous seeds (Table 1). This list could be materially lengthened if the data from unpublished stomach analyses in the files of the Fish and Wildlife Service were assembled. Van Dersal (64) lists the animals that feed on all species of conifers in the United States, but from his descriptions it is impossible to separate seed eaters from vegetative feeders.

Although the list of seed eaters is long, only a few species are of significance in forest regeneration. The tree squirrels, chipmunks, white-footed mice, and a few species of seed-eating fringillid birds are responsible for the greater part of all trouble caused by mammals and birds in regenerating forests by seeding. Habitat is the governing factor which determines which species of animal might be present to consume the seeds.

Tree squirrels (*Sciurus*) are not commonly found very far from trees with the result that their depredations are usually on the cones or on the seed dropping from them. On denuded areas that are being artificially reseeded, these squirrels are of minor importance except around the tree-fringed borders. On the other hand, they

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TABLE 1.--LIST OF BIRDS AND MAMMALS KNOWN TO EAT THE SEEDS OF CONIFEROUS TREES
(AND THE AUTHORITY REFERENCE)¹

Common name	Scientific name	Reference
Birds		
✓Blue grouse	<i>Dendragapus obscurus</i>	4
Sierra grouse	<i>Dendragapus fuliginosus sierrae</i>	52
Ruffed grouse	<i>Bonasa umbellus</i>	52
Bobwhite	<i>Colinus virginianus</i>	8
California quail	<i>Lophortyx californica</i>	52
Band-tailed pigeon	<i>Columba fasciata</i>	52
Eastern mourning dove	<i>Zenaidura macroura carolinensis</i>	8, 58, 60
✓Red-shafted flicker	<i>Colaptes cafer collaris</i>	57
✓Lewis woodpecker	<i>Asyndesmus lewis</i>	52
Canada jay	<i>Perisoreus canadensis</i>	59
✓Blue jay	<i>Cyanocitta cristata</i>	59
✓Steller's jay	<i>Cyanocitta stelleri</i>	52, 57
✓Crow	<i>Corvus brachyrhynchos</i>	52
✓Clark's nutcracker	<i>Nucifraga columbiana</i>	62
✓Winter wren	<i>Tannus hiemalis</i>	36
✓Robin	<i>Turdus migratorius</i>	15, 59
English sparrow	<i>Passer domesticus</i>	59
Southern meadowlark	<i>Sturnella magna argutula</i>	8
Red-wing blackbird	<i>Agelaius phoeniceus</i>	8
Rusty blackbird	<i>Euphagus carolinus</i>	8
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	8
Blackbirds	No species named	15, 59
Cowbird	<i>Molothrus ater</i>	8
Bronzed grackle	<i>Quiscalus quisqualis deneus</i>	15
Blue grosbeak	<i>Guiraca caerulea</i>	59
✓Evening grosbeak	<i>Hesperiphona vespertina</i>	52
California purple finch	<i>Carpodacus purpureus californicus</i>	36
✓Pine grosbeak	<i>Pinicola enucleator</i>	52
✓Redpoll	<i>Acanthis linaria</i>	59
✓Goldfinch	<i>Spinus tristis</i>	Text
✓Red crossbill	<i>Loxia curvirostra</i>	52
Towhee	<i>Pipilo maculatus</i>	36
✓Slate-colored junco	<i>Junco hyemalis hyemalis</i>	Text
Carolina junco	<i>Junco hyemalis connectens</i>	13
Oregon junco	<i>Junco oregonus</i>	36
Red-backed junco	<i>Junco phaeonotus dorsalis</i>	39, 52
✓Chipping sparrow	<i>Spizella passerina</i>	2
Song sparrow	<i>Melospiza melodia</i>	36
Mammals		
Cinereous shrew	<i>Sorex cinereus</i>	Text
Trowbridge shrew	<i>Sorex Trowbridgii</i>	37
Wandering shrew	<i>Sorex vagrans</i>	37
Baird's dusky shrew	<i>Sorex obscurus bairdi</i>	37
Yaquina shrew	<i>Sorex yaquinae</i>	37
Gibbs shrew-mole	<i>Neurotrichus gibbsii</i>	37
Columbia ground squirrel	<i>Citellus beecheyi</i>	23
Rock squirrel	<i>Citellus variegatus</i>	24
California ground squirrel	<i>Citellus beecheyi</i>	23
Fisher ground squirrel	<i>Citellus beecheyi fisheri</i>	52
White-tailed antelope squirrel	<i>Citellus leucurus</i>	24
Mantled ground squirrel	<i>Citellus lateralis</i>	24, 59
	<i>Citellus lateralis arizonensis</i>	57
	<i>Citellus lateralis chrysodeirus</i>	52
✓Western chipmunk	<i>Eutamias minimus</i>	52
	<i>Eutamias minimus jacksoni</i>	Text
	<i>Eutamias amoenus</i>	52
	<i>Eutamias quadrivittatus</i>	52
	<i>Eutamias quadrivittatus speciosus</i>	52
	<i>Eutamias cinereicollis</i>	52, 57
	<i>Eutamias townsendii</i>	26, 52
	<i>Eutamias quadrimaculatus</i>	52
	<i>Eutamias sp.</i>	12, 30, 49, 58, 61
✓Eastern chipmunk	<i>Tamias striatus striatus</i>	53
	<i>Tamias striatus griseus</i>	Text

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are probably the heaviest consumers of coniferous seeds under natural conditions. Heavy cutting of sugar pine cones (even before they are mature) by the California gray squirrel was reported by Berry (6) and Jotter (27). As much as 70 to 75 percent of the seed crop was reported taken by these squirrels and as many as 702 ponderosa pine cones were found under one tree.

VORACIOUS RODENTS ARE HEAVY SEED CONSUMERS

The appetite for pine seeds by squirrels was shown by Hatt (18) when he reported one pair of captive red squirrels ate the seeds from 422 cones of eastern white pine in one week's time. Mollenhauer (35) found red squirrels clipped from 50 to 100 percent of the cone-bearing limbs of the table mountain pine. It was the opinion of Pulling (41) that red squirrels took all the white pine seed produced during a poor year in one area in New York State. An examination of three red squirrel stomachs from a jack pine slash area in Minnesota showed that they had consumed 1,178 jack pine seeds or an average of 392 seeds per squirrel. In this latter case, the squirrels were collected at the edge of the cutting area. None was observed in the main body of the clearing. This localization was further illustrated by Smith (53) when he wrote, "The greatest rodent damage occurred on the fully-timbered area where red squirrels invaded

the quadrats several times searching for ungerminated seeds."

Ground squirrels (*Citellus*) are not commonly pests on sites requiring reforestation. These animals occur only in the western states in open types of habitat where reforestation is not likely to be practiced. However, these animals are known to retard forest regeneration at times, as Tinsley (58) reported the Columbian ground squirrel in Idaho to have consumed practically all the seeds (ponderosa and western white pine) sown.

One associated quite closely with the forest is the mantled squirrel. Throughout the ponderosa pine belt, this group is common and believed to be an important ponderosa pine seed consumer by Wahlenberg (60) and Taylor and Gorsuch (57).

Chipmunks play an important role in preventing the reseedling of forests. The western chipmunk (*Eutamias*) has been a greater factor in this respect than the eastern form (*Tamias*). Most seeding studies have been made in the West and in the Lake States where the western form is much more abundant. In the Lake States, both chipmunks occupy the same range, but *Eutamias* is found more in the logged or burned areas and is much more numerous over the whole area.

In northern Minnesota, chipmunks were found to be pronounced pine seed destroyers. The examination of stomachs from 88 chipmunks col-

TABLE 1—(Continued)

Common name	Scientific name	Reference
Red squirrel	<i>Tamiasciurus hudsonicus</i>	5, 9, 15, 26, 29, 41, 43, 49, 53, 56
	<i>Tamiasciurus hudsonicus baileyi</i>	41, 43, 49, 53, 56, 18
	<i>Tamiasciurus hudsonicus loquax</i>	65
	<i>Tamiasciurus hudsonicus ventorum</i>	21
	<i>Tamiasciurus hudsonicus richardsoni</i>	36, 54
	<i>Tamiasciurus douglasii</i>	36, 52
	<i>Tamiasciurus douglasii albolimbatus</i>	17
	<i>Tamiasciurus fremontii fremontii</i>	19
Western gray squirrel	<i>Sciurus griseus</i>	36, 52
Flying squirrel	<i>Glaucomys sabrinus latipes</i>	3
Pocket mouse	<i>Perognathus fasciatus</i>	Text
	<i>Perognathus parvus mollipilosus</i>	51
Kangaroo rat	<i>Dipodomys heermanni</i>	52
White-footed mouse	<i>Peromyscus maniculatus</i>	52
	<i>Peromyscus maniculatus gracilis</i>	Text
	<i>Peromyscus leucopus noveboracensis</i>	53
	<i>Peromyscus sp.</i>	55, 62
Woodrat	<i>Neotoma fuscipes</i>	14
Red-backed mouse	<i>Clethrionomys gapperi</i>	Text
Meadow mouse	<i>Microtus montanus</i>	58
House mouse	<i>Mus musculus</i>	53

This list does not include species eating Juniper and Taxis, and includes references only from published articles and findings from the author's field work.

lected in a jack pine slash area revealed that 72 percent contained the remains of jack pine seeds. They averaged 31 seeds per stomach, but one chipmunk had eaten 796 and another had 204 in its stomach and 168 in its cheek pouches. The 88 animals had disposed of a total of 2,749 jack pine seeds. Although chipmunks formed only 39.5 percent of the rodent population, they consumed 61 percent of the jack pine seeds removed by rodents on this area.

Coniferous seed destruction by chipmunks has been reported by Dearborn (12) from the Black Hills, Tinsley (58) in the Northern Rocky Mountains, Korstian and Baker (30) in the intermountain region of Utah, Taylor and Gorsuch (57) in the Southwest, Willis (62) and Moore (36) in the Pacific Northwest, L. Smith (53) for the New England area, and Horn, in an unpublished (1932) report from California.

Mice as a group, because of their wide habitat and geographic distribution, are perhaps the greatest animal factor in retarding forest regeneration by seeds. A great many of the authors reviewed, mentioned mice as one of the chief offenders.

White-footed mice (*Peromyscus*) have been found by the authors to be the most widely distributed and the most influential species in their studies. Where other authors have specified species, the white-footed group are usually mentioned. According to Silver (50), white-footed mice damaged from 10 to 90 percent of the seed spots on a planting program in the Ocala National Forest, Florida, Willis (62) attributed 98 percent failure of seed spots of Douglas-fir on the Columbia National Forest to the work of mice, and cage tests showed that a mouse could consume 300 seeds of this species daily. In the Lake States white-footed mice were found to be second only to chipmunks in numbers and in the consumption of jack pine seeds. The examination of 30 stomachs revealed that 70 percent had eaten jack pine seeds and the whole lot averaged 19 seeds per stomach. The greatest number eaten by a single animal was 156.

Other mice known to feed on coniferous seeds are red-backed mice (*Clethrionomys*), meadow mice (*Microtus*), jumping mice (*Zapus*), pocket mice (*Perognathus*), and house mice (*Mus musculus*).

The red-backed mice are perhaps the most characteristic forest species, but their food preferences run more to succulent vegetation than to

seeds. After a logging operation where most of the timber is cut, these mice are rapidly replaced by the white-footed species. That they can be a minor factor in seed consumption, however, is shown by the analysis of 59 stomachs of mice trapped on a jack pine slash area. Only 14 percent of them had eaten jack pine seed, the greatest number per individual being 25, and the average .6.

BIRDS ALSO TAKE MUCH SEED

Birds are more of an influence in seed consumption than is generally believed. Many workers have referred to seed destruction by birds and rodents but few have specified which birds are involved. As early as 1916, Toumey (59) listed mourning doves, redpoll, Canada jay, blue jay, English sparrow, robin, blackbird, finch, junco, and blue grosbeak as forest seed eaters. In the longleaf pine area of Mississippi, Burleigh (8) found heavy consumption of seeds by mourning doves, bobwhites, meadow larks, Brewer's rusty, and red-winged blackbirds, and cowbirds. He found that damage by these birds was most severe during years of heavy seed production and relatively light during scanty seed years, the explanation being that the seed crop when abundant attracted and held larger bird populations. Pearson (39) and Krauch in a 1937 report for the southwest named the junco as a cause of failure of seeding experiments.

In the northwest, Moore (36) found Douglas-fir seeds attractive to winter wrens, purple finches, song sparrows, towhees, and juncos.

Four juncos, eight chipping sparrows, eight goldfinches, and one Brewer's blackbird were collected on a jack pine slash area in northern Minnesota. Of these 21 birds only three (chipping sparrows) had failed to feed on jack pine seeds. Most of these birds were present in fair-sized flocks, which could have been responsible for the consumption of a large part of the seed crop.

It is rather surprising to find such insectivorous mammals as shrews consuming coniferous seeds, but Moore (37) states, "They play a definite and deleterious part in natural reforestation." He lists five species of shrews that were found to eat Douglas-fir seeds. Jack pine seeds were found in the stomach of one long-tailed shrew in Minnesota.

Many workers have deplored serious losses of seed by rodents and birds without specifying the identity of the animals concerned. In fact, the writers have found it impossible to attribute

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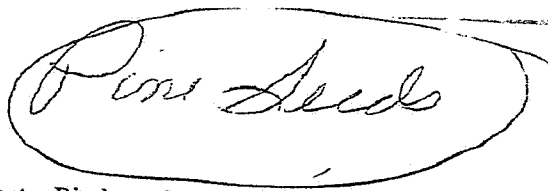
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Competition Among Insects, Birds and Mammals for Conifer Seeds

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SYNOPSIS Species of at least 5 orders of insects, 6 families of birds, and 2 orders of mammals, in various combinations, can exploit the cones and seeds of most species of conifers. Lodgepole pine is the exception to this pattern of broad taxonomic diversity of seed predators in that only pine squirrels and coreid bugs attack its serotinous cones. The contrast between lodgepole pine and other conifers demonstrates that large intrinsic variation in the abundance of a resource fosters the evolution of a broad range of taxonomic groups to exploit the resource. The diverse groups are limited by different predators and alternate resources when conifer seeds independently decrease in abundance.

INTRODUCTION

Because conifers are such an important source of lumber, a great amount of effort has been put into the study of their biology (Fowells, 1965), their seeds (USDA, 1974), and the predators of their seeds (Keen, 1958). People concerned with the lumber industry are interested in how many seeds escape predation to allow reforestation of logged or burned areas. Questions of general biological interest that do not relate directly to reforestation may go unasked even though pertinent information is available. In this paper, we use the extensive literature on conifer seeds and their predators to outline the nature of these seeds as a food resource and the manner in which the various seed predators use this resource. The information can then be used as a basis for answering three questions: 1) Why are there many different distantly related taxa of animals exploiting a distinctive and easily delimited resource? 2) How do the various taxa interact in using the resource? 3) How do the different taxa avoid competitive ex-

clusion? Our personal experience is mainly limited to the conifers of western North America and our discussion will be concentrated on those, although some of the patterns probably apply generally to conifers in the Northern Hemisphere (Bock and Lepthien, 1976).

THE RESOURCE

As a food resource, single viable conifer seeds are highly uniform as to size (weight of female gametophyte and embryo) and quality (caloric value of female gametophyte and embryo) within an individual cone, tree or species population (Table 1). The total number of viable seeds in single cones within a single annual crop for one tree or a species population is more variable than seed size or quality, especially in lodgepole pine (*Pinus contorta* Dougl.) (Table 1). The sizes of annual cone crops for single trees or species populations are by far the most variable feature of conifer seeds in all western North American species, except lodgepole pine (Table 1).

The variation in caloric value of seeds given in Table 1 is probably an underestimation because 5 to 10 seed kernels were burned to derive each value thus masking the variation between individual seeds. The similar variations between samples from the same cone, cones from the same tree,

We wish to thank Jim Reichman for stimulating us to think about competition between distantly related taxa. Gary Bateman and Gilbert Schubert made helpful comments in reviewing the manuscript. Anne Slobodchikoff was very helpful in editing and typing the manuscript.

TABLE 1. *The source of variation in conifer seeds as a food resource.*

Species	Source of units	Number	Range	Mean	Coefficient of variation
Lodgepole pine	Caloric value of female gametophyte and embryo (Cal/g dry weight):				
Lodgepole pine	groups of 6 to 10 seeds from one cone	5	6.55-6.91	6.74	2.0%
Lodgepole pine	groups of 6 to 10 seeds from one tree	6	6.63-7.04	6.79	2.3%
Lodgepole pine	groups of 5 to 10 seeds from one population	7	6.54-6.96	6.83	2.2%
Engelmann spruce	Weight of female gametophyte and embryo (mg/seed):				
Lodgepole pine	seeds from one cone	40	1.6-2.0	1.91	7.5%
Lodgepole pine	seeds from one cone	25	1.7-2.3	1.88	9.5%
Lodgepole pine	10 means of seeds from 10 cones from one tree	10	2.01-3.27	2.49	14.8%
Lodgepole pine	6 means of seeds from 6 cones from different trees	6	1.88-3.63	2.53	24.0%
Lodgepole pine	Filled seed content of cones (filled seeds/cone):				
Lodgepole pine	cones from one tree	5	9-23	15.8	40.4%
Lodgepole pine	10 means of cones from 10 trees	10	4.4-18.8	11.6	39.5%
Ponderosa pine	cones from one tree	5	53-89	70.4	22.9%
Ponderosa pine	7 means of cones from 7 trees	7	39.0-70.4	53.5	20.6%
Douglas-fir	Annual cone crops (cones/tree or cones/acre):				
Ponderosa pine	11 annual means for several trees (cones/tree)	11	0-14,244	4219	124.6%
Ponderosa pine	10 annual crops (cones/acre)	10	316-7521	2437	93.1%
Douglas-fir	Ratios of successive cone crops (%):				
Ponderosa pine	smaller crop/larger crop $\times$ 100 for 10 pairs of successive years	10	0.0-67.2	6.9	
Lodgepole pine	smaller crop/larger crop $\times$ 100 for 9 pairs of successive years	9	4.2-94.4	40.2	
Lodgepole pine	smaller crop/larger crop $\times$ 100 for 4 pairs of successive years	4	50.8-73.5	62.4	

Family: Sittidae			
✓ White-breasted Nuthatch	<i>Pinus</i>	uses and makes cache of seeds and <u>finds seeds on ground</u>	alternate foods
✓ Red-breasted Nuthatch	<i>Abies, Picea, Pinus, Pseudotsuga, Tsuga</i>	seeds from open cones cached and eaten by adults	alternate foods, emigration
✓ Tygny Nuthatch	<i>Abies, Picea, Pseudotsuga, Pinus</i>	seeds from open cones cached and eaten by adults	alternate foods
Family: Pitygillidae			
✓ Crossbills	<i>Abies, Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	seeds from closed and open cones fed to young and adults	nomadic nesters, emigrate to alternate foods
✓ Pine Siskins	<i>Abies, Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	seeds from open cones and the <u>ground fed to young and adults</u>	emigration, alternate foods
Genus: <i>Corvus</i>			
MAMMALS:			
Order: Rodentia			
pine squirrels	<i>Abies, Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	cache and feed from whole closed cones	territoriality, emigration, alternate foods
Genus: <i>Tamiasciurus</i>	<i>Pinus</i>	seeds from closed cones	alternate foods
tree squirrels			
Genus: <i>Sciurus</i>	<i>Abies, Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	cache and eat seeds from closed or open cones	alternate foods
chipmunks	<i>Pinus</i>	forage for single seeds	alternate foods
Genus: <i>Eutamias</i>			
golden-mantled ground squirrel	<i>Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	forage for single seeds and cache seeds	alternate foods
<i>Spermophilus lateralis</i>	<i>Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	forage for single seeds and cache seeds	alternate foods
deer mice	<i>Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	forage for single seeds and cache seeds	alternate foods
Genus: <i>Peromyscus</i>	<i>Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	forage for single seeds and cache seeds	alternate foods
red-backed voles			
Genus: <i>Clithronomys</i>			
Order: Insectivora			
shrews	<i>Larix, Picea, Pinus, Pseudotsuga, Tsuga</i>	forage for single seeds	alternate foods
Genus: <i>Sorex</i>			

TABLE 3. *continued*

Taxonomic group of seed predators	Genera of trees exploited	Method of conifer exploitation	Method of escaping starvation during cone crop failure
BIRDS:			
Family: Psittacidae parrots Genus: <i>Rhynchopitta</i>	<i>Pinus</i>	extracted seeds from closed and open cones	emigration, nomadic
Family: Picidae Hairy Woodpecker White-headed Woodpecker Genus: <i>Picoides</i>	<i>Pinus</i>	extracted seeds from closed and open cones eaten by adults and juveniles	alternate foods
Family: Corvidae Pion Jay Genus: <i>Gymnorhinus</i>	<i>Pinus</i>	cache seeds extracted from closed and open cones to feed young and adults	alternate foods, emigration
✓ Clark's Nutcracker Genus: <i>Nucifraga</i>	<i>Pinus</i>	cache seeds extracted from open and closed cones to feed young and adults	alternate foods, emigration
✓ Gray Jay Genus: <i>Perisoreus</i>	<i>Abies, Picea</i>	may extract seeds from open cones or retrieve from ground to eat and store as bolt	alternate foods, territorial
✓ Steller's Jay Genus: <i>Cyanocitta</i>	<i>Pinus</i>	cache seeds from open cones to feed adults	alternate foods, territorial, emigration
Scrub Jay Mexican Jay Genus: <i>Apelocoma</i>	<i>Pinus</i>	cache seeds from open cones and ground to feed adults	alternate foods, territorial
✓ Black-billed Magpie Genus: <i>Pica</i>	<i>Pinus</i>	cache seeds from open cones and ground to feed adults	alternate foods, territorial
Family: Paridae ✓ Mountain Chickadee	<i>Abies, Picea, Pseudotsuga, Pinus</i>	cache seeds from open cones and ground to feed adults	alternate foods
Boreal Chickadee	<i>Abies, Picea, Pseudotsuga</i>	cache seeds from open cones and ground to feed adults	alternate foods
Plain Titmouse Genus: <i>Parus</i>	<i>Pinus</i>	cache seeds from open cones and ground to feed adults	alternate foods, territorial

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Conservation Strategy for the Pinyon Jay (*Gymnorhinus cyanocephalus*)

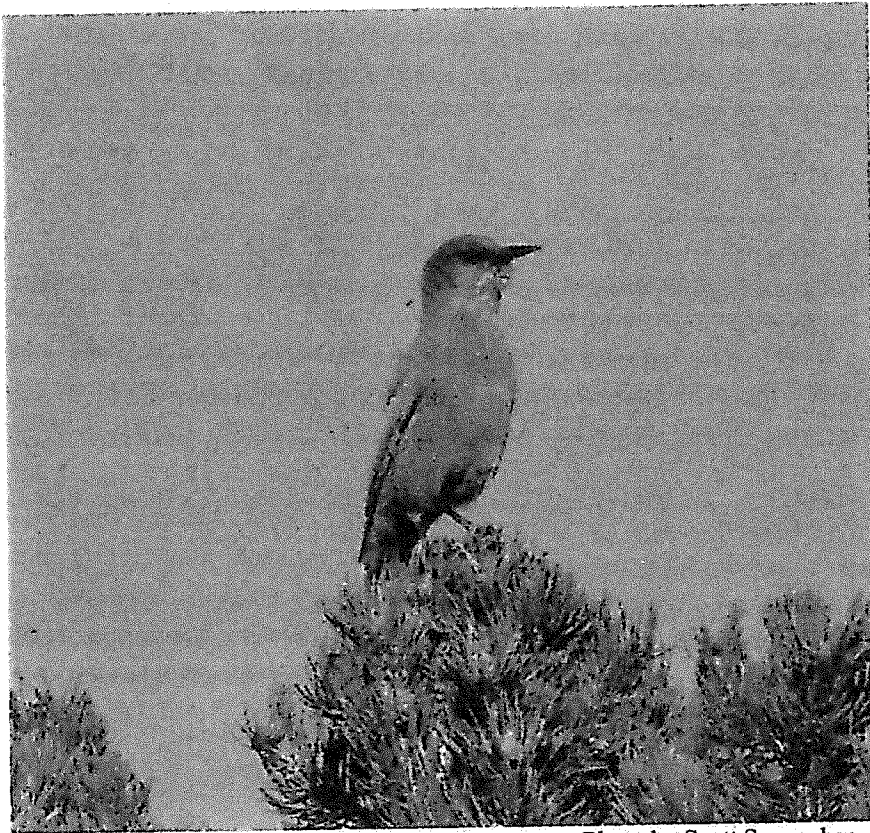
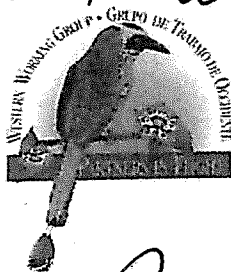


Photo by Scott Somershoe

Version 1, February 2020

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Partners in Flight Western
Working Group & USFWS

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Clearance surveys
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Executive Summary

The Pinyon Jay (*Gymnorhinus cyanocephalus*) is an obligate bird of piñon-juniper and other pine-juniper woodlands that has experienced significant population declines and is of increasing conservation concern. The purpose of this strategy is to summarize current knowledge about Pinyon Jays and identify research, monitoring, and conservation actions required to improve their population status.

Pinyon Jays are highly social and maintain year-round flocks that occupy large home ranges and use a variety of woodland habitats for foraging, caching piñon nuts, nesting, and roosting. The Partners in Flight North American Landbird Conservation Plan estimates a current global population of 770,000 Pinyon Jays. Over the period from 1967–2015, populations declined by 3.69% annually for an estimated total loss of 83.5%. The causes of these declines are unclear, largely because Pinyon Jays remain understudied. Most earlier research has occurred in New Mexico and Arizona and has focused on behavior or on habitat associations at nest colonies. More recent and ongoing research efforts are focused on understanding habitat requirements, resource needs, and movement patterns throughout the entire annual cycle in different regions of the species' range. Future research needs include: identifying home ranges and nesting colony sites, habitat use and requirements, nesting biology and survival, assessing causes of local and regional declines, and assessing effects of management.

As Pinyon Jay populations have declined, the piñon-juniper woodlands that provide most of their habitat also face potential threats, including removal of trees to accomplish other management priorities, long-term fire suppression, changes in woodland age and tree density, and changing climatic conditions that cause reduced piñon nut production and increased piñon pine mortality.

Effective management and conservation of the Pinyon Jay depends on a better understanding of the species' habitat requirements, identification of the factors that limit population size, and a clearer understanding of woodland dynamics and health. The information provided in this strategy to inform management is based on the best available science and is intended to help minimize unintended negative impacts to Pinyon Jays associated with current vegetation management activities. Collaboration between land managers and Pinyon Jay researchers provides a compelling approach to increase our knowledge of the species, better understand management trade-offs, and identify positive actions that could improve habitat for the species and reverse negative long-term population trends.

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Chapter 1. Pinyon Jay Conservation Status and Trends

The Pinyon Jay (*Gymnorhinus cyanocephalus*) (Figure 1) is a highly social corvid of the interior West (Figure 2) that has experienced a major population decline over the past half century. Data from the North American Breeding Bird Survey (BBS) indicate that Pinyon Jay numbers have decreased significantly survey-wide by 3.69% per year from 1967–2015, with an overall population loss of approximately 83.5% (Sauer et al. 2017). On the basis of current trends, the estimated global population of 770,000 Pinyon Jays (range 530,000–1,100,000, 95% confidence bounds) is predicted to be reduced by an additional 50% over the next 19 years (the so-called population “half-life”) (Rosenberg et al. 2016, Partners in Flight 2019; see Table 1 and Figures 3, 4, and 5 for population abundance and BBS trends at multiple spatial and temporal scales).

The Pinyon Jay was listed as *Vulnerable* on the Red List of Threatened Species by the International Union for Conservation of Nature (IUCN), which suggests it faces a high risk of extinction in the medium-term future (BirdLife International 2017). The Pinyon Jay is also recognized as a Species of Greatest Conservation Need (SGCN) in State Wildlife Action Plans (Table 1). The U.S. Fish and Wildlife Service has identified the Pinyon Jay as a priority species continentally and in several Bird Conservation Regions (BCR's; for definition and geographic boundaries, see <http://nabci-us.org/resources/bird-conservation-regions-map/>) on the Birds of Conservation Concern (BCC) list (U.S. Fish and Wildlife Service 2019, in review). Partners in Flight (PIF) identified Pinyon Jay as a Yellow Watch List Species in the 2016 PIF Landbird Conservation Plan (Rosenberg et al. 2016) due to overall population declines and moderate to high threats. Department of Defense PIF has elevated the Pinyon Jay to their list of 16 “Mission Sensitive Species” (R. Fischer, pers. comm.).

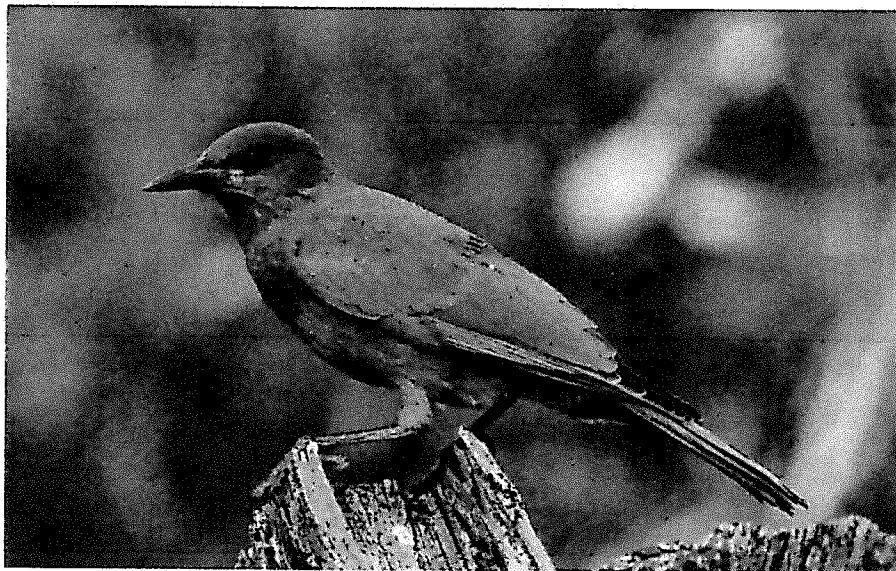


Figure 1. Pinyon Jay in southern Idaho. Photo by Wallace Keck, USNPS.

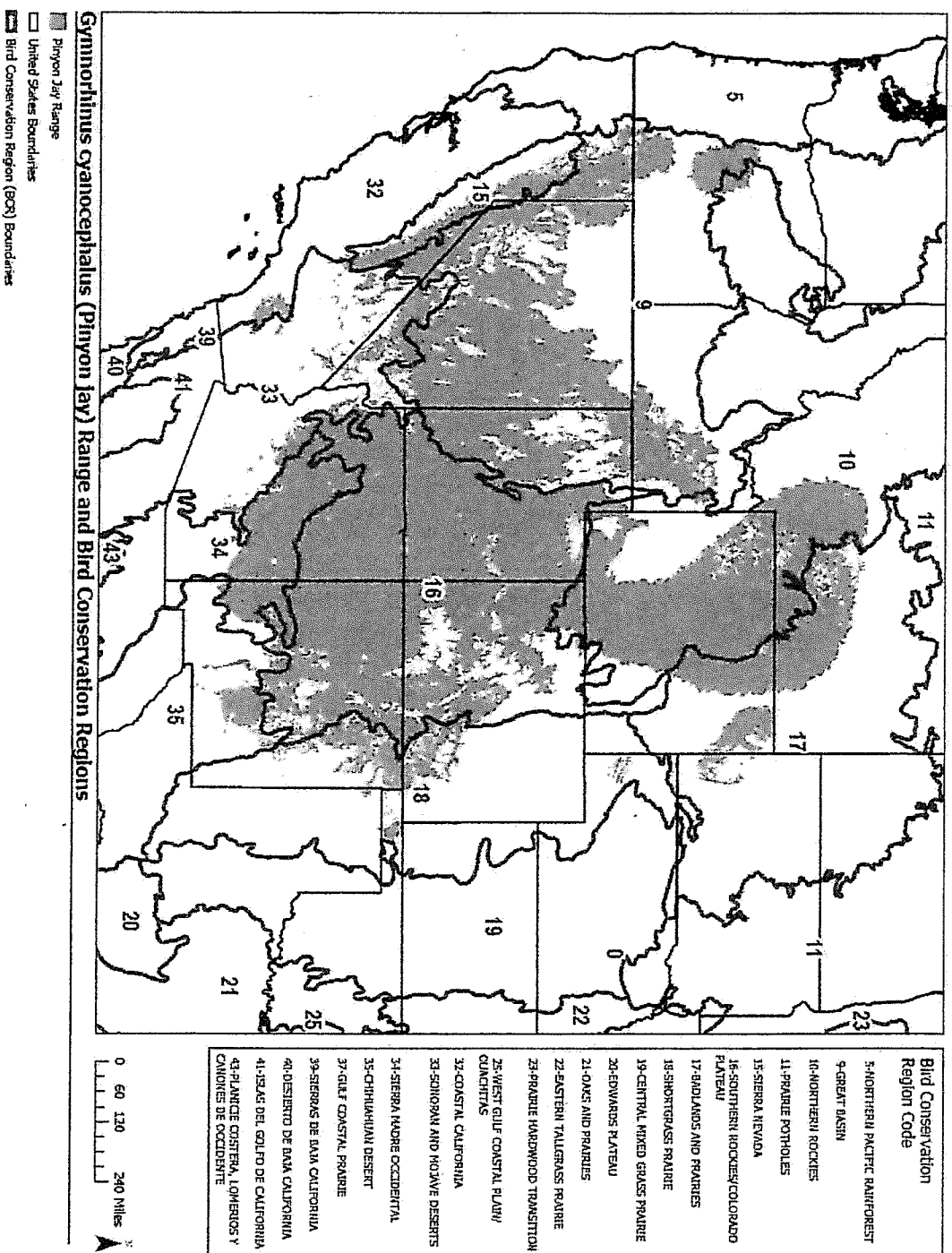


Figure 2. Pinyon Jay range and Bird Conservation Regions. Image courtesy of Liz Moore, Utah Division of Wildlife Resources.

Table 1. Estimated Pinyon Jay population and trends by BCR and state for the entire analyzed BBS period (1967–2015) and most recently analyzed 10-year BBS period (2005–2015). For the BBS trends, n = number of survey routes on which the species was encountered during the entire survey period. BBS trends are presented as yearly percentage change. Numbers in parentheses are the credible intervals for the trend estimate; the values represent the 2.5% and 97.5% percentiles of the posterior distribution of trend estimates (Sauer et al. 2017). Trends for which credible intervals do not include zero are considered statistically significant, and red text represents a significant negative trend. Where there are data deficiencies or where the species does not breed, “n/a” is used, meaning data are not available or not applicable.

Region/State	Percentage of population	BBS Sample size (n)	BBS Trend 1967-2015 (%/yr, 95% CI)	BBS Trend 2005-2015 (%/yr, 95% CI)
Range wide				
Survey wide	n/a	285	-3.69 (-5.1, -2.4) ^a	-2.67 (-4.9, 0.4)
BCR-level ^b				
S. Rockies/CO Plateau BCR	50.3	138	-3.16 (-4.7, -1.5) ^a	-2.56 (-5.0, 1.4)
Great Basin BCR	37.5	53	-4.12 (-6.4, -1.8) ^a	-3.57 (-7.7, 0.9)
Sierra Madre Occidental BCR	4.0	10	-4.00 (-10.6, 2.9)	-4.16 (-17.9, 11.1)
Northern Rockies BCR	3.2	29	-4.37 (-9.0, 0.1)	-1.81 (-12.1, 15.7)
State				
Arizona*	9.7	29	-2.13 (-5.8, 1.7)	1.28 (-7.3, 8.1)
California	3.1	30	0.49 (-4.1, 4.2)	3.42 (-2.9, 13.8)
Colorado*	9.0	51	-3.61 (-6.3, -1.0) ^a	-3.12 (-7.8, 2.2)
Idaho*	0.2	n/a	n/a	n/a
Montana*	1.7	12	-5.46 (-9.8, -0.6) ^a	-4.12 (-17.6, 13.0)
Nebraska*	0.2	n/a	n/a	n/a
Nevada*	27.3	20	-4.55 (-7.4, -1.6) ^a	-4.66 (-9.9, 1.1)
New Mexico*	30.4	37	-3.46 (-5.6, -1.4) ^a	-3.09 (-5.9, 0.8)
Oregon	0.3	12	-2.90 (-9.2, 3.5)	-1.13 (-9.6, 10.6)
South Dakota	0.2	4	-6.11 (-13.9, 2.9)	-8.79 (-36.3, 7.3)
Utah	15.7	65	-4.03 (-6.1, -2.1) ^a	-3.76 (-7.1, 0.01)
Wyoming	1.4	25	-5.61 (-10.5, -1.0) ^a	-5.35 (-17.5, 3.5)

BBS trends: ^a High confidence (Sauer et al. 2017).

^b Percentage of populations for BCRs do not equal 100% as BCRs with <3% of the global population are excluded from this table.

*Designates SGCN (Species of Greatest Conservation Need) per the State Wildlife Action Plans.

Chapter 2. Pinyon Jay Distribution, Natural History and Habitat

Distribution Patterns and Natural History

The Pinyon Jay is most abundant in the southern Great Basin and the southwestern U.S. (Figure 4), where it is usually associated with the piñon pines (e.g., *Pinus edulis*, *P. monophylla*) for which it is named (Figure 6). Pinyon Jays are found in lower densities outside the range of piñon pines, in South Dakota, Nebraska, California, Oregon, Wyoming, and Montana, where they occur in habitat types dominated by ponderosa pine (*P. ponderosa*), Jeffrey pine (*P. jeffreyi*), and limber pine (*P. flexilis*) (Burleigh 1972, Grenfell and Laudenslayer 1983, Balda 2002, Faulkner 2010, Marks et al. 2016, Drilling et al. 2018, Silcock and Jorgensen 2018). Pinyon Jays are associated with juniper (in the absence of piñon pine) in southern Idaho (Brody 1992) and may also use juniper-dominated areas in Montana (J. Marks, pers. comm.), New Mexico (Johnson et al. 2014) and other areas.

Pinyon Jays are highly social throughout the year. They occur in flocks of up to a few hundred individuals and nest colonially, sometimes cooperatively, often using the same general nesting colony site annually (Marzluff and Balda 1992). Home ranges are large, typically 8,645 acres (3,500 hectares) to 15,800 acres (6,400 hectares) (Marzluff and Balda 1992; Balda 2002; Johnson et al. 2016, 2017a). Unlike traditionally territorial species, their nests are spatially clumped in nesting colonies that can cover 141 acres (57.4 hectares) or more (Figure 7, Johnson et al. 2014, 2015, 2018a). NR
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Across their geographic range, Pinyon Jays inhabit varying elevations and latitudes with diverse woodland structures, dominant tree species, and landscape characteristics, and thus home range attributes may vary substantially from region to region. Additionally, local home ranges may shift seasonally, and jays may occasionally make large-scale movements (up to hundreds of miles) out of their normal home range when food resources are limited in fall and winter (Balda 2002). Pinyon Jays may also adjust daily and annual habitat use within home ranges as habitat conditions and resources vary over space and time. As a result, well-established occupancy patterns can change with seasons and with habitat conditions in unanticipated ways.

Pinyon Jays have a mutualistic relationship with piñon pines where they co-occur (Ligon 1978, Lanner 1996). Piñon pines are a masting species, producing highly nutritional nuts in 'arge crops that historically occurred within local stands or regions at irregular intervals, from one to three crops every 10 years for *P. edulis* (Forcella 1981) and one crop every one to three years for *P. monophylla* (Sutton 1984). These intermittently abundant nuts sustain Pinyon Jays throughout the winter, support successful nesting, and significantly influence population viability (Marzluff and Balda 1992). Pinyon Jay nesting success and productivity are higher following mast years than non-mast years (Ligon 1978, Marzluff and Balda 1992), and adult survivorship is highest after moderate cone crops (Marzluff and Balda 1992). In turn, Pinyon Jays serve as the

primary long-distance seed disperser for piñon trees within the species' range. They transport piñon nuts to caching areas up to several miles from the source woodland and may cache in sites favorable for seed germination (Ligon 1978). Therefore, Pinyon Jays likely serve an important role in overall woodland health and regeneration.

Outside the range of piñon pines, Pinyon Jays feed on and cache nuts of other pines, such as Jeffrey, limber, and ponderosa pines, but no information is available on the importance this seed dispersal by Pinyon Jays on the ecology and distribution of these other tree species. The effects of what may be a lower-quality food source on Pinyon Jay ecology, diet, and movements are also unknown. In addition to consuming piñon and other pine nuts, Pinyon Jays also forage extensively for insects in the shrub and grass understory.

Although Pinyon Jay mutualism with piñon pines has been emphasized, the species also eats insects (Ligon 1978, Balda 2002). Jays may rely on insects when piñon nuts are unavailable. Pinyon Jays have been reported to nest successfully in response to a large emergence of periodical cicadas (Ligon 1978), and most foraging observed during the nesting season involved capture of insects in the shrub understory of woodlands (Balda 2002, J. Boone and E. Ammon, unpublished data).

Piñon-Juniper Woodland Types

Piñon and piñon-juniper woodlands vary considerably across the Pinyon Jay's range. Perhaps the best framework for classifying these woodlands is the U.S. National Vegetation Classification (NVC, <http://usnvc.org/>), a collaborative effort of NatureServe and the Ecological Society of America (ESA). This classification system has been formally adopted by the U.S. Forest Service, the ESA, NatureServe, and the U.S. Geological Survey Core Science System. The NVC is a hierarchical classification of all U.S. vegetation types which provides common reference points for the various land management and conservation entities in the U.S.

Within the NVC, in the Southern Rockies and Colorado Plateau region, Pinyon Jays occur in the Intermountain Pinyon-Juniper Woodland Macrogroup, including the Colorado Plateau Pinyon-Juniper Woodland Group, and associated alliances. Jays also occur in the Southern Rocky Mountain Two-needle Pinyon-Juniper Woodland Macrogroup and associated groups and alliances. In New Mexico, Pinyon Jays have been documented nesting in the Southern Rocky Mountain Pinyon-Juniper Open Woodland Macrogroup, including the Southern Rocky Mountain Juniper Open Woodland Group (juniper-dominated woodland and savanna) and Southern Rocky Mountain Pinyon-Juniper Woodland Group (woodlands dominated by *P. edulis* and *Juniperus monosperma*) (Johnson et al. 2014, 2015). Here they tend to winter at lower-elevation, juniper-dominated woodland and savanna types of the Southern Rocky Mountain Juniper Open Woodland Group (Johnson et al. 2014). In the Great Basin, Pinyon Jays primarily occupy the Intermountain Pinyon-Juniper Woodland Macrogroup, including the Great Basin Pinyon-Juniper Woodland Group and associated alliances.

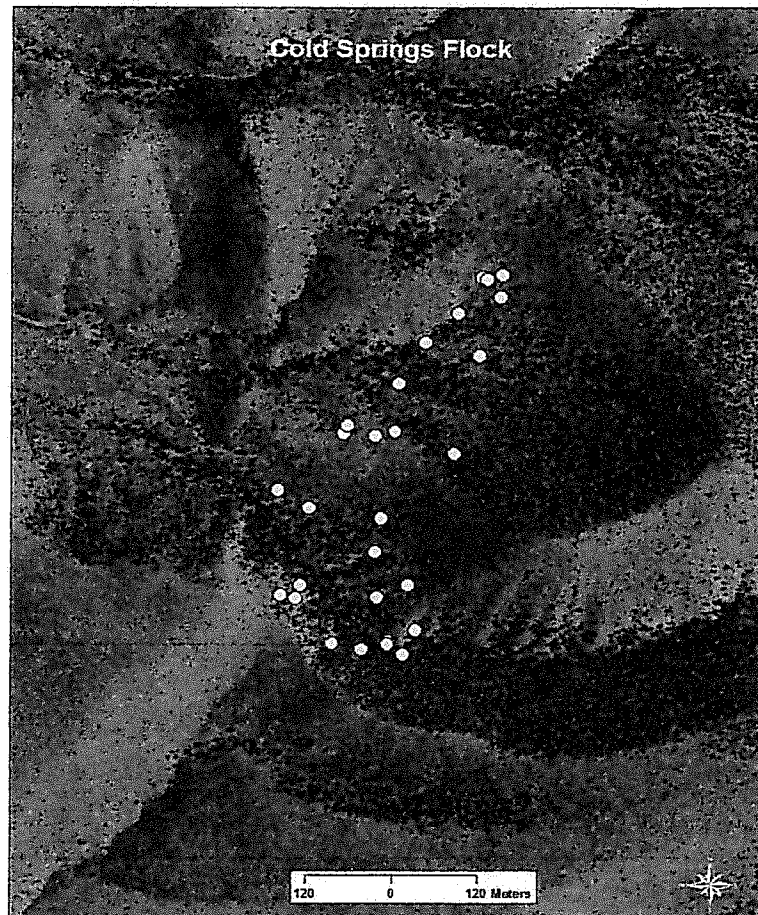


Figure 7. Spatial extent of a typical nesting colony in Nevada, with known nest sites as yellow points (J. Boone and E. Ammon, unpublished data).

Two other classification systems for piñon-juniper vegetation provide useful additional perspectives (Table 2, Figures 8–20). First, Romme et al. (2009) define three main piñon-juniper vegetation types based on historical disturbance regimes (Table 2) that vary in geography, site condition, and tree species. A second scheme (Miller et al. 2008 and references therein) classifies piñon-juniper vegetation in the Great Basin in terms of “phases”. This system has become widely referenced in areas where Greater Sage-Grouse (*Centrocercus urophasianus*) are a management focus. The descriptions shown in Table 2 refer to the early (Phase I), middle (Phase II), and late (Phase III) successional phases of woodland development (Miller et al. 2008).

Table 2. Descriptions of piñon-juniper woodland types (Romme et al. 2009) and successional stages (phases) in the Great Basin (Miller et al. 2008).

Piñon-juniper vegetation types
Persistent piñon-juniper woodlands: sparse to dense tree cover, typically in rugged areas with coarse soils, and with minimal herbaceous ground cover (Figures 8–13)
Piñon-juniper savannas: low to moderate tree density with dense, nearly continuous grass and forb understory on coarse- to fine-textured soils (Figures 14 and 15)
Wooded shrublands: variable tree density, from very sparse to relatively dense, and shrubs are the dominant understory plants, including sagebrush (<i>Artemisia</i> spp.) (Figures 16–20)
Piñon-juniper woodland phases (Great Basin)
Phase I: trees present, but shrubs and herbaceous cover are the dominant vegetation type (Figures 16–18)
Phase II: trees co-dominant with shrubs and herbaceous cover (Figures 8 and 18)
Phase III: trees are dominant vegetation (Figures 9, 11, and 18)



Figure 8. Medium density piñon-juniper wooded shrubland (Phase II) near a nesting colony, western Nevada, April 2018. Photo by Scott Somershoe.



Figure 13. Persistent piñon-juniper woodland, Mesa Verde National Park, Colorado.
Photo by Scott Somershoe.



Figure 14. Piñon-juniper savanna, New Mexico. Photo by Natural Heritage New Mexico.



Figure 15. Piñon-juniper savanna, central New Mexico.
Photo by Natural Heritage New Mexico.

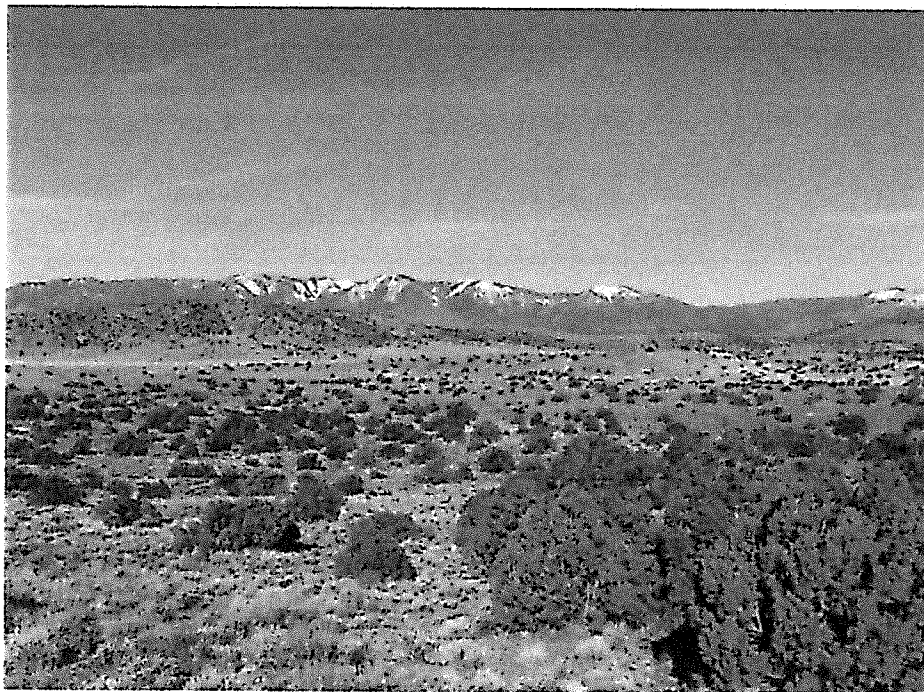


Figure 16. Low density piñon-juniper wooded shrubland (Phase I), western Nevada,
April 2018. Photo by Scott Somershoe.



Figure 17. Wooded shrubland (Phase I), Nevada.
Photo by Great Basin Bird Observatory.

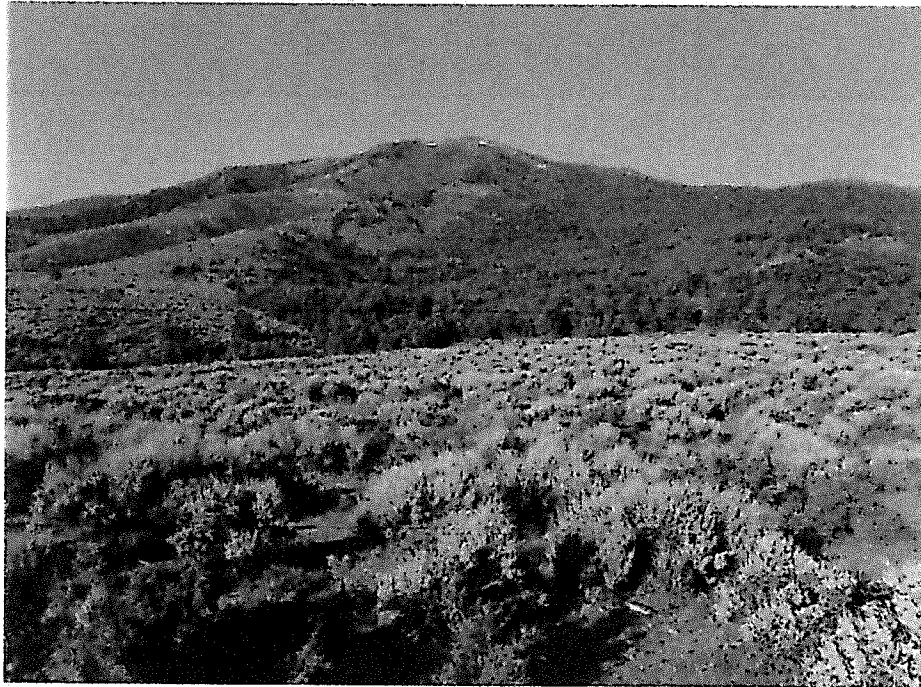


Figure 18. Wooded shrubland (multiple phases), Nevada.
Photo by Great Basin Bird Observatory.

primary objectives, but simultaneously investigate Pinyon Jay responses. This could include designing treatments with different levels of retained woodland cover (e.g., canopy cover) to assess jay response and determine critical thresholds to minimize negative impacts to jays. **Current knowledge:** Pinyon Jay response to management has been assessed in one study in central Colorado (BCR 16) (Magee et al. 2019) and at a single nesting site in New Mexico (BCR 16) (Johnson et al. 2018b).

d. Investigate Pinyon Jay responses to disturbances. Very little is known about how sensitive Pinyon Jays are to physical disturbances associated with management and multiple-use activities, such as infrastructure development, infrastructure operation, recreation, and noise. Clarifying these issues, especially with regard to nest colony disturbances that might affect nest success, is important. This will facilitate the development of clear and regionally-specific guidelines (including non-disturbance buffers) for management and other activities to minimize or avoid negative impacts to Pinyon Jays. **Current knowledge:** The limited guidance recommends maintenance of a 0.6 mile (1 kilometer) undisturbed buffer around Pinyon Jay nest colonies when planning energy develop projects, OHV trails, or road building, especially when there is potential for significant noise disturbance or vehicular traffic associated with developments (Wiggins 2005, Johnson et al. 2013, Kleist et al. 2018).

Handwritten note in a circle:
0.6
buffer

Pinyon Jay Nesting Biology

With the exception of studies by R. Balda and students in the 1980s in Flagstaff, Arizona, little information exists about nest success, productivity, adult and juvenile survival, and other associated demographic parameters across most of the range. More importantly, few studies have related habitat covariates to reproductive success and current information may not be applicable to a broader geographic region, specifically regions and/or BCRs.

Specific research needs are:

a. Conduct research on Pinyon Jay nesting biology, productivity, and other demographic parameters. Studies to assess nesting success, productivity, and site fidelity are needed, as basic nesting demographics are largely unknown. Additional largely unstudied population parameters critical to understanding declines include adult and post-fledging juvenile survival, and causes of predation. The degree to which Pinyon Jays have a strict or approximate fidelity to nesting colony sites over multiple years is also unknown (see item d., below). **Current knowledge:** Nesting demographic data are largely limited to New Mexico (BCR 16) (Johnson et al. references in literature cited) and Flagstaff, Arizona (BCR 34) (Balda 2002). Survivorship has only been assessed in Flagstaff, Arizona (BCR 34) (Balda 2002).

developed models for the Colorado portion of the Colorado Plateau (BCR 16). Several climate projection models exist for the Southwest.

Effects of Piñon-Juniper Woodland Management

Although current paradigms for “best woodland management practices” and “forest health” could translate into benefits for Pinyon Jays, this conjecture has not been explicitly studied and evaluated. Determining how current vegetation management practices and goals relate to Pinyon Jay conservation needs, including health and productivity of piñon pines, is a high priority, and a prerequisite to inform future management designed to benefit or minimize negative impacts to Pinyon Jays.

Specific research needs are:

a. Investigate the effects of woodland thinning on tree health and survival.

Woodland thinning treatments using mechanical approaches and herbicide application occur mostly, but not exclusively, in the Southwest region of the Pinyon Jay range. However, the effects of these management practices on mast production and health of remaining trees are largely unexplored. **Current knowledge:** Instead of improving tree health or survival within the stand by reducing intraspecific competition, limited information suggests under some circumstances, thinning can be detrimental due to increased evapotranspiration (Greenwood and Weisberg 2007, Clifford et al. 2008, Morillas et al. 2017). There is also anecdotal evidence that piñon pine trees retained after woodland thinning may be highly vulnerable to drought-related bark beetle mortality (Coop and Magee 2016). Limited research suggests the survival of remaining trees after thinning may depend upon the type of piñon-juniper woodland; wooded shrublands, and perhaps piñon-juniper savannas, may respond positively to thinning, while persistent piñon-juniper woodlands may respond negatively (Roundy et al. 2014, Morillas et al. 2017, Flake and Weisberg 2018). Further, effects of thinning could vary with pre-treatment tree density and age, soil type, and final tree density (e.g., canopy cover, basal area). Thinned piñon pines may be more vulnerable to drought conditions than undisturbed stands in central New Mexico (BCR 16) (Morillas et al. (2017).

b. Examine the comparative effects of different vegetation management techniques and designs on Pinyon Jays, tree health, and pine nut productivity. In some cases, vegetation management goals can be accomplished through multiple methods. For instance, woodland stands can be removed by prescribed fire, mastication, or lop-and-scatter cutting. A comparative assessment of impacts on tree health, productivity and habitat quality, along with Pinyon Jay response, could be used to identify the best management option for a given situation. In order to quantify habitat and jay response, monitoring should be conducted in association with management projects. **Current**

knowledge: Lop-and-scatter may be preferable to other slash management methods by reducing erosion, protecting the health of the remaining trees, and promoting healthy invertebrate populations (Stoddard et al. 2008). Prescribed surface fire is not recommended as a follow-up to thinning within persistent piñon-juniper woodlands and wooded shrublands because these ecosystems did not evolve with frequent, low-intensity surface fires (Baker and Shinneman 2004, Romme et al. 2009). Targeting thinning in areas of natural die-offs (from drought, beetle kill, or other factors) may promote or retain a diverse woodland mosaic that better mimics how historical fire would have affected the landscape in these woodland types (Romme et al. 2009).

fire

c. Incorporate expanding knowledge about Pinyon Jays and habitat use into existing guidelines for vegetation management. As the new information outlined in this chapter is obtained, it will be advantageous to actively look for opportunities to integrate these insights into existing vegetation management guidelines. This will ensure that appropriate knowledge is considered with designing and implementing vegetation management for a variety of compatible goals.

Chapter 6. Management Considerations

Overview

Currently, our understanding of how land and vegetation management may affect Pinyon Jay populations is not sufficient to support comprehensive recommendations for Pinyon Jay conservation. However, the limited data that are available provide a basis for the management considerations outlined in this section. In presenting these considerations, we recognize there is a wide variety of objectives and priorities that managers must balance in designing and implementing their woodland treatment projects in areas used by Pinyon Jays. Most often, these are either: a) thinning or herbicide treatments in the Southwest for fuels management or wildlife habitat, or b) sagebrush restoration treatments in the Great Basin to create or improve habitat for priority species such as Greater Sage-Grouse and other sagebrush obligate species. The information presented below is a resource for managers who wish to adopt measures that reduce the likelihood of negative impacts to Pinyon Jays. We do not have sufficient knowledge to describe and quantify management actions that would actively improve habitat for Pinyon Jays at this time; rather we focus on minimizing adverse effects when woodland treatments are conducted for other purposes. As new research becomes available, the Working Group plans to update this document with more detailed conservation actions and recommendations that encompass a wider variety of objectives, including Pinyon Jay population recovery and forest health, with improved regional specificity.

Considerations for the Location of Woodland Treatment Projects

Pinyon Jay use of the landscape within a flock's home range is likely to vary across a daily cycle, a seasonal cycle, and possibly across years. Although it is important to model Pinyon Jay habitat and occupancy at multiple scales (Johnson et al. 2014, 2015, 2016, 2017), standardized, site-specific assessments to determine whether Pinyon Jays are present in a proposed treatment area and how they are using the habitat may be especially useful in informing management at the treatment scale. These assessments can include surveys to locate nests during the breeding season (e.g.; "clearance surveys", as typically used for Migratory Bird Treaty Act [MBTA] compliance) or other surveys to identify whether Pinyon Jays use the area for other activities, such as caching or foraging.

Vegetation thinning within a traditional nesting colony site can cause the birds to abandon treated areas (Johnson et al. 2018b) or alter the suitability of the habitat (Johnson et al. 2019), and complete removal of the colony site removes nesting substrate altogether. Therefore, avoiding treatment of nest colony sites is recommended. Pinyon Jays often use the same general area each year for nesting, with colony site shifts of up to 550 yards (~500 meters) between years (Marzluff and Balda 1992, Johnson et al. 2017c, J. Boone and E. Ammon, pers. comm.). Thus, a buffer of undisturbed habitat of 550 yards (~500 meters) around a known breeding colony is

Clearance surveys

*1635
3 mi*

recommended and allows for typical colony shifts across years (Johnson et al. 2017c).

*Clearance
surveys*

The Working Group website (<https://www.partnersinflight.org/resources/pinyon-jay-working-group/>) provides information about how to conduct clearance surveys for Pinyon Jays. Similar guidance is available from Natural Heritage New Mexico (Petersen et al. 2014) and Great Basin Bird Observatory (www.gbbo.org). Additional information and assistance with conducting more generalized occupancy surveys that incorporate caching and foraging habitat use can be obtained by contacting partners in the Working Group with Pinyon Jay survey experience.

Considerations for the Timing of Woodland Treatment Projects

It is preferable to conduct treatments outside of the Pinyon Jay breeding season, especially if an active nest colony is within the area where a treatment must occur. Pinyon Jays tend to breed earlier than most passerine land birds. Data from Nevada (J. Boone and E. Ammon, unpublished data), Utah, and Colorado (R. Norvell and L. Rossi, unpublished data) indicate that nesting activity in these regions begins in late February or early March and ends in late May. Studies in New Mexico suggest that nesting phenology may occur later than in more northerly regions, except in the case of a mast crop the previous fall (Johnson et al. 2014, 2015, 2017c); however, Pinyon Jays in New Mexico still breed earlier than most piñon-juniper bird species. The specific timing of the breeding season may vary from year-to-year depending on the severity of the preceding winter and on the availability and abundance of nuts cached during the previous fall (Balda 2002).

Documenting the Effects of Woodland Treatments on Pinyon Jays

If a woodland treatment is conducted in an area that is occupied by Pinyon Jays, conducting systematic, standardized pre- and post-treatment monitoring of Pinyon Jay habitat use and vegetation parameters will help to determine the effects of the treatment on Pinyon Jays. If treatments are conducted within a known nesting colony, post-treatment monitoring should be completed to determine if the colony moves and if the new habitat has similar characteristics to the original colony location. Pre- and post-treatment monitoring of vegetation measures (e.g., tree size, tree density, canopy cover, tree vigor, and piñon nut productivity) is necessary for understanding the impacts of thinning treatments on Pinyon Jays (Johnson et al. 2018a, 2018b, 2019).

Post-treatment monitoring could be conducted by the agency performing the treatment, but may be facilitated by collaboration between managers and Pinyon Jay researchers. We strongly encourage this collaboration to take advantage of the information gathering opportunities presented by ongoing woodland treatments and among researchers to compare and contrast regionally-specific findings to strengthen our overall knowledge of Pinyon Jay conservation needs.

04/13
treatment areas. If juniper is the target species, avoiding treating areas that contain piñon trees avoids compromising piñon nut production.

- d. As piñon nut production is critical to Pinyon Jays, mast-producing trees are particularly valuable. Therefore, thinning may be particularly detrimental in known productive piñon woodlands containing old or very old trees, likely of prime piñon nut producing age, and trees of moderate age to support future nut production (Parmenter et al. 2018, Crist et al. 2019). Parmenter et al. (2018) identified age and size of *P. edulis* as an indicator of probable nut productivity: little to no productivity (<3.5 inches or <9 centimeter diameter at breast height [dbh]); medium productivity (3.5–5.9 inches or 9–15 centimeter dbh); and high productivity (>6.3 inches or >16 centimeter dbh) (Zlotin and Parmenter 2008). Old and very old trees likely produce more mast due to their large size and larger number of fruiting branches (Parmenter et al. 2018).
- e. South- and west-facing slopes, as opposed to north- and east-facing slopes, may be more suitable for treatments avoiding impacts to Pinyon Jays because north- and east-facing slopes are projected to better survive future climate change scenarios (Rondeau et al. 2017). Sites with lower heat load (north-facing) are also favored for Pinyon Jay colony sites (Johnson et al. 2017b). *thermal!*
- f. Large and densely crowned trees are particularly valuable for Pinyon Jay nesting, particularly when they occur within areas of higher tree density (Wiggins 2005, Johnson et al. 2014, 2015, Johnson and Sadoti 2019).
- g. Retaining and promoting native grasses, forbs, and shrubs in the understory may increase available invertebrate prey for Pinyon Jays (Bombaci and Pejchar 2016).
- h. If cheatgrass and other invasive annual plants are in the vicinity of a planned treatment area, aggressive invasive species control in post-treatment management plans decreases fire risk and fire intensity (Chambers et al. 2017), thus lowering the risk to stands important to Pinyon Jays. A minimum of 20% perennial native herbaceous cover in a treatment area is recommended for preventing a large increase in cheatgrass and other annual invasive plants post-treatment (Chambers et al. 2017). *Cheat*

Considerations for Region Wide Fuels Reduction and Fire Management Projects

Reduction of fuels and fire risk is a common reason for woodland thinning or prescribed fire treatments in some regions. For the purposes of this document, we assume that treatments that successfully reproduce the woodland conditions associated with historical natural fire patterns may help minimize negative impacts for Pinyon Jays, but considerable research is still needed to confirm this assumption.

The historical role of fire in piñon-juniper woodlands is not fully understood, but Romme et al. (2009) provide a comprehensive assessment of the frequency and significance of fire in each of the three piñon-juniper vegetation types. In persistent piñon-juniper woodlands and wooded shrublands, low-intensity, frequent surface fire generally did not occur due to the limited ground fuels; instead, these habitats typically experienced stand-replacing crown fires at approximately 300–400 year intervals (Baker and Shinneman 2004, Romme et al. 2009, Friggens et al. 2018, Miller et al. 2019). As a result, management actions designed to replicate the effects of frequent, low-intensity fires, such as thinning and prescribed burning may not achieve ecological restoration goals. Fire disturbance regimes are not well understood in piñon-juniper savannas. Although the higher grass component in savannas would suggest these habitats supported low-severity fires, there is little empirical information to support this supposition (Romme et al. 2009). Because of these complexities and information gaps, there are no one-size-fits-all recommendations for fuels reduction and fire management treatments. If fuels treatments are planned, the following guidance may help to minimize negative impacts to Pinyon Jays:

- a. If thinning in persistent piñon-juniper woodlands or wooded shrublands, creating a patchy-clumpy mosaic of suitable nesting habitat within the treated area, as opposed to evenly spaced thinning, allows for shifting colony locations. Further, thin and/or retain Phase I and/or II woodlands rather than closed canopy woodlands (Phase III) to provide woodland conditions preferred by Pinyon Jays. This treatment pattern also better mimics how fire would have impacted the landscape in persistent piñon-juniper woodlands and wooded shrublands (Romme et al. 2009). Provided that sufficient suitable habitat is retained throughout the treatment area, retaining as many larger trees as possible within areas of higher tree density and/or higher canopy cover will likely conserve more Pinyon Jay nesting habitat than thinning all size/age classes to a uniform density. For example, a guideline is to retain trees within the 25–75% quartiles of these measures at the target site or similar sites (Johnson and Sadoti 2019).
- b. As piñon nut production is critical to Pinyon Jays, mast-producing trees are particularly valuable. Therefore, thinning may be particularly detrimental in known productive piñon woodlands containing old or very old trees, likely of prime piñon nut producing age, and trees of moderate age to support future nut production (Parmenter et al. 2018, Crist et al. 2019). Parmenter et al. (2018) identified age and size of *P. edulis* as an indicator of



Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Region, Shoshone National Forest

March 2024

Green Union Project

Draft Environmental Assessment



bank from site access and operations would be very similar to vegetation removal. These effects would be limited to areas where disturbance is at higher intensity levels, such as temporary roads and landings. Effects to the seed bank would be minimized through the application of standard soil design features incorporated to minimize detrimental soil conditions that persist over the long-term, such as rehabilitation components and operating condition restrictions.

Prescribed burning (broadcast burning, jackpot burning, and pile burning) may result in mortality to trees and damage seed viability in seedbanks through soil heating. Burn timing and conditions, as well as project design should minimize these effects. Rehabilitation of pile burn areas (soil ripping, seeding, and planting) may create larger openings in the canopy and foster seedling establishment and caching sites.

Tree seedling planting would occur in the project areas as needed. Some units will be planted with whitebark pine seedlings where conditions are likely to support long-term survival and stand development. Seeds will be sourced from the appropriate white pine blister rust resistant genetic stock. Rust resistant seedlings will promote healthier stands and may be more resilient in the face of predicted climate change.

Over the long-term, proposed silvicultural and burning treatments would improve forest health, reduce fuel loads, and create fuelbreaks. Prescriptions for specific unit goals (desired tree spacing, composition, insect and disease prevalence, fuel loads, and whitebark pine restoration potential) dictate levels of overstory and understory removal for all species. Whitebark pine would continue to be present in all units where it currently exists. Silvicultural treatments would be designed to retain growing space for whitebark pine under all treatment types at varying levels. Mature, healthy, whitebark pine trees with the highest reproductive potential would be prioritized for retention in concert with treatment goals. Treatments around these trees would maximize full and open crown development that would result in increased tree ring growth, cone production, and reproductive capacity (Keane et al. 2007). Loss of individuals would be focused on suppressed seedlings and saplings, as well as those mature trees that are diseased, damaged, or otherwise have low reproductive capacity (table 6). Table 6 includes loss of individuals both in areas where whitebark pine is a minor part of the forested stands as well as areas where it is a more significant component of stands.

Table 5. Analysis area and acres of whitebark pine habitat affected by treatments in the analysis area. The analysis area is comprised of the entirety of the six watersheds where treatments would occur.

Analysis Area (acres)	Treatment Units (acres)	Percent of Analysis Area Being Treated	Whitebark Pine Habitat in Analysis Area (acres)	Treatment Units in Whitebark Pine Habitat (acres)	Percent of Whitebark Pine Habitat in Analysis Area Affected by Treatments
105,816	9,677	9.1	43,931	2,749	6.5

Table 6. Total number of trees and estimated loss of the number of existing whitebark pine and percent of total loss by size class as a result of project activities

Whitebark Pine Size Class	Estimates of Existing Trees in All Treatment Areas	Mortality from Temporary Roads and Landing Construction	Intentional Mortality (Tree Removal to Address Management Objectives)	Unintentional Mortality (Inadvertent Mortality as a Result of Project Activities)	Total Estimated Mortality
Seedlings	2,481,176 (74%)	92,168 (3.8%)	863,434 (36.2%)	355,480 (14.9%)	1,310,082 (54.9%)

Whitebark Pine Size Class	Estimates of Existing Trees in All Treatment Areas	Mortality from Temporary Roads and Landing Construction	Intentional Mortality (Tree Removal to Address Management Objectives)	Unintentional Mortality (Inadvertent Mortality as a Result of Project Activities)	Total Estimated Mortality
Saplings	756,793 (22.6%)	25,539 (3.5%)	230,914 (31.6%)	95,439 (13.1%)	351,892 (48.1%)
Mature trees	113,998 (3.4%)	3,518 (3.2%)	8,925 (8.1%)	0 (0.0%)	12,433 (11.3%)

Typically, effects to trees would vary from survivable damage to mortality. For this analysis, effects are all considered mortality due to the inability to estimate with any accuracy what damage rates or subsequent survival rates could be across age classes. As a result, estimated mortality is likely higher than what actual mortality may look like after project completion (table 7). Mortality estimates were developed by a forester and silviculturist and were based on literature reference and professional judgment from prior mechanical treatments on the forest. Mortality estimates were calculated based on specific prescriptions and anticipated effects. Some suitable units would be replanted with whitebark pine seedlings after treatment. Temporary roads and landings would be rehabilitated after project activities are completed through soil ripping, seeding, and planting, if required. Once rehabilitated, these areas would provide larger openings in the canopy available for seedling establishment and caching sites.

Cumulative Effects

Vegetation treatments, grazing, recreation, and invasive plant management in conjunction with the proposed action could result in cumulative effects to whitebark pine. Project design features for this and other projects are incorporated to minimize effects.

For whitebark pine, past and ongoing vegetation treatments for fuel reduction, insect and disease management, salvage, and timber management have been authorized in the last 20 years in seven separate projects across the analysis area. Activities associated with vegetation management include planting, temporary road construction, prescribed fire, and mechanical vegetation removal. The effects of these activities are the same as described above for the proposed action. Approximately 11,154 acres have been authorized for treatment in the analysis area that fall within modeled whitebark pine habitat. When combined with the proposed action, 13,903 acres of whitebark pine habitat would be authorized for treatment out of 43,931 total acres of whitebark pine habitat in the analysis area, which amounts to 31.6 percent.

The authorization to treat in whitebark pine habitat does not equate to complete whitebark pine removal. As with the proposed action, treatments in other projects will affect individual trees, but are concentrated in the seedling and sapling size class. Areas where whitebark pine has existed within these project areas continue to support whitebark pine after treatment. These treatments also include beneficial effects to whitebark pine, such as planting, as well as removal of standing dead and infected trees. Treatments in other projects avoid mature whitebark pine removal, using similar methods to the proposed action. Healthy, mature, cone-producing individuals are preferentially retained where possible. Future vegetation treatments have not been identified in the analysis outside those that are ongoing and have already been authorized.

Authorized cattle grazing does not meaningfully interact with whitebark pine habitat. While cattle grazing may affect individuals through hoof action and above ground disturbance in some areas, it would be insignificant and likely undetectable.

States?
31.6%
treat
removal
genetic
diversity

***Project Recommendations for Migratory Bird Conservation
U.S. Fish and Wildlife Service, Utah Field Office (May 2020)***

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. The USFWS maintains a list of all species protected by the MBTA at 50 C.F.R. § 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and songbirds. The MBTA does not protect introduced species such as the house (English) sparrow, European starling, rock dove (pigeon), Eurasian collared-dove, and non-migratory upland game birds.

The U.S. Fish and Wildlife Service (USFWS) recommends that the following migratory bird conservation measures be implemented as you complete your project:

- a. Wherever possible we recommend that projects be completed outside the migratory bird nesting season to avoid and minimize impacts to migratory birds.
- b. If the project includes the loss or degradation of migratory bird habitat then complete all portions of the project that could impact migratory birds outside the maximum migratory bird nesting season. This includes ground-disturbing activities, habitat removal, clearing or cutting of vegetation, grubbing, burning, etc. If that is not feasible, we recommend that you complete the project outside the minimum migratory bird nesting season.

The time period associated with the maximum migratory bird nesting season is approximately December to August. The time period associated with the minimum migratory bird nesting season is April 1 to July 15 (time-frame when the majority of annual bird nesting occurs).

- c. If the project needs to occur during the migratory bird nesting season, impacts to birds can be avoided or minimized by completing vegetation treatments and vegetation clearing and removal actions during the fall and winter (outside the migratory bird nesting season per above) prior to the nesting season when the project will begin.
- d. If a project may impact migratory birds and/or cause the loss or degradation of migratory bird habitat, and such work cannot occur outside the migratory bird nesting season, we recommend surveying impacted portions of the project area to determine if migratory birds are present and nesting. Surveys should emphasize detecting presence of USFWS Birds of Conservation Concern, take place during the nesting season the year before the nesting season in which project is scheduled to occur, and should document presence of migratory birds at least throughout the entire minimum migratory bird nesting season (April 1 to July 15). Nest surveys should be conducted by qualified biologists using accepted survey protocols.
- e. If your project must occur during the maximum migratory bird nesting season, implement measures to prevent migratory birds from establishing nests in the potential impact

area. These steps could include covering equipment and structures and hazing birds away from the project footprint. Migratory birds can be hazed to prevent them from nesting until egg(s) are present in the nest. However, we acknowledge that hazing migratory birds away from a project site is likely only practical for projects with a relatively small footprint (i.e. projects about 5 to 10 acres in size or smaller). Do not haze or exclude access to nests for bald or golden eagles or any migratory bird species federally listed under the Endangered Species Act (ESA), as these actions are prohibited without a permit for these species.

- f. If your project must be scheduled during the maximum migratory bird nest season, and vegetation clearing and removal work cannot be completed prior to the nesting season, then we recommend performing a site-specific survey for nesting birds no more than 7 days prior to all ground-disturbing activities or vegetation treatments.

If you document active migratory bird nests during project nest surveys, we recommend that a spatial buffer be applied to these nests for the remainder of the nesting season. Vegetation treatments or ground-disturbing activities within the buffer areas should be postponed until after the birds have fledged from the nest. A qualified biologist should confirm that all young have fledged.

We recommend the use of the *Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances* (Romin and Muck 2002) to provide consistent application of raptor conservation measures to your project or action in Utah. We provide recommendations for raptor surveys and conservation measures in the Guidelines to ensure that proposed projects will avoid adverse impacts to raptors. Locations of existing raptor nests should be identified prior to the initiation of project activities. We recommend that appropriate spatial buffers and timing limits be applied to your project for raptors during crucial breeding and nesting periods relative to raptor nest sites or territories per our Guidelines. Raptors may initiate nesting as early as December for certain species. Nesting and fledging can continue through August and for some species the young may not fledge from nests until September.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington D.C. 20240



DIRECTOR'S ORDER NO.: 225

Subject: Incidental Take of Migratory Birds

Sec. 1 What is the purpose of this Order? The U.S. Fish and Wildlife Service (Service) interprets the Migratory Bird Treaty Act (MBTA) to prohibit incidental take of migratory birds and will enforce the statute accordingly. This Order provides background and guidance to Service employees, including expectations for conducting Service activities, providing technical assistance, and prioritization of our enforcement activities.

Sec. 2 What is the legal authority for this Order? The legal authority for this Order is the MBTA (16 U.S.C. 703-712).

Sec. 3 What terms do you need to know to understand this Order?

- a. **Migratory bird** in 50 CFR 10.12 means "any bird, whatever its origin and whether or not raised in captivity, which belongs to a species listed in 50 CFR 10.13, or which is a mutation or a hybrid of any such species, including any part, nest, or egg of any such bird, or any product, whether or not manufactured, which consists, or is composed in whole or part, of any such bird or any part, nest, or egg thereof." The list of protected birds is maintained in regulation at 50 CFR 10.13 and includes over 1,000 species. Migratory birds are protected based on whether their species, family, or taxonomic group is covered under at least one of the four bilateral migratory bird treaties. Birds are protected even if they do not migrate, no matter their origin, and whether or not they are raised in captivity (50 CFR 10.12).
- b. **Incidental take** means the taking or killing of migratory birds that results from, but is not the purpose of, an activity.¹ Our assessment of whether an activity violates the MBTA will take into account case law, including the case law applicable in particular jurisdictions.
- c. **Beneficial practice** means an action implemented in an effort to avoid and minimize the incidental take of migratory birds. We also refer to beneficial practices as best management practices, conservation measures, best practices, mitigation measures, etc.

¹ Note that "take," and thus incidental take, under the Endangered Species Act (ESA) differs in scope from "take" under the MBTA. Compare 16 U.S.C. 1532(19) and 50 CFR 17.3 with 16 U.S.C. 703(a) and 50 CFR 10.12.

Sec. 4 What is the background for this Order?

- a. A wide range of activities can result in the incidental take of migratory birds, including activities conducted by public- and private-sector entities and the general public. Most individuals and organizations have an interest in, and in the case of Federal entities, a responsibility for, protecting migratory birds.
- b. This Order confirms that the Service has reestablished its longstanding policy and practice of enforcing the MBTA pursuant to its interpretation of the Act as prohibiting the incidental take of birds federally protected on the List of Migratory Birds (50 CFR 10.13). With the October 4, 2021 rulemaking (86 FR 54642), the Service revoked the interpretation codified by the January 7, 2021 rule (86 FR 1134), which had briefly established the opposite interpretation.
- c. With the revocation rule, the Service returns to the interpretation of the MBTA implemented for the previous several decades by the Service, the Department of the Interior, and the Department of Justice. This Order clarifies how we will prioritize program and law enforcement resources consistent with that interpretation upon the effective date of that rule, which is December 3, 2021.

Sec. 5 What is the policy on enforcement of incidental take of migratory birds?

The Service recognizes that a wide range of activities may result in incidental take of migratory birds. Pursuing enforcement for all these activities would not be an effective or judicious use of our law enforcement resources. For that reason, the Service will focus our enforcement efforts on specific types of activities that both foreseeably cause incidental take and where the proponent fails to implement known beneficial practices to avoid or minimize incidental take. Our intention through this policy is to apply a transparent and consistent approach to managing and prioritizing our enforcement of incidental take, taking into account the case law applicable in a given jurisdiction and the facts and circumstances of each case.

- a. The following types of conduct are not a priority for enforcement:
 - (1) A member of the general public conducting otherwise legal activities that incidentally take migratory birds;
 - (2) A Federal agency conducting activities in accordance with a signed memorandum of understanding with the Service developed under Executive Order 13186 for the conservation of migratory birds; or
 - (3) A public- or private-sector entity conducting activities in accordance with applicable beneficial practices for avoiding and minimizing incidental take.
- b. The Service prioritizes the following types of conduct for enforcement:
 - (1) Incidental take that is the result of an otherwise illegal activity; or
 - (2) Incidental take that:
 - (i) results from activities by a public- or private-sector entity that are otherwise legal;
 - (ii) is foreseeable; and

(iii) occurs where known general or activity-specific beneficial practices were not implemented.

- c. The Migratory Bird Program maintains a comprehensive website of beneficial practices, conservation measures, and decision support tools.

Sec. 6 What is the policy on Service activities that may result in incidental take of migratory birds?

- a. Service personnel must review their activities to determine if incidental take is likely. Common actions that may result in incidental take of migratory birds include, but are not limited to, infrastructure construction, operation, and maintenance; vegetation clearing and management; controlled burns; and projects meant to eradicate invasive species.
- b. If an activity will foreseeably result in incidental take of migratory birds, Service personnel must develop and implement beneficial practices to avoid or minimize impacts to migratory birds.
- c. Service personnel should ensure their activities minimize negative effects to migratory bird habitats to promote the conservation of migratory bird populations.
- d. Service personnel may consult with the Regional Migratory Bird Program to review actions for potential effects to migratory birds and their habitats and provide technical assistance on beneficial practices intended to avoid or minimize those effects.

Sec. 7 Where can Service employees find information on beneficial practices to reduce impacts to migratory birds? The Migratory Bird Program maintains a comprehensive website of beneficial practices, conservation measures, and decision support tools. For further assistance, contact Migratory Bird Program representatives.

Sec. 8 What is the status of other guidance relevant to this Order?

- a. This Order revokes and replaces the Director's memorandum entitled "Guidance on the Recent M-Opinion Affecting the Migratory Bird Treaty Act," April 11, 2018.
- b. Solicitor Opinion M-37041, Incidental Take Prohibited Under the Migratory Bird Treaty Act (January 10, 2017), remains suspended and temporarily withdrawn as of February 6, 2017.
- c. Solicitor Opinion M-37050, The Migratory Bird Treaty Act Does Not Prohibit Incidental Take (December 22, 2017), was permanently withdrawn on March 8, 2021.

Sec. 9 When is this Order effective? This Order goes into effect on December 3, 2021. It remains in effect until we incorporate our interpretation that the MBTA prohibits incidental take into the Code of Federal Regulations (CFR), incorporate it into the U.S.

Fish and Wildlife Service Manual, or until we extend, amend, supersede, or revoke it, whichever comes first. If we do not take any of these actions, the provisions of this Order will terminate 18 months from the date it was signed.

Sec. 10 Application. This Order is intended only to improve the internal management of the U.S. Fish and Wildlife Service and does not create any right or benefit, substantive or procedural, separately enforceable at law or equity by a party against the United States, its agencies or instrumentalities, its officers or employees, or any other person.

/sgd/ Martha Williams
PRINCIPAL DEPUTY DIRECTOR,
Exercising the Delegated Authority of the Director,
U.S. Fish and Wildlife Service

Date: October 5, 2021

U.S. Fish & Wildlife Service

Birds of Conservation Concern 2021

Migratory Bird Program

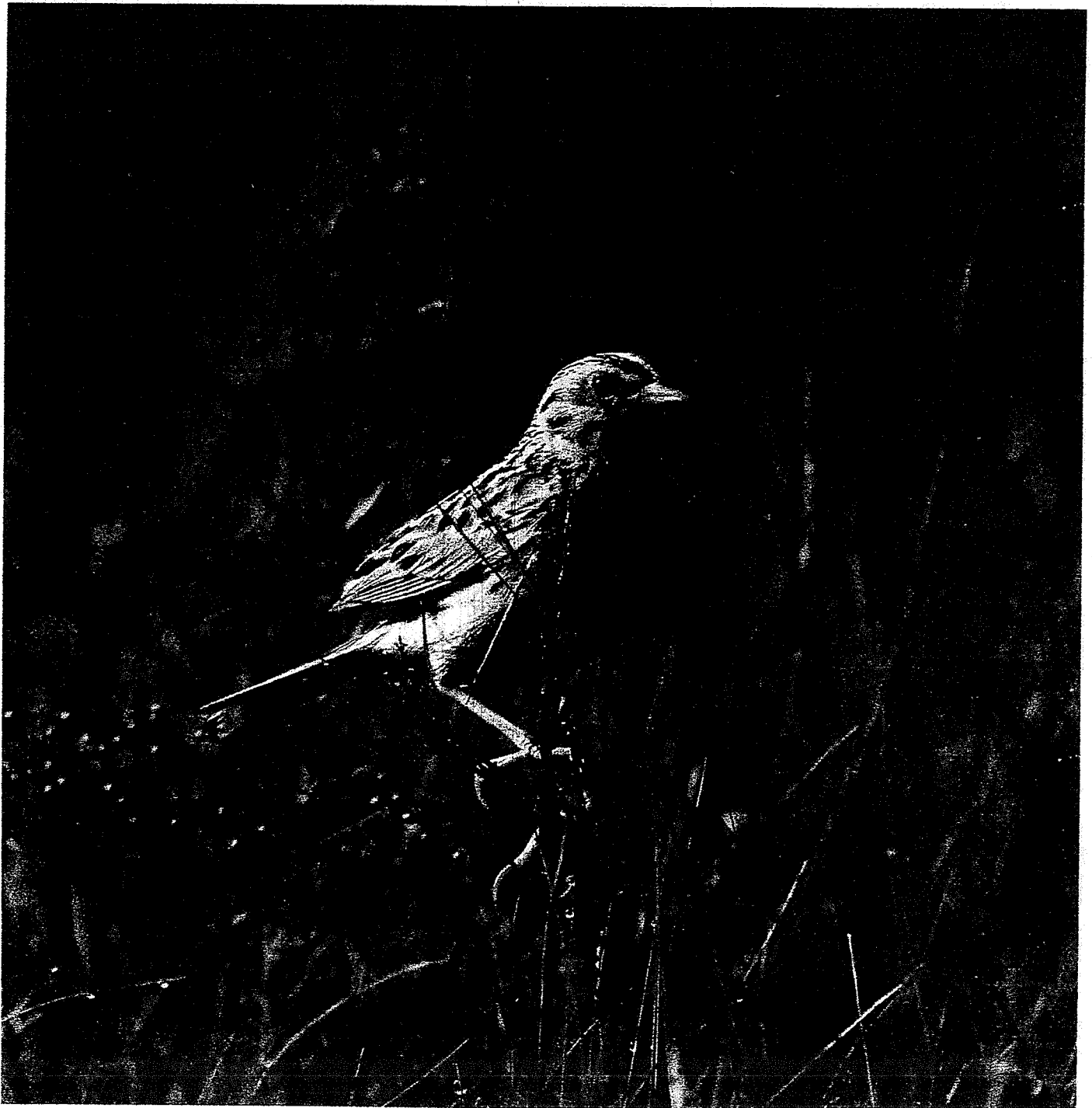


Table 2.

Terrestrial Bird Conservation Regions (BCR) and Marine Bird Conservation Regions (MBCR) either wholly or partially within the jurisdiction of the Continental USA, including Alaska, used in the Birds of Conservation Concern 2021.

BCR/ MBCR	BCR/MBCR Name
1	Aleutian/Bering Sea Islands
2	Western Alaska
3	Arctic Plains and Mountains
4	Northwestern Interior Forest
5	Northern Pacific Rainforest
9	Great Basin
10	Northern Rockies
11	Prairie Potholes
12	Boreal Hardwood Transition
13	Lower Great Lakes/St. Lawrence Plain
14	Atlantic Northern Forest
15	Sierra Nevada
16	Southern Rockies/Colorado Plateau
17	Badlands and Prairies
18	Shortgrass Prairie
19	Central Mixed-grass Prairie
20	Edwards Plateau
21	Oaks and Prairies
22	Eastern Tallgrass Prairie
23	Prairie Hardwood Transition
24	Central Hardwoods
25	West Gulf Coastal Plain/Ouachitas
26	Mississippi Alluvial Valley
27	Southeastern Coastal Plain
28	Appalachian Mountains
29	Piedmont
30	New England/Mid-Atlantic Coast
31	Peninsular Florida
32	Coastal California
33	Sonoran and Mohave Deserts
34	Sierra Madre Occidental
35	Chihuahuan Desert
36	Tamaulipan Brushlands
37	Gulf Coastal Prairie
M13	Chukchi and Beaufort Seas
M14	East Bering Sea
M15	Gulf of Alaska
M17	California Current
M18	Northeast U.S. Continental Shelf and U.S. waters (M16) beyond the shelf
M19	Southeast U.S. Continental Shelf and U.S. waters (M16) beyond the shelf
M20	Gulf of Mexico

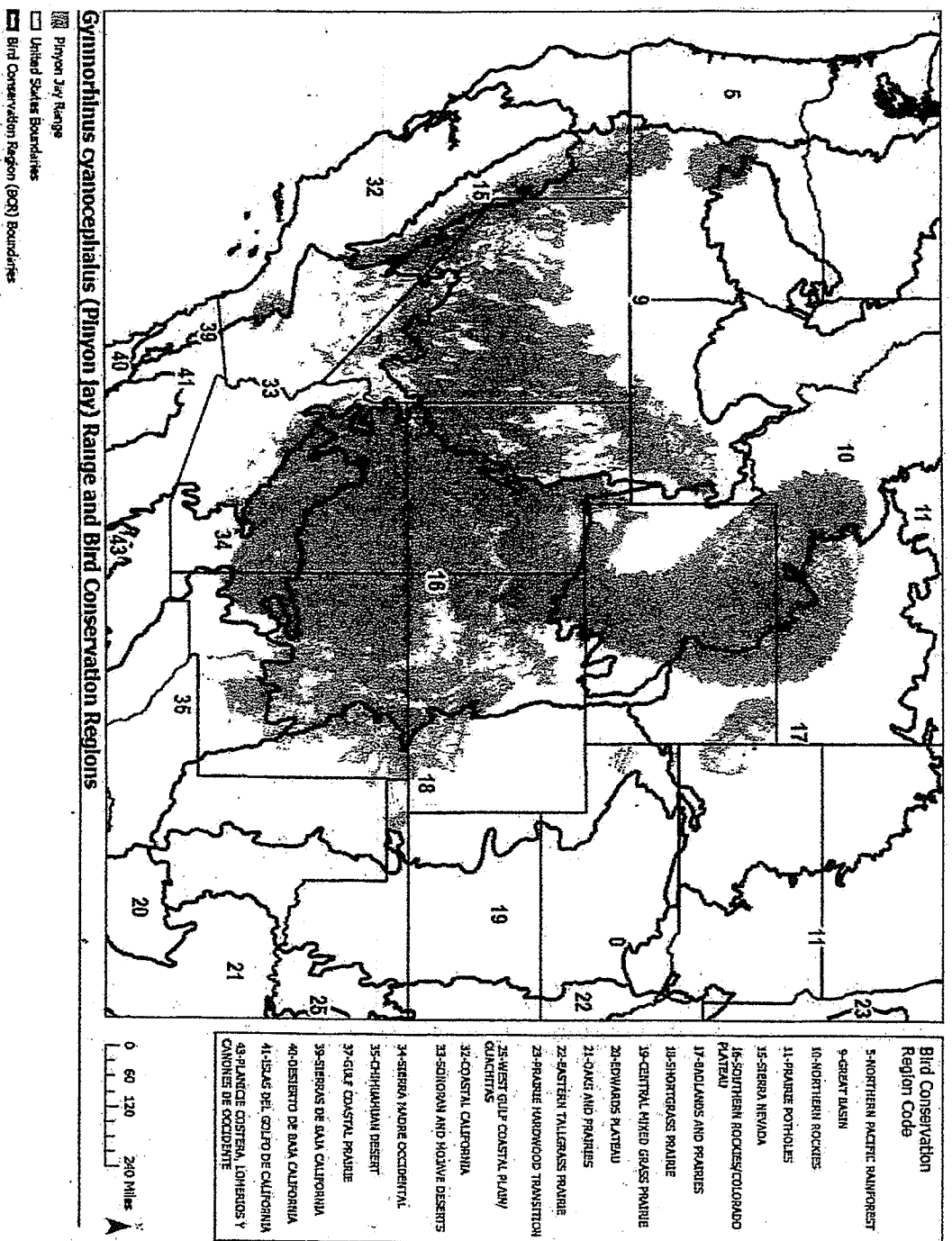


Figure 2. Pinyon Jay range and Bird Conservation Regions. Image courtesy of Liz Moore, Utah Division of Wildlife Resources.

Table 7.

Birds of Conservation Concern 2021 designated within BCRs 9, 16, 33, 34, 35 and 36. See Table 2 for descriptions of BCRs. Scientific names of species, subspecies and populations are provided in Appendix 1. Breeding (X) and nonbreeding (nb) status are indicated for each BCR; breeding BCRs may also support passage or wintering birds.

Taxon Common Name	BCR/MBCR					
	9	16	33	34	35	36
Western Grebe	X	X	X	X		
Clark's Grebe	X	X	X		X	
Common Nighthawk (Henry's)					X	
Mexican Whip-poor-will				X	X	
Black Swift	X	X				
Chimney Swift						X
Lucifer Hummingbird					X	
Costa's Hummingbird			X			
Calliope Hummingbird	X					
Rufous Hummingbird	X					
Broad-tailed Hummingbird	X	X		X	X	
King Rail						X
Yellow Rail	X					
American Avocet	X		X			
American Golden-Plover						nb
Wilson's Plover						X
Mountain Plover		X	nb		nb	nb
Snowy Plover (Interior/Gulf Coast)	X	X	X		X	X
Long-billed Curlew					nb	nb
Marbled Godwit	nb		nb			
Red Knot (Pacific)	nb					
Buff-breasted Sandpiper						nb
Pectoral Sandpiper	nb	nb				nb
Lesser Yellowlegs	nb	nb				nb
Willet	X		nb			
Franklin's Gull	X					
Yellow-footed Gull			nb			
California Gull	X	X				
Gull-billed Tern			X			X
Black Tern	X					
Forster's Tern	X					
Black Skimmer			X			
American White Pelican	X					
Northern Harrier	X					
Harris's Hawk						X
Ferruginous Hawk					X	
Flammulated Owl	X	X		X	X	
Whiskered Screech-Owl				X		
Burrowing Owl (Western)			X		X	
Long-eared Owl	X	X	X	X		
Short-eared Owl	X	X				

Taxon Common Name	BCR/MBCR					
	9	16	33	34	35	36
Elegant Trogon				X		
Lewis's Woodpecker	X	X		X		
Gila Woodpecker			X			
Arizona Woodpecker				X		
Gilded Flicker			X	X		
Olive-sided Flycatcher	X	X		X		
Cordilleran Flycatcher				X		
Black-capped Vireo					X	
Plumbeous Vireo				X		
Pinyon Jay	X	X	X	X	X	
Woodhouse's Scrub-Jay (Woodhouse's)					X	
Clark's Nutcracker		X				
Chihuahuan Raven						X
Mexican Chickadee				X		
Verdin (Southwest)			X			
Cactus Wren (Speckled)					X	
Curve-billed Thrasher (Palmer's))			X			
Curve-billed Thrasher (Brownsville)						X
Bendire's Thrasher	X	X	X	X	X	
California Thrasher			X			
LeConte's Thrasher			X			
Sage Thrasher	X					
Phainopepla (Southwest)				X		
Sprague's Pipit				nb	nb	nb
Evening Grosbeak	X	X		X	X	
Black Rosy-Finch	X	X				
Brown-capped Rosy-Finch		X				
Cassin's Finch	X	X				
Cassia Crossbill	X					
Lawrence's Goldfinch			X			
Chestnut-collared Longspur				nb	nb	nb
Thick-billed Longspur					nb	
Rufous-winged Sparrow			X	X		
Cassin's Sparrow					X	
Black-chinned Sparrow		X	X	X	X	
Baird's Sparrow				nb	nb	
Yellow-headed Blackbird		X				
Bobolink	X					
Eastern Meadowlark					X	X
Orchard Oriole						X
Scott's Oriole				X	X	
Tricolored Blackbird			X			
Colima Warbler					X	
Virginia's Warbler	X	X		X	X	
Grace's Warbler		X	X	X	X	

Great Basin
Southern Rockies

90-DAY FINDING PETITION REVIEW FORM

LISTING AS A THREATENED OR AN ENDANGERED SPECIES

Federal Docket No. FWS-R6-ES-2022-0177

90-DAY FINDING ON A PETITION TO LIST THE PINYON JAY (*Gymnorhinus cyanocephalus*) AS A THREATENED OR ENDANGERED SPECIES UNDER THE ENDANGERED SPECIES ACT

Petitioned action being requested:

- ☒ List as an endangered or a threatened species
- ☐ Reclassify (uplist) from a threatened species to an endangered species
- ☐ Other

Petitioned entity:

- ☒ Species
- ☐ Subspecies
- ☐ DPS of vertebrates

Background

Section 4(b)(3)(A) of the Endangered Species Act (Act) requires that we make a finding on whether a petition to list, delist, uplist (reclassify the species from a threatened species to an endangered species), or downlist (reclassify the species from an endangered species to a threatened species) a species presents substantial scientific or commercial information indicating that the petitioned action may be warranted. Our regulations provide that, for a petition to meet the “substantial scientific or commercial information” standard, we must determine in the 90-day petition finding that the petition includes “credible scientific or commercial information in support of the petition’s claims such that a reasonable person conducting an impartial scientific review would conclude that the action proposed in the petition may be warranted” (50 CFR § 424.14(h)(1)(i)).

The Act and our regulations are clear that the responsibility is squarely on the petitioner to present the requisite level of information to meet the substantial information test to demonstrate that the petitioned action may be warranted. This means that the petitioner must not only present credible information that threats may be present; they also need to present credible information concerning a species’ documented or likely response to that threat, and that the species’ response is to such a level that listing or uplisting may be warranted. Where the petitioner has failed to do so, we should make a not-substantial finding on the petition -- we should not augment their petition with our own knowledge or other information we are aware of. If we are aware of species that may be in danger of extinction, we should undertake a status review on our own accord, regardless of the receipt of a petition.

Our regulations further state that we will consider whether a petition presents a complete and balanced representation of the relevant facts when making our finding of whether a petition presents substantial information that the requested action may be warranted. Thus, if we find that a petition cherry-picked information, ignored relevant and readily available information, and presented a biased and incomplete representation of facts, we should consider whether the petition has met the requirement to present substantial information (see instructions below for more information).

We note that designating critical habitat is not a petitionable action under the Act. Petitions to designate critical habitat (for species without existing critical habitat) are reviewed under the Administrative Procedure Act and are not addressed here. See 50 C.F.R. § 424.14(j). To the maximum extent prudent and determinable, any proposed critical habitat will be addressed concurrently with a proposed rule to list a species, if applicable.

Petition History

On April 25, 2022, we received a petition from Defenders of Wildlife requesting that pinyon jay (*Gymnorhinus cyanocephalus*) be listed as a threatened species or an endangered species and critical habitat be designated for this species under the Act. The petition clearly identified itself as such and included the requisite identification information for the petitioner, required at 50 CFR 424.14(c). This finding addresses the petition.

Evaluation of a Petition to List the Pinyon Jay as an Endangered or a Threatened Species Under the Act

Species and Range

Does the petition present substantial information that the petitioned entity may be a listable entity (i.e., a species, subspecies, or distinct population segment)?

☒ Yes

☐ No

Pinyon Jay (*Gymnorhinus cyanocephalus*)

Historical range: Oregon; California; Nevada; Idaho; Utah; Arizona; Montana; Wyoming; South Dakota; Nebraska; Colorado; Oklahoma; New Mexico; and Baja California, Mexico

Current range: Oregon; California; Nevada; Idaho; Utah; Arizona; Montana; Wyoming; South Dakota; Nebraska; Colorado; Oklahoma; New Mexico; and Baja California, Mexico

The pinyon jay is a recognized species by the Integrated Taxonomic Information System and the American Ornithological Society's North American Classification and Nomenclature Committee.

Statutory and Regulatory Standards for Evaluation of the Petition

Section 4 of the Act (16 U.S.C. 1533) and its implementing regulations (50 CFR part 424) set forth the procedures for determining whether a species is an "endangered species" or a "threatened species." The Act defines an endangered species as a species that is "in danger of extinction

throughout all or a significant portion of its range,” and a “threatened species” as a species that is “likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.” The Act requires that we determine whether any species is an “endangered species” or a “threatened species” because of any of the following factors:

- (A) The present or threatened destruction, modification, or curtailment of its habitat or range;
- (B) Overutilization for commercial, recreational, scientific, or educational purposes;
- (C) Disease or predation;
- (D) The inadequacy of existing regulatory mechanisms; or
- (E) Other natural or manmade factors affecting its continued existence.

These factors represent broad categories of natural or human-caused actions or conditions that could have an effect on a species’ continued existence. In evaluating these actions and conditions, we look for those factors that may have a negative effect on individuals of the species, as well as other actions or conditions that may ameliorate any negative effects or may have positive effects.

In accordance with 50 CFR 424.14(d), the Service’s determination as to whether the petition provides substantial scientific or commercial information indicating that the petitioned action may be warranted will depend in part on the degree to which the petition includes the following types of information:

- (1) Information on current population status and trends and estimates of current population sizes and distributions, both in captivity and the wild, if available;
- (2) Identification of the factors under section 4(a)(1) of the Act that may affect the species and where these factors are acting upon the species;
- (3) Whether and to what extent any or all of the factors alone or in combination identified in section 4(a)(1) of the Act may cause the species to be an endangered species or threatened species (i.e., the species is currently in danger of extinction or is likely to become so within the foreseeable future), and, if so, how high in magnitude and how imminent the threats to the species and its habitat are;
- (4) Information on adequacy of regulatory protections and effectiveness of conservation activities by States as well as other parties, that have been initiated or that are ongoing, that may protect the species or its habitat; and
- (5) A complete, balanced representation of the relevant facts, including information that may contradict claims in the petition.

Evaluation of Information in the Petition

When evaluating a petition, we assess the information in the petition and may use any readily available information (e.g., in our files or published literature that we are aware of) to determine the credibility of the information presented in the petition. Our implementing regulations at 50 CFR 424.14(h)(1)(i) state that conclusions drawn in the petition without the support of credible scientific or commercial information will not be considered “substantial information.” “Credible scientific or commercial information” may include all types of data, such as peer-reviewed literature, gray literature, traditional ecological knowledge, etc. Thus, we first must determine

whether the information provided in the petition is credible. In other words, the Service must evaluate whether the information in the petition is substantiated and not mere speculation or opinion. Any claims that are not supported by credible scientific or commercial information do not constitute substantial information and will not be further evaluated. Next, we determine whether the conclusions drawn in the petition are reasonable (i.e., actually supported by that credible information).

After identifying the claims in the petition that are supported by credible information, we consider those claims in the context of the factors in section 4(a)(1) of the Act. When evaluating information presented in the petition, we consider factor D in light of the other factors, not independently. In other words, we consider whether the petition presents substantial information indicating that existing regulatory mechanisms may be inadequate to address the magnitude or imminence of threats identified in the petition related to the other four factors; therefore, we consider existing regulatory mechanisms in conjunction with each relevant claim presented in the petition.

To complete our analysis for a 90-day petition finding to list or uplist, we first identify the claims in the petition that are supported by credible information indicating that a potential threat is occurring or is likely to occur within the species' range. After identifying the claims that are supported by credible information that a threat is occurring or likely to occur, we next determine whether the petition has presented credible information that those threats affect the species at a population or species level, after taking into account any mitigating actions or conditions that may ameliorate those threats, such that the petitioned action may be warranted. If we find that the petition does not present substantial information that the petitioned action may be warranted based on the information provided regarding the status and trends of the species or on one or more factors, we consider the cumulative impact of all of the threats that are supported by credible information. Based on these steps, we draw our conclusion and petition finding based on the standard for 90-day findings, which is whether the petition presents "credible scientific or commercial information in support of the petition's claims such that a reasonable person conducting an impartial scientific review would conclude that the action proposed in the petition may be warranted." Our evaluation assesses the extent to which the credible information in the petition indicates that a reasonable person would conclude that the petitioned action may be warranted.

Claims Addressing Threats

We first assess whether the claims in the petition are supported by credible information (i.e., whether the petition has presented credible information that the threat is occurring or is likely to occur and that the species may be exposed to the threat) (Table 1). If the supporting information indicates that the threat is occurring or is likely to occur in the future and that the species may be exposed to it, we then assess whether the petition presented credible information that reasonably indicates the presence of negative effects on the species as a whole.

If there is no credible information indicating population-level effects, our analysis of that individual threat presented in the petition is complete, as there would be no species-level effects; we may then analyze that threat later if we need to evaluate cumulative effects. If the credible information about the particular threat indicates species-level effects, our analysis of that individual threat presented in the petition is complete. If the credible information about the

particular threat does not indicate species-level effects but does indicate population-level effects, we assess the extent to which the credible information in the petition indicates that the scale of the effects of that threat are such that a reasonable person would conclude that listing or uplisting may be warranted.

If we find that there is credible information indicating that threats are having or are likely to have a negative effect on the species as a whole, such that a reasonable person would conclude that listing or uplisting may be warranted, we can stop and make a positive “substantial information” finding. We would then evaluate all of the threats in detail based on the best scientific and commercial data available when we conduct the status assessment and make the 12-month finding. A positive 90-day petition finding does not indicate that the petitioned action is warranted. Such a finding indicates only that the petition presents substantial information that the petitioned action may be warranted and that a full review should occur.

TABLE 1: Evaluation of claims in the petition. Assessment of the credibility of scientific and commercial information in the petition and the extent to which claims supported by credible scientific or commercial information in the petition corroborates the presence of negative effects to populations, or the species.

Threat or Activity	Exposure. Is the claim of the threat in the petition supported by credible scientific and commercial information? Does the petition support the claim that there is a potential threat and it is occurring or is likely to occur within the range of the species? If no, explain. If yes, include brief summary statement and citations to the credible information.	Response (Populations/Species). Do the claims and the supporting information indicate negative effects such that listing or uplisting may be warranted? Yes or no. Explain and describe below.
Woodland Management – including Historical Woodland Dynamics and Disturbance Regimes, Management for Other Wildlife species, and Agricultural Practices/Grazing (Factor A)	Yes. The petition presents credible evidence that reducing the extent and density of piñon-juniper woodlands, often with complete tree removal, is taking place across the majority of the range of the pinyon jay (Bombaci et al. 2017, 63; Defenders of Wildlife 2022, 66-78) (1) to improve wildlife habitat (e.g. Greater Sage-Grouse, mule deer) (Bender et al. 2013, 55-56; Bergman et al. 2014, 449; Bombaci and Pejchar 2016, 40; Kramer et al. 2015, 30 and 33; Boone et al. 2018, 191) and livestock forage (Aro 1971, entire), (2) to reduce fuels and support fire mitigation plans (Schoennagel and Nelson 2011, 273-275), (3) to improve watershed function and reduce soil erosion (Jacobs 2015, 1427), and (4) increase plant community heterogeneity (Miller et al. 2014, 479).	Yes. The petition provides the limited available information indicating that certain habitat treatments in piñon-juniper woodlands are potentially having negative effects on pinyon jay occupancy and nesting colony sites and that they are occurring at a species level such that a listing may be warranted (Johnson et al. 2018, 5-6; Magee et al. 2019, 7 and 10). The petition presents credible evidence that regulatory mechanisms to manage pinyon jays across their range may be inadequate to ameliorate the impacts of woodland management (Factor D). The petition claims that the National Environmental Policy Act reviews are inadequate to protect the species because habitat treatments, many of which are quite extensive, may be approved under Categorical Exclusions (Smith 2021, 5-7). The petition provides supporting evidence that the Migratory Bird Treaty Act does not provide for protection of pinyon jay habitat and that inclusion in the U.S. Fish and Wildlife Service's Birds of Conservation Concern 2021 list, Bureau of Land Management state-level sensitive species lists, the International Union for Conservation of Nature Red List of Threatened Species, and state Species of Greatest Conservation Need lists do not provide legal protection to pinyon jays or their habitat (Defenders of Wildlife 2022, 42-43).

Wildfire (Factor A)	Yes. The petition presents credible evidence that the annual area burned, number of fires per year, fire season length, and fire size have increased in piñon-juniper woodland habitat (Board et al. 2018, 40-45) throughout the range of the pinyon jay.	Yes. The petition provides supporting information to indicate that the change in fire frequency and intensity may result in the replacement of the piñon-juniper woodlands used by pinyon jays with non-native grassland vegetation and that this threat is occurring at a species level such that a listing may be warranted (Floyd et al. 2021, entire). <u>Increased wildfire return intervals in areas where piñon-juniper woodlands were lost and replaced with non-native vegetation may further prevent recovery of a piñon-juniper woodland ecosystem and thus may result in permanent loss of habitat for pinyon jays</u> (Floyd et al. 2021, entire). The petition provides supporting information that increased wildfire frequency can further contribute to the expansion of non-native vegetation that perpetuates the cycle of increased loss of piñon-juniper woodland cover (D'Antonio and Vitousek 1992, 73-75), which continues to reduce available habitat for pinyon jays.
Invasive Species (Factor A)	Yes. The petition presents credible evidence that invasive species <u>including cheatgrass and other non-native bromes</u> are establishing after woodland disturbance from wildfire and grazing (Shinneman and Baker 2009, 191) and fuels reduction (Havrilla et al. 2017, 617) throughout the range of piñon-juniper woodlands that provide habitat for pinyon jay (Floyd 2021, 20).	Yes. The petition provides supporting information to indicate increased <u>invasive annual grasses can increase wildfire frequency and loss of piñon-juniper woodlands that provide habitat for pinyon jays</u> and that this threat is occurring at a species level such that a listing may be warranted (D'Antonio and Vitousek 1992, 74-75).
Development (Factor A)	Yes. The petition presents credible evidence that various types of development may negatively affect pinyon jays. Examples cited in the petition include effects to pinyon jay communication and stress-levels from oil and gas development (Johnson et al. 2013, 30; Kleist et al. 2018, entire). Additional examples include urban development expansion and collisions with wind turbines, solar panels, windows, and additional various human	No. Although various types of development may cause negative effects to pinyon jay populations, including direct mortality of individuals, the petition does not present quantifiable evidence that development effects specific to pinyon jays are occurring at an extent such that a species listing may be warranted. The petition points to historical loss of piñon woodlands associated with mining and farming, but the petition demonstrates no quantifiable effect to pinyon jay populations as a result, and further mentions recovery of habitat due to changing landscape

	infrastructure placed in pinyon jay habitat (Walston et al. 2016, entire).	policies such that current effects are not as evidenced. Further, the evidence for negative effects due to oil and gas development and urban development provided are circumstantial and are not substantially quantified to support causation of effects at a population or species scale. Lastly, the description of renewable energy development and various infrastructure effects offer numbers associated with avian mortalities, in general, but the mortality information lack specificity to pinyon jays.
Disease (Factor C)	Yes. The petition presents credible evidence that pinyon jays are affected by West Nile Virus and external parasites (Centers for Disease Control and Prevention 2016, 1) throughout the range of the pinyon jay.	No. The petition does not present evidence that adverse effects from disease would occur at a species level such that listing may be warranted. The petition lacks specific details on the rates of disease transmission among pinyon jays and doesn't demonstrate effects are occurring at a population or species level.
Predation (Factor C)	Yes. The petition presents credible evidence that pinyon jays are affected by predation (Marzluff 1985, 559) throughout the range of the pinyon jay.	No. The petition does not present evidence that adverse effects from predation would occur at a species level such that listing may be warranted. Rates of predation by the avian predators listed in the petition are not adequately quantified to demonstrate measurable effects to pinyon jays across their distribution.
Climate Change (Factor E)	Yes. The petition presents credible evidence that climate change is occurring throughout the range of the pinyon jay and <u>potentially affecting the piñon-juniper woodlands that provide habitat for the species (IPCC 2018, entire).</u>	Yes. The petition provides credible evidence and supporting information on the current and future effects of climate change on <u>piñon-juniper woodlands throughout the pinyon jay range.</u> Negative effects of climate change include <u>increased rates of tree mortality (especially piñon)</u> (Mueller et al. 2005, 1087-1089; Shaw et al. 2005, 281-283; Clifford et al. 2011, 953, 956; Redmond et al. 2015, 5-9), <u>reduced piñon mast production</u> (Redmond et al. 2012, 7-11; Wion et al. 2019, 6-10), <u>reduced piñon tree vigor</u> (Johnson et al. 2017, 7-8), and <u>reduced tree recruitment</u> (Floyd et al. 2015, 24-26; Redmond et al. 2015, 5-9), which can have negative effects on pinyon jay survival and availability of suitable habitat (Ligon 1978, 122-125; Marzluff

		and Balda 1992, 209-210, 262-263; Johnson and Smith 2008, 15-17; Johnson et al. 2017, 8; Johnson et al. 2021, 7-8; Novak et al. 2021, 5-6). <u>Accumulated effects of climate change, specifically drought and tree mortality, can lead to increased wildfire risk, resulting in loss of piñon-juniper woodlands per interaction of Wildfire and Invasives Threats under Factor A</u> and this threat is occurring at a species level such that a listing may be warranted.
Additional Manmade Factors (Factor E)	Yes. The petition presents credible evidence that piñon seed harvesting occurs throughout the range of the pinyon jay (Somershoe et al. 2020, 27).	No. The petition does not present evidence that negative effects from piñon seed harvest would occur at a species level such that listing may be warranted. The petition does not quantify or demonstrate measurable effects of piñon seed harvesting on pinyon jay populations.

Cumulative Effects of Claims Supported by Credible Information

Because we have found that the petition presented substantial information that one or more threats are having an effect on the species to the point that the species' status may have changed, the petition presents substantial information indicating that the species may warrant listing. We do not need to assess cumulative effects at the 90-day finding stage because we will address cumulative effects of all threats in the 12-month finding.

Evaluation of Information Summary

The petitioner provided credible information indicating potential threats to pinyon jay such that listing may be warranted due to woodland management (Factor A), wildfire (Factor A), invasive species (Factor A), and due to climate change (Factor E). The petitioner also provided credible information that the existing regulatory mechanisms may be inadequate to address those potential threats (Factor D). Therefore, the petition presents substantial information indicating that the petitioned entity may warrant listing. We will evaluate these and all other potential threats in detail based on the best scientific and commercial data available when we conduct the status assessment and make the 12-month finding.

Petition Finding

We reviewed the petition, sources cited in the petition, and other readily available information. We considered the credible information that the petition provided regarding effects of the threats that fall within factors under section 4(a)(1) as potentially ameliorated or exacerbated by any existing regulatory mechanisms or conservation efforts. Based on our review of the petition and readily available information regarding woodland management (Factor A), wildfire (Factor A), invasive species (Factor A), inadequacy of existing regulatory mechanisms (Factor D), and climate change (Factor E), we find that the petition presents substantial scientific or commercial information 4 indicating that listing the pinyon jay (*Gymnorhinus cyanocephalus*) as a threatened species or an endangered species may be warranted. The petitioners also presented information suggesting development, disease, predation, and additional manmade factors may be threats to the pinyon jay. We will fully evaluate these potential threats during our 12-month status review, pursuant to the Act's requirement to review the best scientific and commercial information available when making that finding.

Author

The primary authors of this notice are the staff members of the Utah Field Office, Region 6 Migratory Bird Program, and the Region 6 Ecological Services Regional Office, U.S. Fish and Wildlife Service.

FOR FURTHER INFORMATION CONTACT: George Weekley, Utah Field Office, telephone 801-554-7660

Regional Outreach Contact: Joe Szuszwalak, telephone 303-236-4336



United States Department of the Interior

FISH AND WILDLIFE SERVICE
334 Parsley Boulevard
Cheyenne, Wyoming 82007



In Reply Refer to:

January 17, 2023

Memorandum

To: Assistant Regional Director, U.S. Fish and Wildlife Service, Ecological Services,
Lakewood, Colorado

From: *for* Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office,
Cheyenne, Wyoming NATHAN
DARNALL

Subject: Standing Analysis for Effects to Whitebark Pine (*Pinus albicaulis*) from Low
Effect Projects and Whitebark Pine Restoration and Recovery Activities within
Montana and Wyoming

Digitally signed by
NATHAN DARNALL
Date: 2023.01.17 14:40:48
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On December 15, 2022, the U.S. Fish and Wildlife Service (Service) published a final rule to list the whitebark pine (*Pinus albicaulis*) as threatened under the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 *et seq.*) (87 FR 76882). The attached Standing Analysis was developed to expedite the consultation process for ongoing maintenance and management actions, new development or construction projects that will damage or kill small numbers of live whitebark pine, and for activities that are beneficial for the restoration or recovery of whitebark pine within Montana and Wyoming. The Standing Analysis considers the range-wide status of the species, the status of whitebark pine within Montana and Wyoming, including threats and the impact of ongoing activities and conservation efforts. The Standing Analysis evaluates these factors and the effects to whitebark pine from recovery activities and other actions considered to have low effects, along with cumulative effects. Based on the Standing Analysis, we developed a determination key to be used in the Service's online Information for Planning and Consultation (IPaC) system.

Federal agencies or their designated representatives may use the determination key in IPaC for consultation. Information submitted online (e.g., project description and location, responses to questions about the project) is evaluated by a determination key in IPaC to ensure that projects fall within the scope of what is analyzed in the Standing Analysis. The Standing Analysis provides the basis for Service concurrence with "may affect but not likely to adversely affect" determinations. The Standing Analysis documents the Service's analysis for a wide variety of small effect actions and activities, and the Standing Analysis can be readily updated with new information.

The determination key in IPaC will be used to evaluate potential effects to whitebark pine from individual projects. Based on the information provided in IPaC, the determination key may confirm that a project either (1) is not anticipated to have any effect on the whitebark pine, or (2) "may affect but is not likely to adversely affect" the whitebark pine. Projects falling into these categories will receive a response either acknowledging the "no effect" determination or

may remove no more than 125 trees, thus providing an additional buffer. However, we will continue to evaluate development projects that remove more than 125 WBP trees separately (outside of this SA), even if the aggregate number of trees removed per year is less than 12,500 (of which, 5,000 are assumed to be rust-resistant). We anticipate the recovery efforts (*e.g.*, planting rust-resistant trees) will either remain the same or are likely to increase after the species has been listed under the Act; however, we will continue to use the approach described above and its thresholds rather than increasing the number of projects and trees. We will re-evaluate this SA at least annually and will reconsider its application, use, thresholds, and efficacy at a minimum of five years after implementation.

2.f. Conservation Measures

To fully understand the extent of the effect that individual project activities analyzed by the SA will have on WBP trees (seedlings, saplings, and mature trees), and to avoid and minimize these impacts, the SA provides a detailed list of successfully-implemented conservation measures from which project applicants can choose. We consider the damage of a WBP to include, but is not limited to, soil tilling, disking, plowing, excavating, raking, sod rolling, soil compaction, soil disturbance, weed management, revegetation, crushing, bumping, and scraping WBP, root damage, mycorrhizal damage, nicks and opening wounds on WBP bark, and pruning.

The following conservation measures are considered part of the actions under the SA. The commitments and implementation of the following conservation measures and exploration of additional opportunities to reduce impacts made by the federal action agencies will reduce adverse effects of the proposed actions to the WBP. These conservation measures will become commitments by federal action agencies where appropriate and practicable. Many of these conservation measures are to be applied throughout the action area, though others specify the location or distance from WBP trees for application. Not all conservation measures are applicable or reasonable for all actions that are covered under this SA. The Determination Key includes a section where project applicants must select which of the following conservation measures they plan to implement as part of their action, which will be repeated back to the applicant in our IPaC generated response letter or memo:

General

- CM 1. Conduct pre-project surveys to identify WBP individuals of all age classes. If not feasible, conduct surveys using appropriate agency protocols to estimate the number of WBP individuals of all age classes.
- CM 2. When marking is appropriate, all mature WBP trees or clusters of other age class trees will be marked in a manner that does not cause damage to the tree or introduce disease.
- CM 3. Damaging or killing a plus, elite, or phenotypically resistant tree will only occur in situations where human health and safety are at risk or when restoration actions such as pruning are occurring.

3. Status of the Species

This SA provides a general background on the status of the species and its habitat, relying on the Service's 2021 SSA (USFWS 2021, entire). No critical habitat has been designated for this species. A detailed status of the WBP's biology, range, habitat, needs, stressors, and conservation can be found in Appendix C.

The WBP is a five-needle conifer species placed in the subgenus *Strobus*, which also includes other five-needle white pines. Recent phylogenetic studies (Liston *et al.* 1999; Syring *et al.* 2005, 2007; as cited in Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2010) showed no difference in monophyly (ancestry) between subsection *Cembrae* and subsection *Strobi* and merged them to form subsection *Strobus*. No taxonomic subspecies or varieties of WBP are recognized (COSEWIC 2010). Based on this taxonomic classification information, we recognize WBP as a valid species (USFWS 2021).

There are four stages in the life cycle of the WBP: seed, seedling, sapling and mature trees, also referred to as reproductive adults. Seeds are produced in female cones and once on the ground may take two years or more, up to 11 years in some cases, to germinate. Germinated seeds become seedlings that are between 3 to 4 inches tall (8 and 10 centimeters) with a taproot that can measure between 5 to 7 inches (13 to 18 centimeters), with 7 to 9 cotyledons, also known as the embryonic first leaves, as documented by (Arno and Hoff 1989). WBP seedlings may persist for multiple years, depending on growing conditions, until reaching the sapling stage of the life cycle. WBP saplings persist for few to many years, depending on growing conditions, until they produce male and female cones. Mature reproductive WBPs contain both female and male cones, which is known as monoecious reproduction, and can survive on the landscape for hundreds of years. This slow-growing long-lived tree with a life span between 500 years and 1,000 years (Arno and Hoff 1989; Perkins and Swetnam 1996), provided it is located in an area with lower competition, such as a more open canopy with low litter depth and high rock cover (Maloney 2014). Therefore, in addition to the four general needs for all life stages, mature WBP trees require a more open canopy, dispersal of seeds by Clark's nutcracker, two summers of suitable temperatures and precipitation for pollinated cones to mature, as well as levels of nitrogen and phosphorus that are adequate to restore values after being depleted in masting year (USFWS 2021).

The WBP is a five-needle pine that lives in windy, cold, high-elevation or high-latitude environments across the western United States and southern Canada. The WBP pine has a broad range both latitudinally, occurring from a southern extent of approximately 36° north in California to 55° north latitude in British Columbia, Canada, and longitudinally, occurring from approximately 128° in British Columbia, Canada to an eastern extent of 108° west in Wyoming. It also occurs in scattered areas of the warm and dry Great Basin. As a result, many stands are geographically isolated as documented by (Arno and Hoff 1989).

Most current management and research focus on producing and planting white pines (including WBP) with genetic resistance to white pine blister rust, but also include natural regeneration (e.g., those areas identified in Appendix B, Tables A, B, and C) and silvicultural treatments, such as appropriate site selection and preparation, pruning, and thinning (Zeglen *et al.* 2010).

5.d. Forest (Vegetation) Management Actions

Forest (vegetation) management includes a variety of methods and techniques used to manage healthy forests, and known previous projects that fall within this action type are summarized in Table D of Appendix C. These types of forest management activities include timber harvest (using chainsaws and using machinery which may create skid trails) and management/hazardous fuels reduction (using chainsaws and using machinery which may create skid trails, to remove dead and dying trees and understory vegetation that may carry wildfire), salvage harvest (removing dead trees either by hand or using machinery which may create skid trails), pest control (use of Verbenone or Carbaryl insecticide), precommercial thinning (thinning trees that are too small for a commercial timber harvest), silviculture stand improvement projects (using a planned set of treatments such as thinning, harvesting, planting, pruning, prescribed burning, and site preparation designed to change the current stand structure and composition to one that meets a management goal), and silvicultural reforestation activities (planning for natural regeneration or tree planting).

Forest management related road construction, maintenance, and use may also be part of vegetation management projects. Harvest of WBP has not been well tracked as records often group it with other species and incorrectly identify it as another species. Silviculture approaches create a system that excludes regeneration opportunities and increases competition by planting faster-growing species, and consequently, stands that contain WBP prior to harvest are not routinely replanted with WBP.

Projects that implement resetting the successional stage of the forest stands need to be carefully thought out and planned to increase WBP recruitment. Campbell and Antos (2003) noted that successional patterns in WBP forests are more complex than others have reported, finding that subalpine fir readily established after fire in their British Columbia study areas, and although subalpine fir density was increasing in older WBP stands with relatively open canopies, they estimated that succession to subalpine fir would take more than 500 years. Campbell and Antos (2003) reported that WBP in their study area was stress-tolerant (able to persist under conditions that restrict production), was capable of surviving long periods of suppressed growth, and was able to release upon reaching the main canopy after more than 150 years of low growth rates. The results of these studies indicate that the loss of WBP due to succession to subalpine fir and Engelmann spruce in some areas may be an extremely slow process and that WBP may be more shade-tolerant and resilient to suppression than previously suggested. Further, thinning and timber harvest projects intended to improve WBP recruitment may increase WBP susceptibility to mountain pine beetle infestation, if the beetles do not have their preferred food sources during outbreak years. The densification of and succession of subalpine fir and Engelmann spruce co-occurred with WBP mortality caused by bark beetle outbreaks and/or blister rust; therefore, disentangling the effects of blister rust- and bark beetle-mortality on succession from the effects of fire suppression in these studies is difficult (Hartwell *et al.* 1997; Arno *et al.* 1993 in Keane *et al.* 1994; Flanagan *et al.* 1998).

Projects including those in WUI, salvage harvests, and pest control efforts remove dead and diseased trees, and may encourage natural WBP recruitment. In large acreages of dead trees, salvage harvest and firewood cutting projects can be designed to avoid damaging or killing live

Appendix C. Status of the Species

This appendix provides a more detailed status of the species than what is included in the body of the SA. To understand the current status of the species, we must identify specific life stages: seedling, sapling, and mature WBP are described under the following definitions of their life stages. First year seedlings are those recently germinated with no mature foliage and have not experienced a winter. The *seedling stage* of WBP is detectable when a germinated seeds reach growth between 8 and 10 cm (3 to 4 in.) tall with a 13 to 18 cm (5 to 7 in.) taproot, and 7 to 9 cotyledons (embryonic first leaves) (Arno and Hoff 1990). The WBP seedling stage is generally when the trees are between 1 and 29 years of age and are up to 1.37 m (4.5 ft), which is the height assessed at diameter at breast height (dbh) (Tomback and Pansing 2018). *Saplings* are non-reproductive trees greater than 1.37 m (4.5 ft) in height; for WBP. The average age of reproductive maturity (*mature WBP*) is 29 to 40 years of age (Tomback and Pansing 2018). Some WBP individuals are capable of producing limited amounts of seed cones at 20–30 years of age, although large cone crops usually are not produced until 60–80 years (Krugman and Jenkinson 1974, as cited in McCaughey and Tomback 2001), with average earliest first cone production at 40 years (Tomback and Pansing 2018). Therefore, the generation time of WBP is approximately 40 to 60 years (Tomback and Pansing 2018; COSEWIC 2010). Size class data should not be used as a surrogate for determining the age class of a WBP tree. Larson and Kipfmüller (2012) found small subalpine fir trees occurring below the WBP trees that visually appeared to be young saplings were more than 100 years of age.

1. Taxonomy

The WBP is a five-needle conifer species placed in the subgenus *Strobus*, which also includes other five-needle white pines. This subgenus is further divided into two sections (*Strobus* and *Parrya*), and under section *Strobus*, into two subsections (*Cembrae* and *Strobi*). *Strobus* sp have five-needled fascicles, wingless seeds, and cones that remain closed at maturity (Lanner, 1990). Stone pines are morphologically defined by wingless seeds and cones that remain closed at maturity, retaining their seeds within (Lanner, 1990). The traditional taxonomic classifications placed WBP in the subsection *Cembrae* with four other Eurasian stone pines (Critchfield and Little 1966; Lanner 1990). However, recent phylogenetic studies (Liston *et al.* 1999; Syring *et al.* 2005, 2007; as cited in Committee on the Status of Endangered Wildlife in Canada (COSEWIC) 2010) showed no difference in monophyly (ancestry) between subsection *Cembrae* and subsection *Strobi* and merged them to form subsection *Strobus*. No taxonomic subspecies or varieties of WBP are recognized (COSEWIC 2010). Based on this taxonomic classification information, we recognize WBP as a valid species.

2. Life History

There are four stages in the life cycle of the WBP: seed, seedling, sapling, and mature trees (*i.e.*, reproductive mature trees). Seeds are produced in female cones and may take 2 years or more (up to 11 years) to germinate. Germinated seeds become seedlings that are between 8 and 10 centimeters (cm) (3 to 4 inches) (in.) tall with a 13 to 18 cm (5 to 7 in.) taproot with 7 to 9 cotyledons (embryonic first leaves) (Arno and Hoff 1990). WBP seedlings are generally

between one and 29 years of age and, on average, are 1.37 m (4.5 ft), which is the height assessed at dbh (Tomback and Pansing 2018). WBP seedlings have highly variable survival rates; seedlings originating from nutcracker caches ranged from 56 percent survival over the first year to 25 percent survival by the fourth year (Tomback 1982). Seedlings of WBP may persist for multiple years, depending on growing conditions, until reaching the sapling stage of the life cycle. Saplings are non-reproductive trees greater than 1.37 m (4.5 ft) in height; for WBP, the average age of reproductive maturity is 29 to 40 years of age (Tomback and Pansing 2018). Saplings of WBP persist for few to many years, depending on growing conditions, until they produce male and female cones and are considered reproductive at approximately 60 years of age. Some WBP individuals are capable of producing limited amounts of seed cones at 20 to 30 years of age, although large cone crops usually are not produced until 60 to 80 years (Krugman and Jenkinson 1974, as cited in McCaughey and Tomback 2001), with average earliest first cone production at 40 years (Tomback and Pansing 2018). Therefore, the generation time of WBP is approximately 40 to 60 years (Tomback and Pansing 2018; COSEWIC 2010). Mature WBP trees require two summers of suitable temperatures and precipitation for fertilized cones to mature (Rapp *et al.* 2013). Years with high seed production (mast years) typically occur once every three to five years; however, that time interval can vary by geographic location and health condition of the stand (McCaughey and Tomback 2001). After such a masting year, each individual WBP is depleted of nitrogen and phosphorus and so those nutrients must be replaced during the three to five years between masting events (Sala *et al.* 2012). Mature reproductive WBP trees contain both female and male cones (*i.e.*, monoecious reproduction), and can survive on the landscape for hundreds of years.

The WBP is the only stone pine (so-called for their stone-like seeds) in North America of the five species worldwide (McCaughey and Schmidt 2001). Characteristics of stone pines include five needles per cluster, indehiscent seed cones (scales remain essentially closed at maturity) that stay on the tree, and wingless seeds that remain fixed to the cone and cannot be dislodged by the wind. Because WBP seeds cannot be wind disseminated, primary seed dispersal occurs almost exclusively by Clark's nutcrackers in the avian family Corvidae (whose members include ravens, crows, and jays) (Lanner 1996; Schwandt 2006). Consequently, Clark's nutcrackers facilitate WBP regeneration and influence its distribution and population structure through their seed caching activities (Tomback *et al.* 1990).

The WBP may occur as a climax species, early successional species, or seral (mid-successional stage) codominant associated with other tree species. Although it occasionally occurs in pure or nearly pure stands at high elevations, it more typically occurs in stands of mixed species in a variety of forest community types. WBP is typically 5 to 20 m (16 to 66 ft) tall with a rounded or irregularly spreading crown shape. On higher density conifer sites, WBP tends to grow as tall, single-stemmed trees, whereas on open, more exposed sites, it tends to have multiple stems (McCaughey and Tomback 2001). Above the tree line, it grows in a krummholz form (stunted, shrub-like growth) (Arno and Hoff 1989). Production of male and female cones in mature trees will begin sometime from June to September depending on environment (McCaughey and Tomback 2001; Sala *et al.* 2012). Female cones take 2 years to fully develop (Weaver 2001). Its characteristic dark brown to purple seed cones are 5 to 8 cm (2 to 3 in.) long and grow in clusters of 2 to 4 cones at the outer ends of upper branches (Hosie 1969).

Ensuring future generations of WBP are genetically resistant to white pine blister rust is the most critical action for achieving long-term recovery of this species (Mahalovich and Dickerson 2004; Perkins *et al.* 2016). Genetic management of white pine blister rust is actively conducted for WBP, including the USFS white pine blister rust resistance screening programs (Mahalovich 2016; Sniezko 2016). Seeds and pollen sourced from plus trees or elite trees are used for screening and selective breeding for white pine blister rust resistance (not immunity), molecular genetics studies, assessing levels of inbreeding, growing compatible rootstock for grafting in seed orchards, clone banking and gene conservation, and identifying genetic macro-refugia (Mahalovich 2016; Perkins *et al.* 2016; Sniezko 2016).

Eventually, the long-term goal is to establish WBP seed orchards in situ across the spectrum of WBP habitat to provide reliable and accessible sources of genetically resistant seed (Mahalovich 2017). Scions (*i.e.*, living branches) taken from trees with proven genetic resistance to white pine blister rust are grafted onto established root stocks, enabling them to develop the capability to produce cones much sooner than the time required for out planted seedlings to reach reproductive maturity (approximately 60 years).

Seeds from cone collections in the northwest (*i.e.*, Washington, Oregon) are now stored at the United States Department of Agriculture (USDA) National Center for Genetic Resources Preservation in Fort Collins, Colorado for long-term ex situ gene conservation (Sniezko and Kegley 2017). Seven separate white pine blister rust screening trials are occurring at the USFS Coeur d'Alene Nursery in Idaho using over 100,000 seedlings (Mahalovich 2016, 2017).

4.c. Fuel Reduction Treatment

Silvicultural practices, such as thinning, are frequently employed to treat existing stands of WBP to modify surface and ladder fuels and improve their chances of surviving fire. Table D of Appendix C describes the silvicultural and restoration activities in WBP habitat within Montana between 2009 and 2021 and Wyoming between 1991 and 2020. Most thinning treatments are designed to mimic non-lethal mixed-severity fire (Keane and Arno 2001), reduce or eliminate competition from other conifer species such as subalpine fir (*Abies lasiocarpa*), and to increase regeneration space for potentially rust-resistant seedlings. Approaches include creating openings wherein all trees except live WBPs are cut within a 1- to 5-ac opening to provide open growing space for WBP regeneration and existing WBP trees (Keane and Arno 2001; Keane and Parsons 2010); thinning of all non-WBP trees below a certain diameter (Chew 1990); and fuel enhancement treatments where other competing trees are directionally felled to modify fire behavior and reduce fire intensity (Keane and Arno 2001; Keane and Parsons 2010). Reducing tree density within WBP stands may result in increased vigor (*i.e.*, growth rate) of remaining sapling to mature-class trees (Keane *et al.* 2007; Retzlaff *et al.* 2018); however, counterintuitively, increased WBP vigor may not impart increased resistance to mountain pine beetle, as some evidence suggests that mountain pine beetles select faster growing trees for attack (Six *et al.* 2021). In addition to or in place of treating fuels within WBP stands, managers should consider conducting fuel reduction treatments in non-WBP stands adjacent to WBP, thereby reducing the intensity of fire as it moves from the adjacent stand into the WBP stand.

WBP both as a stressor that can cause mortality of all life stages of WBP and as a mechanism that may affect forest succession (Arno 2001; Shoal *et al.* 2008; Keane and Parsons 2010). Although WBP has been described as fire-adapted, there is uncertainty surrounding the specifics of these adaptations, including the species' ability to survive fires of differing intensity, the role of low-severity fire, and how fire suppression interacts with fire return intervals to affect forest succession across the range of WBP.

Fire regimes in WBP systems are often characterized as being of mixed severity (Arno *et al.* 2000; Arno 2001, Campbell and Antos 2003; Larson *et al.* 2009). However, some WBP systems are dominated by high-severity fire events (Romme 1982; Campbell and Antos 2003). Low-severity surface fires may also occur in WBP stands, particularly at higher elevations (Barrett 1994). Clark's nutcracker ecology provides further insight into the typical fire regime in WBP ecosystems. The Clark's nutcracker serves as the main dispersal agent for WBP (Tomback *et al.* 2001). Eighty-five percent of the WBP seeds cached are above ground in the trunks of live trees. In most cases Clark's nutcracker avoids caching seeds in forest openings (Brodin and Clark 2007; Lorenz 2011; Lorenz *et al.* 2012). Clark's nutcrackers have been found dispersing seeds farther than the wind-dispersed seeds of other conifers, allowing for the establishment of WBP seedlings in the interior of large patches of high severity fire effects and over broad geographic areas (McCaughey *et al.* 1985; Tomback *et al.* 1990, 1993 in Keane and Parsons 2010). To promote a greater than 75 percent probability of Clark's nutcracker occurrence at a site containing WBP, the landscape composition must contain a minimum 12,500 to 25,000 ha cone bearing WBP within a 32.6-km radius (Schaming and Sutherland 2020). Clark's nutcrackers feed equally on Douglas-fir seeds and WBP seeds, so the optimal habitat mosaic includes moderate levels of Douglas-fir habitat (Schaming 2016).

Although some experts have suggested that WBP is phenotypically adapted to survive low-intensity fire, Stevens *et al.* (2020) found that WBP had relatively thin bark compared to other conifer species and, based on a systematic ranking of numerous traits associated with fire resistance in western conifers, WBP was found to have one of the lowest fire resistance scores of the 29 conifers examined in the study. Others have also observed that WBP trees can be sensitive to bole (main stem of the tree) scorching, resulting in cambium injury or death, even from low-intensity fire (Hood *et al.* 2008). Keane *et al.* (2020) noted several recent reports of prescribed fire and low-intensity fire killing WBP trees, despite pre-fire site preparation activities implemented to reduce or modify surface and ladder fuels and protect the residual WBP trees. Keane and Parsons (2010) studied the effects of seven different fuel treatment combinations on WBP at five treatment sites in Montana and Idaho and found that WBP mortality from low-intensity fire was comparable to subalpine fir under all treatment combinations. As a result, empirical evidence shows that low-intensity fire in WBP can result in higher-severity fire effects. In summary, although it is clear that WBP individuals are capable of surviving some low-intensity fire, based on the presence of multiple fire scars in some areas, the biotic and abiotic (*i.e.*, terrain, weather, and fuel) conditions under which the species is most likely to survive such fires remain largely unknown.

Determining if periodic fire is necessary to maintain ecosystem integrity in WBP systems may be as important as understanding the conditions under which WBP trees are most likely to survive fire. Experts have suggested that, without periodic low-severity fire in some subalpine forests

where WBP co-occurs with subalpine fir and Engelmann spruce, successional pathways can lead to climax communities dominated by these shade-tolerant conifers and the loss of WBP (Arno 1980; Arno 2001; Keane *et al.* 2017; Keane and Parsons 2010; Flanagan *et al.* 1998). It has further been suggested that, in these WBP systems, fire suppression policies over the past 90 years have resulted in WBP declines due to succession to subalpine fir and Engelmann spruce (Arno 1980; Arno 2001; Keane *et al.* 2017; Keane and Parsons 2010; Flanagan *et al.* 1998). This is supported by the presence of multiple fire scars in WBP trees at some locations, which shows they are capable of surviving repeated low-intensity fires and maintaining dominance or co-dominance in stands for long-periods of time when these fires are occurring periodically (Morgan and Bunting 1990, Barrett 1994). Additional support for the successional theory is based on documented densification of subalpine fir and Engelmann spruce in stands where WBP was once prevalent (Hartwell *et al.* 1997; Arno *et al.* 1993 in Keane *et al.* 1994; Flanagan *et al.* 1998). However, in these studies, the authors noted that the densification of and succession to subalpine fir and Engelmann spruce co-occurred with WBP mortality caused by bark beetle outbreaks and/or blister rust; therefore, disentangling the effects of blister rust- and bark beetle-mortality on succession from the effects of fire suppression in these studies is difficult.

The idea that fire suppression in some whitebark systems has resulted in densification and loss of WBP has been a predominant theory in the WBP literature (Arno 1980; Arno 2001; Keane *et al.* 2017; Keane and Parsons 2010; Flanagan *et al.* 1998). However, some have recently called into question the idea that fire suppression has led directly to forest succession and the loss of WBP. For example, Larson and Kipfmüller (2012) suggested there is uncertainty in the effects of fire suppression on WBP and a relative lack of data supporting the hypothesis. Larson and Kipfmüller (2012) noted that age structure data in their study showed that many of the small subalpine fir trees occurring below the WBP, trees that visually appeared to be young saplings, were more than 100 years of age, suggesting that size class data should not be used as a surrogate for tree age or to determine the rate of succession. Campbell and Antos (2003) also noted that successional patterns in WBP forests are more complex than others have reported, finding that subalpine fir readily established after fire in their British Columbia study areas, and although subalpine fir density was increasing in older WBP stands with relatively open canopies, they estimated that succession to subalpine fir would take more than 500 years. Campbell and Antos (2003) reported that WBP in their study area was stress-tolerant (able to persist under conditions that restrict production), was capable of surviving long periods of suppressed growth, and was able to release upon reaching the main canopy after more than 150 years of low growth rates. The results of these studies indicate that the loss of WBP due to succession to subalpine fir and Engelmann spruce in some areas may be an extremely slow process and that WBP may be more shade-tolerant and resilient to suppression than previously suggested.

The broad range of fire return intervals in WBP ecosystems further complicates theories that fire suppression has caused succession in WBP systems. Fire history studies in WBP forests have identified fire return intervals ranging from 33 years (Morgan and Bunting 1990) to greater than 400 years (Campbell and Antos 2003). Several authors have noted that mean fire return intervals in subalpine forests that include WBP can be much longer than contemporary fire suppression policies (Dolanc *et al.* 2013; Meyer and North 2019; Sibold *et al.* 2006). Over an 80-year period, Dolanc *et al.* (2013) documented an increase in the number of small diameter trees, including WBP, in subalpine forests of the central Sierra Nevada. However, Dolanc *et al.* (2013)

Beetle activity in the phloem mechanically girdles the host tree, disrupting nutrient and water transport and ultimately killing it. Additionally, mountain pine beetles carry symbiotic blue stain fungi on their mouthparts, which are introduced into the host tree upon feeding. These fungi also inhibit water transport and further assist in killing the host tree (Raffa and Berryman 1987; Keane *et al.* 2012).

Mountain pine beetles are considered an important component of natural forest disturbance regimes (Raffa *et al.* 2008; Bentz *et al.* 2010). At endemic, or more typical levels, mountain pine beetles remove relatively small areas of trees, changing stand structure and species composition in localized areas. However, when conditions are favorable (abundant hosts and favorable climate), mountain pine beetle populations can erupt to epidemic levels and create stand-replacing events that may kill 80 to 95 percent of suitable host trees (Berryman 1986 as cited in Keane *et al.* 2012). Such outbreaks are episodic, can have a magnitude of impact on the structure of western forests greater than wildfire (the other major component of natural forest disturbance), and are often the primary renewal source for mature stands of western pines (Hicke *et al.* 2006; Raffa *et al.* 2008; Six *et al.* 2014). Mountain pine beetle outbreaks typically subside only when suitable host trees have been exhausted or temperatures are sufficiently low to kill larvae and adults (Gibson *et al.* 2008).

The range of the mountain pine beetle completely overlaps with the range of the WBP, and mountain pine beetle epidemics affecting WBP have occurred throughout recorded history (Keane *et al.* 2012). Recent outbreaks occurred in the 1930s, 1940s, and 1970s, and numerous ghost forests of dead WBP still dot the landscape as a result (Arno and Hoff 1989; Perkins and Swetnam, 1996, Ward *et al.* 2006). The most recent mountain pine beetle epidemic began in the late 1990s and continues to be a measurable but much reduced source of mortality for WBP (MacFarlane *et al.* 2013; Mahalovich 2013; Shelly 2014) (Figure A).

contorta var. *murrayana*) and mountain hemlock is absent from the Blue Mountains (Arno and Hoff 1990; McCaughey and Schmidt 2001).

Rangewide, WBP occurs on an estimated 32,616,422 ha (80,596,935 ac) in western North America (Figure 2 of the SA). Roughly 70 percent of the species' range occurs in the United States, with the remaining 30 percent of its range occurring in British Columbia and Alberta, Canada (USFWS 2018). In Canada, the majority of the species' distribution occurs on federal or provincial crown lands (COSEWIC 2010). In the United States, approximately 88 percent of land where the species occurs is federally owned or managed (Figure 2 of the SA). The majority is located on USFS lands (approximately 74 percent, or 17,391,455 ha (42,975,220 ac)). The bulk of the remaining acreage is located on NPS lands (approximately 10 percent, or 2,275,746 ha (5,623,490 ac)). Small amounts of WBP also can be found on BLM lands (approximately 4 percent, or 1,002,152 ha (2,476,371 ac)). The remaining 12 percent of the range is under non-federal ownership, on State, private, and Tribal lands. In the United States, 29 percent of the range is designated as wilderness under the Wilderness Act of 1964 (16 U.S.C. 1131-1136). This designation limits management options and conservation efforts in those areas to some degree.

Populations are typically defined by the potential for genetic exchange among their members, to the exclusion of members of other populations (in the absence of immigration or emigration). For WBP, genetic exchange is limited by the dispersal distance of pollen, which is carried by wind, and the seed caching behavior of Clark's nutcracker (Lorenz *et al.* 2011; Keane *et al.* 2017b). Both pollen dispersal and Clark's nutcracker seed dispersal can occur at a scale of few to many kilometers (km) (e.g., up to 30 km in the case of Clark's nutcracker seed dispersal). To promote a greater than 75 percent probability of occurrence of Clark's nutcracker at a site, recommended management plans that achieves landscape composition of a minimum 12,500-25,000 ha of cone bearing WBP habitat within a 32.6-km radius. The optimal Clark's nutcracker habitat mosaic includes moderate levels of Douglas-fir habitat (Douglas-fir seeds are another important food source for Clark's nutcracker in the GYE) (Schaming 2016 and Schaming and Sutherland 2020). WBP is a long-lived species that exhibits masting, where years of high seed production are synchronized within a population approximately every 3 to 5 years (McCaughey and Tomback 2001). This masting strategy is an adaption to heavy seed predation; during masting years seed consumers are satiated, resulting in excess seeds that escape predation (Lorenz *et al.* 2008). WBP populations need a certain density of reproductive individuals to produce sufficient pollen clouds that facilitate the synchronization of masting, and thus increased probability of regeneration (Rapp *et al.* 2013).

4. Conservation Actions and Restoration Strategies

Most current management and research focus on producing and planting white pines (including WBP) with genetic resistance to white pine blister rust, but also include natural regeneration (e.g., those areas identified in Appendix B, Tables A, B, and C) and silvicultural treatments, such as appropriate site selection and preparation, pruning, and thinning (Zeglen *et al.* 2010). Genetic management of white pine blister rust is actively conducted for several five-needle white pine species breeding programs (Snieszko 2016, Mahalovich 2015, Mahalovich 2010, Shelley 2016) including the USFS resistance screening programs for WBP. High-elevation pines such as WBP also present management challenges to restoration due to remoteness, difficulty of access, a

Considered a keystone, or foundation species in western North America, WBP it increases biodiversity and contributes to critical ecosystem functions (Tomback *et al.* 2001). As a pioneer or early successional species, it may be the first conifer to become established after disturbance, subsequently stabilizing soils and regulating runoff (Tomback *et al.* 2001). At higher elevations, snow drifts around WBP trees, thereby increasing soil moisture, modifying soil temperatures, and holding soil moisture later into the season (Farnes 1990). These higher elevation trees also shade, protect, and slow the progression of snowmelt, essentially reducing spring flooding at lower elevations. The WBP also provides nutritious seeds for a number of birds and mammals (Tomback *et al.* 2001).

3. Population Dynamics, Status and Distribution

The WBP has persisted in high elevation sites in western North America for the past 8,000 years (McCaughey and Schmidt, 2001). WBP has a broad range both latitudinally (occurring from approximately 36 degrees in south California to 55 degrees north latitude in British Columbia, Canada) and longitudinally (occurring from approximately 128 degrees in British Columbia, Canada to 108 degrees east in Wyoming). For the SSA, we developed an updated WBP range map based on the best available occurrence and distribution data (Figure 2 of the SA). This range map is at a coarse scale but encompasses the known distribution of the species' occurrences.

The WBP typically occurs on cold and windy high-elevation or high-latitude sites in western North America, although it also occurs in scattered areas of the warm and dry Great Basin. As a result, many stands are geographically isolated (Arno and Hoff 1989; Keane *et al.* 2010). The distribution of WBP includes coastal and Rocky Mountain ranges that are connected by scattered populations in northeastern Washington and southeastern British Columbia (Arno and Hoff 1990; Keane *et al.* 2010). The coastal distribution of WBP extends from the Bulkley Mountains in northwestern British Columbia to the northeastern Olympic Mountains and Cascade Range of Washington and Oregon, to the Kern River of the Sierra Nevada Range of east-central California (Arno and Hoff 1990). Isolated stands of WBP are known from the Blue and Wallowa Mountains in northeastern Oregon and the subalpine zone of mountains in northeastern California, south-central Oregon, and northern Nevada (Arno and Hoff 1990; Keane *et al.* 2010). The Rocky Mountain distribution of WBP ranges from northern British Columbia and Alberta to Idaho, Montana, Wyoming, and Nevada (Arno and Hoff 1990; Keane *et al.* 2010), with extensive stands occurring in the Yellowstone ecosystem (McCaughey and Schmidt 2001).

In general, the upper elevational limits of WBP decrease with increasing latitude throughout its range (McCaughey and Schmidt 2001). The elevational limit of the species ranges from approximately 900 m (2,950 ft) at its northern limit in British Columbia to 3,660 m (12,000 ft) in the Sierra Nevada (McCaughey and Schmidt 2001). WBP is typically found growing at the subalpine treeline or with other high-mountain conifers just below the treeline and subalpine zone (Arno and Hoff 1990; McCaughey and Schmidt 2001). In the Rocky Mountains, common associated tree species include lodgepole pine (*P. contorta* var. *latifolia*), Engelmann Spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), and mountain hemlock (*Tsuga mertensiana*). Common associated tree species are similar in the Sierra Nevada and Blue and Cascade Mountains, except lodgepole pine is present as Sierra-Cascade lodgepole pine (*P.*

WBP, which may be resistant to blister rust. Projects where the removal of surface and ladder fuels through hand cutting, piling of project generated materials, and burning the piles with the purpose of increasing stand resilience to fire may also be beneficial for the recruitment of WBP. Felling trees and creating skid trails for salvage harvests may damage or kill WBP seedlings and saplings and compress the soil and undetected seeds. Implementation of the conservation measures (*e.g.*, CM 1-10, 12-14, and 16-21) in the project design that avoid impacts to WBP seedlings, saplings, and live mature trees, and that minimizes soil disturbance and compaction that may destroy microsites for cached seeds, interrupts drainage, and limits tree rooting will have beneficial long-term impacts to WBP.

Vegetation management includes many project types (*e.g.*, WUI, salvage harvest of dead trees, harvest of Christmas trees, pest control, firewood collection) and sizes (less than 1 acre to thousands of acres). In this SA, we evaluated the effects of smaller forest management projects that damage or kill fewer than 125 live WBP of all age classes. Effects of larger project will be addressed by a standalone consultation or may be covered by a future standing analysis. We have elected to use a limit of 125 WBP of all age classes as a threshold for forest (vegetation) management projects, based on our understanding of the stressors to WBP, the level of ongoing restoration efforts, and our commitment to track and re-evaluate project impacts and restoration efforts for the life of this SA. While forest management projects will result in adverse effects to WBP, these should not result in population level effects for the reasons described above.

5.e. Recreation Development and Activities

The following recreational activities commonly occur in WBP habitat: construction and maintenance of hiking trails and roads (analyzed in the Infrastructure section); motorized use of trails year-round; (snow machines, all-terrain vehicles (ATV), utility task vehicles (UTV), motorcycles, electric bikes, and mountain bikes); operation of facilities (snow making, lift chairs analyzed in the Infrastructure section); firewood consumption; special use permits (hunting, photography); and horseback riding.

There are 91 recreation sites within WBP habitat in the action area, including developed campsites, horse corrals, trail heads, parking areas, toilets, staging areas, scenic overlooks, and primitive campsites. Back country campers and hikers may burn WBP for campfires, cause ground compression, climb on trees, or remove WBP when clearing trails. Motorized recreation activities, hiking, use of pack animals, and construction equipment used for trail maintenance and construction, may cause soil disturbance and compaction, destroy microsites for cached seeds, interrupt drainage, limit tree rooting, and damage seedlings. Over snow vehicles (OSV) could break the tops of trees or could damage branches or seedlings and saplings. We acknowledge that there may be some damage and death to WBP seedlings and saplings from authorized and unauthorized off-road motorized recreation activities which could affect individuals or local areas. Overall, impacts from all recreation activities could affect less than one percent of the species wide range (based on IUCN threats summary for WBP in Canada) (USFWS 2021) and are not considered a significant threat to WBP.

We conclude that, while not all adverse effects can be avoided, the implementation of the conservation measures (*e.g.*, CM 1-14, and 16-21) will minimize impacts to WBP and that

concurring with the “may affect but is not likely to adversely affect” determination. Projects that fall outside the bounds of the Standing Analysis and projects that “may affect and are likely to adversely affect” whitebark pine, even if they are addressed in the Standing Analysis, are not part of the online determination key in IPaC at this time.

No Effect (NE) Determination

Based on the Standing Analysis, projects within the area of influence (species range) but for which whitebark pine are not present and projects involving only dead trees (no live seedling, sampling, or mature trees) will have no effect (NE) on whitebark pine. Concurrence from the Service is not required for NE determinations; however, IPaC will deliver a letter documenting the outcome of the determination key.

May Affect, Not Likely to Adversely Affect (NLAA) Determination

The Standing Analysis concludes that projects occurring more than 10 meters (33 feet) from any live whitebark pine trees (seedling, sapling, and mature trees) will result in insignificant, discountable, or wholly beneficial effects to the whitebark pine, resulting in a “may affect, not likely to adversely affect” (NLAA) determination (more specifically described in the Standing Analysis). We also anticipate that agencies will implement the appropriate conservation measures from the Standing Analysis and adhere to the most recent best management practices to minimize impacts to whitebark pine.

It is the federal agency’s responsibility to make a final effect determination for potential impacts resulting from actions they conduct or permit and to confirm that the project is consistent with the determination key’s questionnaire and output. This letter only addresses whitebark pine. If other listed species or critical habitat occur within a project area or may be affected by a project, a separate consultation with the Service may be necessary.

Questions regarding this memo or responsibilities under the Act should be directed to the Wyoming Ecological Services Field Office at the letterhead address, by email at WyomingES@fws.gov, or by phone at (307) 772-2374.

EXECUTIVE SUMMARY

On December 15, 2022, the U.S. Fish and Wildlife Service (Service) published the final rule to list the whitebark pine (WBP) (*Pinus albicaulis*) as a threatened species (87 FR 76882) under the Endangered Species Act of 1973, as amended (Act; 16 U.S.C. 1531 et seq.). The Service also published a final 4(d) rule for WBP that identified actions necessary for the conservation and recovery of the species and included prohibited acts as well as a limited number of exceptions to the prohibited acts (87 FR 76882). Previously, on December 2, 2020, the Service published a proposed rule to list the WBP as threatened with a proposed 4(d) rule under the Act (85 FR 77408). No critical habitat was proposed for WBP. Section 4(d) rules cannot and do not absolve federal agencies of their consultation requirements under section 7 of the Act.

This Standing Analysis provides a basis for section 7 consultation for activities that are not prohibited by the 4(d) rule (see Appendix A for more information on the 4(d) rule). The analysis in this Standing Analysis (SA) evaluates effects to WBP from a variety of actions across Montana and Wyoming, including ongoing maintenance and management actions, new development or construction projects that will damage or remove no more than 125 total WBP trees (seedlings, saplings, and mature trees combined), livestock grazing, right-of-way maintenance, and activities that are beneficial for the restoration or recovery of WBP. Specifically, activities considered in the framework include:

- a. Livestock management and range improvements: livestock management and range infrastructure improvements (e.g., grazing, gathering and moving, fencing, stock ponds and tanks, and spring development);
- b. Infrastructure actions: infrastructure maintenance, upgrades, and replacement activities for existing pipelines, communication towers, utility lines, renewable energy facilities, trails, and highway infrastructure (e.g., to roads, bridges, culverts, bike and pedestrian facilities, fencing, lighting, and all other distinct aspects of a highway project); construction of new pipelines, communication towers, utility lines, renewable energy projects, and highway infrastructure;
- c. Mineral and conventional oil and gas exploration and development: maintenance of existing locatable and leasable mining and conventional oil and gas projects; new development of existing mineral and conventional oil and gas leases; and new development of new mineral and conventional oil and gas leases;
- d. Vegetation management actions: vegetation (forest) management activities that take into account age class prescriptions, genetic variability within and among WBP populations, and activities that may impact the adaptive potential and the forest trajectories of WBP (salvage harvests and pest control that remove dead and diseased trees and encourage natural WBP recruitment and are not in existing WBP restoration areas); timber harvest projects, hazardous fuel removal (in Wildland Urban Interface (WUI) areas), and precommercial thinning and group selection projects;
- e. Recreation activities: maintenance of existing trail systems (hiking and biking specifically); maintenance of existing recreational development projects (e.g., ski resorts and campgrounds), and other recreational activities (e.g., off-highway vehicles (OHV) and over-snow vehicles (OSV) use); upgrades, replacement, expansion, or new construction outside the existing disturbance footprint of existing recreation projects, and outfitter and guide permit programs;

Farmington Daily Times

NEWS

'Hundreds of thousands, if not millions': New Mexico sees massive migratory bird deaths

Algernon D'Ammassa Las Cruces Sun-News

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LAS CRUCES - Biologists from New Mexico State University and White Sands Missile Range examined nearly 300 dead migratory birds Saturday at Knox Hall on the university's main campus.

Over the past few weeks, various species of migratory birds are dying in "unprecedented" numbers of unknown causes, reported Martha Desmond, a professor at NMSU's Department of Fish, Wildlife and Conservation Ecology.

"It is terribly frightening," Desmond said. "We've never seen anything like this. ... We're losing probably hundreds of thousands, if not millions, of migratory birds."

In August, large numbers of birds were found dead at White Sands Missile Range and at the White Sands National Monument in what was thought to be an isolated incident, Desmond said.

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After that, however, came reports of birds behaving strangely and dying in numerous locations in Doña Ana County, Jemez Pueblo, Roswell, Socorro and other locations statewide.

The affected birds have included warblers, sparrows, swallows, blackbirds, flycatchers, and the western wood pewee.

"A number of these species are already in trouble," Desmond said. "They are already experiencing huge population declines and then to have a traumatic event like this is – it's devastating."

On Saturday, Desmond was joined by Trish Cutler, a wildlife biologist at WSMR, and two NMSU students for an initial evaluation of the carcasses.

Desmond said her team also began catching and evaluating living specimens on Friday as residents find birds behaving strangely and gathering in large groups before dying.

"People have been reporting that the birds look sleepy ... they're just really lethargic," Cutler said. "One thing we're not seeing is our resident birds mixed in with these dead birds. We have resident birds that live here, some of them migrate and some of them don't, but we're not getting birds like roadrunners or quail or doves."

On the other hand, numerous migratory species are dying rapidly and it is not immediately clear why, although the cause appears to be recent. Desmond said the birds had moulted, replacing their feathers in preparation for their flight south, "and you have to be healthy to do that; but somewhere after that, as they initiated their migratory route, they got in trouble."

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The biologists guessed the cause might involve the wildfires ravaging the western U.S. and dry conditions in New Mexico.

"They may have been pushed out before they were ready to migrate," Desmond said. "They have to put on a certain amount of fat for them to be able to survive the migration. These birds migrate at night and they get up in the jet stream, and they might migrate for three nights in succession, they'll come down and they'll feed like crazy, put on more fat and go again."

The biologists noted that the majority of the dying birds are insectivores, but that seed eaters were sickening and dying as well.

The birds will be sent to the U.S. Fish and Wildlife Service Forensics Laboratory in Ashland, Ore. for further analysis. Desmond it could be weeks before results come back, and the findings could bear serious ecological implications.

"Over 3 billion birds have died since 1970. Insect populations are crashing, and this is just an unprecedented mortality," she said. "Climate change is affecting the abundance of insects, it's affecting the volatility of the fires, and the scary thing is this may be an indication of the future."

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