Forest Ecosystems

CHAPTER SEVEN:

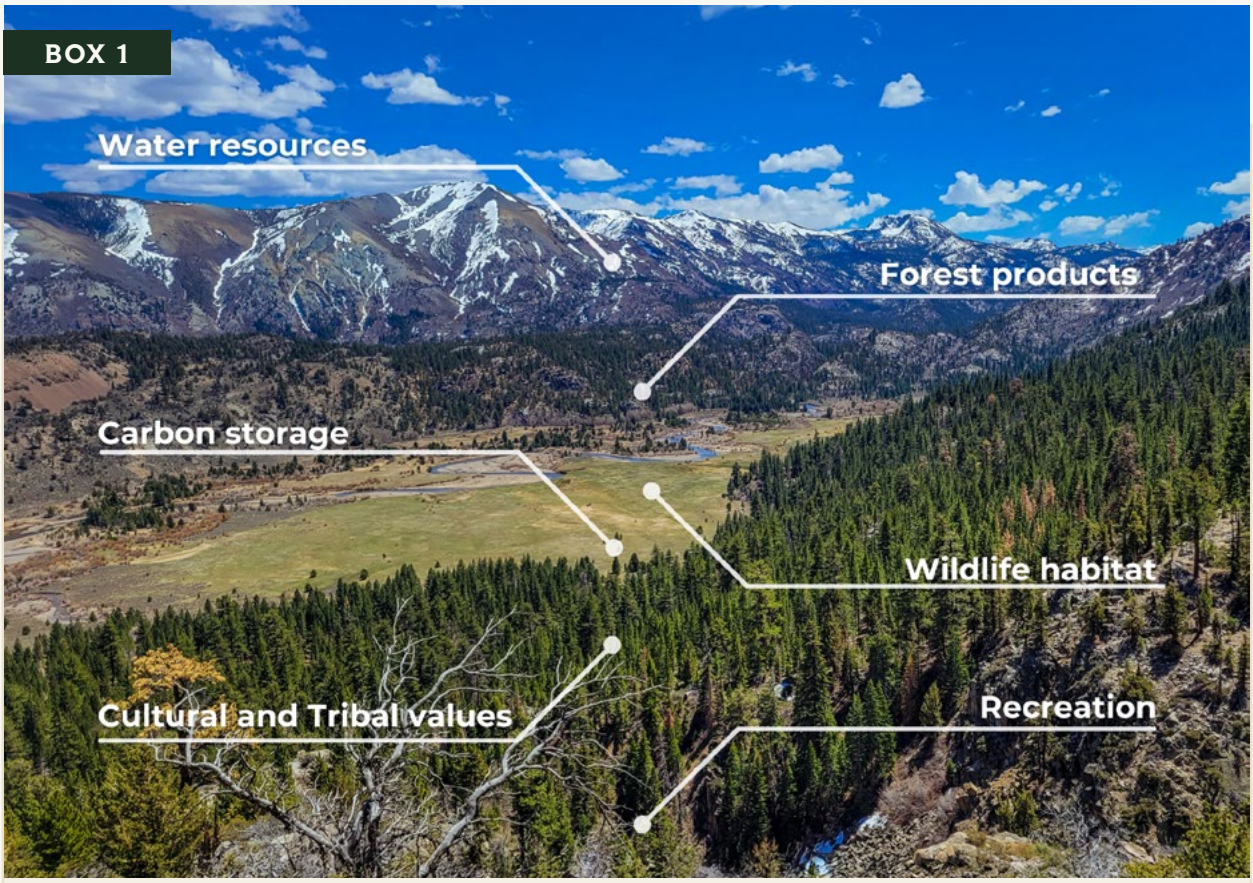
Introduction

Forests are some of the most iconic ecosystems of the West, known for their vastness, wildlife habitats, recreational opportunities, ecosystem services, and economic resources (Box 1). Increasingly, forests are also becoming known for their large and intense wildfires. Although fire is a natural and necessary component of western forest ecosystems, concern is rising about how changing fire regimes may threaten forests and those who rely on them, from birds to people. Because of emerging information highlighting declining forest birds (Box 2)[1], increasingly large and severe wildfires[2], and growing opportunities for active forest management across land ownership boundaries[3], western forests are emerging as a new priority habitat for the IWJV.

In this exciting new area of work, the IWJV will apply our durable and strategic approach to collaborative conservation that focuses on building partnerships, growing capacity, bridging science and implementation, and engaging in innovative communications efforts[4]. We recognize that many agencies, organizations, collaboratives, and partnerships already work in forest ecosystems. As such, our initial focus in western forests will be to identify opportunities for collaborative conservation that integrate wildfire risk reduction and bird habitat conservation, restore appropriate fire to the landscape, strengthen forest climate resilience, and prevent the expansion of invasive weeds (Box 3).

[1] Rosenberg et al. 2019, North American Bird Conservation Initiative 2022, Stephens et al. 2022, [2] Parks et al. 2023, [3] USFS Wildfire Crisis Strategy, [4] See the IWJV Strategic Plan and appropriate chapters of the 2025 Implementation Plan

BOX 1



What Do Forests Provide?

Water resources
In the western United States, forests contribute about 65 percent of water yield from about 23 percent of the land area[1]. Additionally, their soils act as filters, ensuring water quality for downstream users.

Carbon storage
Approximately 69 percent of the carbon in western ecosystems is stored in forests[2], providing resilient, long-term carbon storage.

Cultural and Tribal values
Indigenous peoples have had and still have relationships with forest plants, wildlife, and other beings since time immemorial. These elements of healthy forests are important for food, medicine, and other cultural purposes[3].

Forest products
Most Americans use wood products daily—from construction materials to furniture to firewood—equalling about 640 pounds of wood per person per year[4]. Non-timber forest products such as mushrooms, berries, and pine nuts are important commercially and for individual use.

Wildlife habitat
Western forests provide habitat for a suite of wildlife species, many of which are forest obligates. These include grizzly bears, lynx, deer, elk, and a plethora of bird species[5].

Recreation
Forests are used for recreation by many who enjoy hiking, backpacking, hunting, fishing, rafting, biking, wildlife watching, foraging, and more.

[1] Forest Atlas of the United States, [2] Zhu and Reed 2012, [3] Kimmerer 2015, [4] Forest Atlas of the United States, Chamberlain et al. 2018. [5] See Box 2.

BOX 2

Declining Forest Birds

The abundance of birds that breed in western forests has declined by 30 percent since 1970[1], likely due to widespread changes in forest structure, composition, and disturbance regimes.

A. The Lewis's Woodpecker (Melanerpes lewis) breeds in open ponderosa pine and recently burned forests that contain many snags. Photo: Mick Thompson.

B. The Pinyon Jay (Gymnorhinus cyanocephalus) is an iconic habitant of pinyon-juniper woodlands, congregating in large flocks and moving substantial distances within home ranges. Photo: Trish Gussler.

C. The Cassin's Finch (Haemorhous cassinii) breeds in the conifer forest of the western U.S., where males are known by their characteristic pink crown feathers. Photo: Tom Petit.

D. The Grace's Warbler (Setophaga graciae), like many, is a lover of the Southwest's mature pine forests, where it searches upper branches for insects. Photo: Tom Benson.

[1] Rosenberg et al. 2019

BOX 3

The IWJV Western Forest Toolbox

Priority Western Forest Ecosystems

Known for their diversity, forests within the IWJV boundary vary from lower-elevation, dry pinyon-juniper woodlands to high-elevation whitebark pine forests, with many unique forest types in between (Boxes 4 and 5). Forest types differ dramatically in their climate, species compositions, disturbance dynamics, and threats, and thus in their management needs. Given such diversity, the IWJV must prioritize our investments in forest ecosystems. We have identified dry forests and woodlands as priorities for early engagement because of their risk of catastrophic wildfire, declining bird species, important wildlife habitat, proximity to human communities, and extent within the IWJV boundary. We see opportunities in these forest types to support, expand, and build partnerships for collaborative conservation. In addition to these focal forest types, we're scoping opportunities in biodiversity hotspots, like aspen stands and riparian forests, which cover relatively small areas but provide outsized habitat benefits (Box 5).

We define dry forests and woodlands as dry, frequent-fire forests and pinyon-juniper woodlands. In dry, frequent-fire forests, evidence that active management can prepare forests for fire and improve ecological resilience—the ability of an ecosystem to maintain its ecological functions when experiencing disturbance—to climate change after over a century of fire suppression is a strong impetus for our focus[5]. Work in pinyon-juniper woodland ecosystems is a priority because of the steep decline of the charismatic pinyon-juniper obligate the Pinyon Jay (*Gymnorhinus cyanocephalus*; Box 6), the vulnerability of this ecosystem to catastrophic wildfire and changing climate, and growing interest among our partners to work together to address threats to this vast habitat[6]. Although common themes transcend each forest type, such as climate change and changes in forest structure, we address ecological differences between forest types below, as they are relevant to varying conservation approaches.

[5] Hagmann et al. 2021, Prichard et al. 2021, [6] Somershoe et al. 2020, Shriver et al. 2022, Redmond et al. 2023

Dry, Frequent-Fire Forests

Dry, frequent-fire forests are dominated by fire-tolerant tree species in dry settings, such as ponderosa pine (*Pinus ponderosa*) and sugar pine (*Pinus lambertiana*), and to a lesser degree, Douglas fir (*Pseudotsuga menziesii*) and western larch (*Larix occidentalis*)[7]. Several continentally important birds are associated with these habitats, including Cassin's Finch (*Haemorhous cassinii*), Lewis's Woodpecker (Melanerpes lewis), and Grace's Warbler (*Setophaga graciae*; Box 2)[8]. Historically, dry, frequent-fire forests primarily experienced low to moderate severity fire often, although fire return intervals varied[9]. Ignitions were caused by lightning, and—before Euro-American colonization—fires were used as a management practice by Indigenous peoples. Drought, insects, and pathogens also played a role in structuring dry, frequent-fire forests[11]. As a result of these disturbances, forests contained complex mosaics of fire-resistant species; large, old, fire- and drought-resistant trees were interspersed with non-forest openings. When low-severity fires were frequent, stand-replacing fires were limited[12]. This heterogeneity provided resistance to severe wildfires and created diverse wildlife habitat.

As a result of fire suppression, prohibition of Indigenous burning, historical management, and climate change, forest structure and function have changed in dry, frequent-fire forests, ultimately increasing high severity fire and reducing drought and wildfire resilience[13]. Restoring resilience to these forests requires active management and the return of appropriate fire to the landscape[14]. Research shows that fuels treatments can reduce the risk of catastrophic wildfires[15]. Bird habitat can also benefit from fuels reduction and forest restoration treatments[16] and is a priority for our work in this area. However, increasing the pace and scale of treatments will be necessary to achieve these goals at the landscape scale.

Pinyon-Juniper Woodlands

Across the Intermountain West, low mountains, foothills, and desert landscapes are blanketed by pinyon-juniper woodlands. Pinyon (*Pinus edulis and Pinus monophylla*) and juniper (*Juniperus spp.*) dominate these woodlands, which cover more than 100 million acres in total[17], with over 45 million acres within the IWJV boundary (Box 4). In addition to the Pinyon Jay, continentally important birds associated with these habitats include Virginia's Warbler (*Leiothlypis virginiae*) and Gray Vireo (*Vireo vicinior)*[18]. Although IWJV invests in the targeted removal of pinyon and juniper trees from sagebrush ecosystems for the benefit of sage-grouse[19], our Western Forests program focuses on the threats to and values of pinyon-juniper

Continued on next page →

[7] Dry conifer forests are defined in various ways throughout the literature. We distinguished dry, frequent-fire forests as a subset of dry conifer forests in order to emphasize the well-documented importance of frequent low to moderate severity fire in maintaining fire and drought resilience in these systems, especially in contrast to the more varied fire regimes in pinyon-juniper woodlands. See Taylor and Skinner 1998, Heyerdahl et al. 2001, Hessburg et al. 2005, Falk et al. 2011, Hagmann et al. 2021, and Parks et al. 2023, [8] Partners in Flight 2016, [9] Hessberg et al. 2005, [10] Kimmerer and Lake 2001, Taylor et al. 2016, Long et al. 2021, [11] Dale et al. 2001, Fettig et al. 2007, [12] Churchill et al. 2017, Hagmann et al. 2021, [13] Hagmann et al. 2021, [14] Hagmann et al. 2021, Prichard et al. 2021, [15] Reinhardt et al. 2008, North et al. 2012, Prichard et al. 2020, Prichard et al. 2021, [16] Cahall et al. 2013, Stephens et al. 2019, Latif et al. 2020, Latif et al. 2022, Saab et al. 2022, [17] Romme et al. 2009, [18] Partners in Flight 2016, [19] 2025 IWJV Implementation Plan Sagebrush Ecosystems Chapter

woodland ecosystems in and of themselves. Additionally, this work addresses the ecotone between sagebrush or grassland and pinyon-juniper woodlands because of the opportunity to develop and foster partnerships working across entire landscapes for multiple values and habitat objectives.

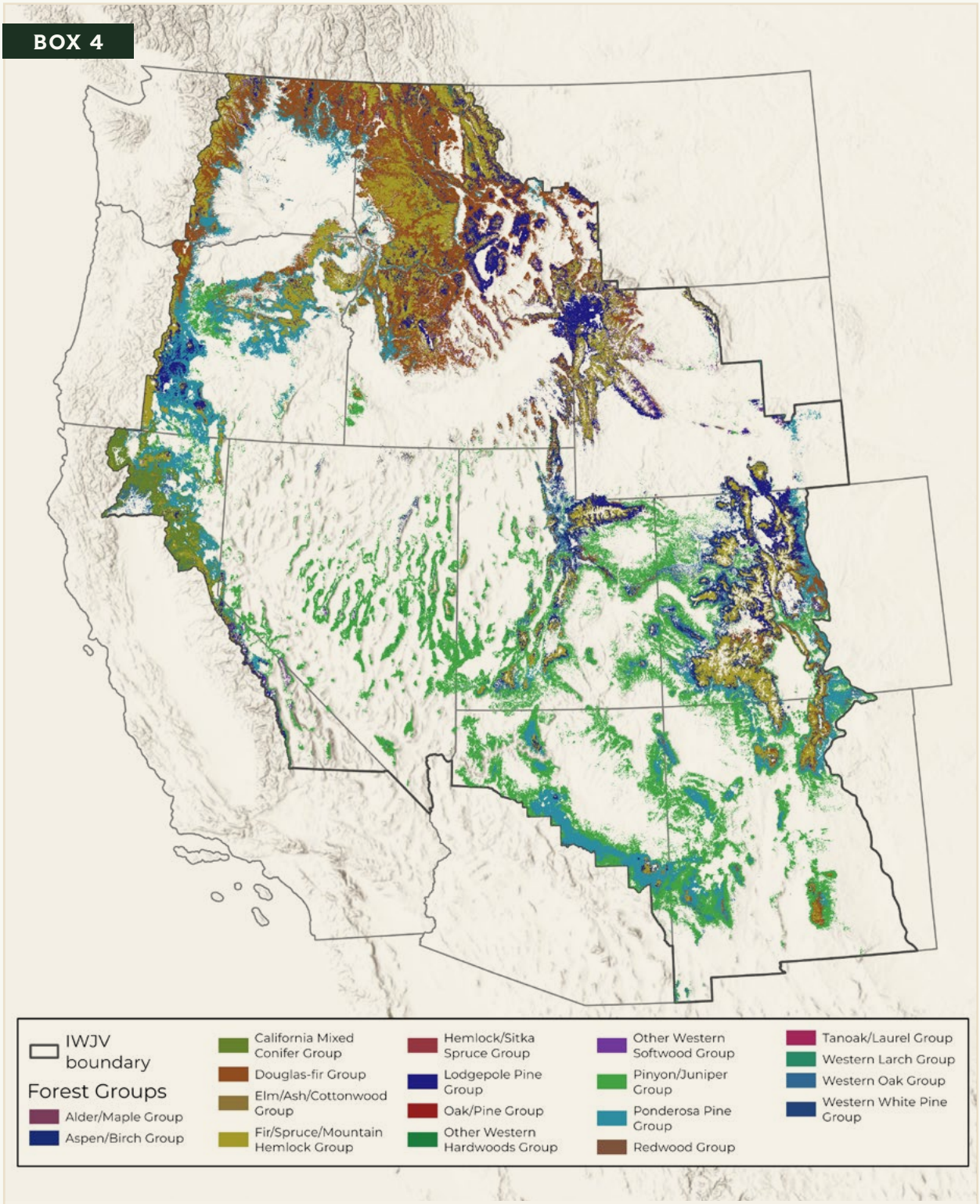
Historical fire regimes in pinyon-juniper woodlands varied substantially. Some areas where fine fuels were limited often experienced small, infrequent, high severity, stand-replacing fires[20]. For stand-replacing fires, although little information exists, fire rotations are estimated to reach 400 years[21]. In pinyon-juniper savannas and the ecotones with ponderosa pine forests and sagebrush steppe—where grasses and thus fine fuels are more prevalent—researchers have documented low severity fire[22]. In some regions, more frequent fire in adjacent sagebrush steppe may have prevented juniper expansion into sagebrush ecosystems[23]. Additionally, Indigenous fire management played a role in shaping pinyon-juniper woodlands[24]. Less is known about historical fire regimes in pinyon-juniper woodlands compared to other ecosystems[25]; thus, caution is needed when considering appropriate management actions.

Drought mortality, bark beetle outbreaks, and disease dynamics also historically played a role in structuring woodlands[26], although presently, climate change has exacerbated their effects on some species and in some geographies.

Pinyon-juniper woodlands support a diverse suite of plants and wildlife species, including the imperiled Pinyon Jay. Additionally, they provide opportunities for recreation and solitude and play a central role in Tribal and rural culture and livelihoods. Pinyon-juniper ecosystems are fundamental to the cultural identities, ceremonies, and traditional practices of Indigenous peoples across the region, many of whom are leaders in conserving these woodlands. Yet, despite their ecological and cultural importance; recent mortality due to wildfires, drought, and insect and disease outbreaks; and the decline of the Pinyon Jay; pinyon-juniper woodlands have received less management focus than other dry conifer forest types. Partnerships focused on collaborative conservation for climate resilience, woodland health, and wildlife habitat are emerging to address this management gap.

Credit: U.S. Forest Service, Southwestern Region, Kaibab National Forest.

[20] Baker and Shinneman 2004, Romme et al. 2009, [21] Baker and Shinneman 2004, Floyd et al. 2004, Bauer and Weisberg 2009, [22] Allen 1989, Miller and Rose 1999, Margolis 2013, [23] Miller and Rose 1999, Miller and Tausch 2002, Miller et al. 2003, [24] Roos et al. 2022, [25] Baker and Shinneman 2004, [26] Miller et al. 2019



Forest Groups within the IWJV Boundary

Forest Group data is from the National Forest Types Dataset. See Appendix 1 for acreage and percent of the IWJV geography for each forest type.

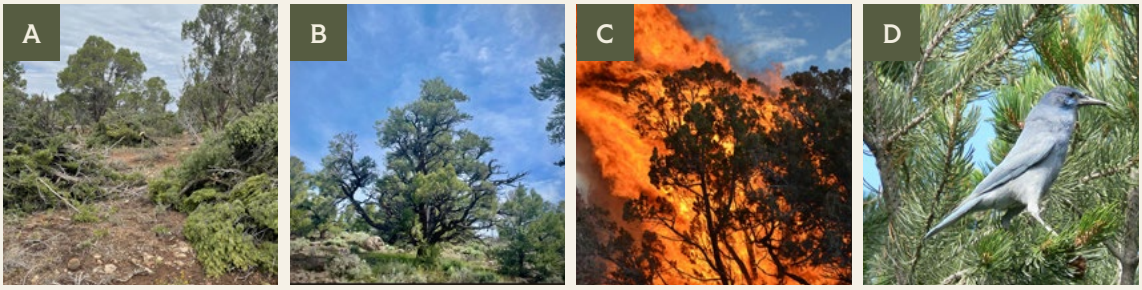
BOX 5

Priority Forest Types

Dry, frequent-fire forests

A. Open ponderosa pine forest, Lolo National Forest, Montana. **B.** Flying J prescribed fire, Kaibab National Forest, Arizona. Photo: Kaibab National Forest. **C.** Pile burning after thinning for fuels reduction in the Elko Front Wildfire Crisis Landscape, Humboldt-Toiyabe National Forest, Nevada. **D.** Beetle kill in ponderosa pine and Douglas fir forest in the Sierra Front Wildfire Crisis Landscape, Humboldt-Toiyabe National Forest, Nevada.

Pinyon-juniper woodlands

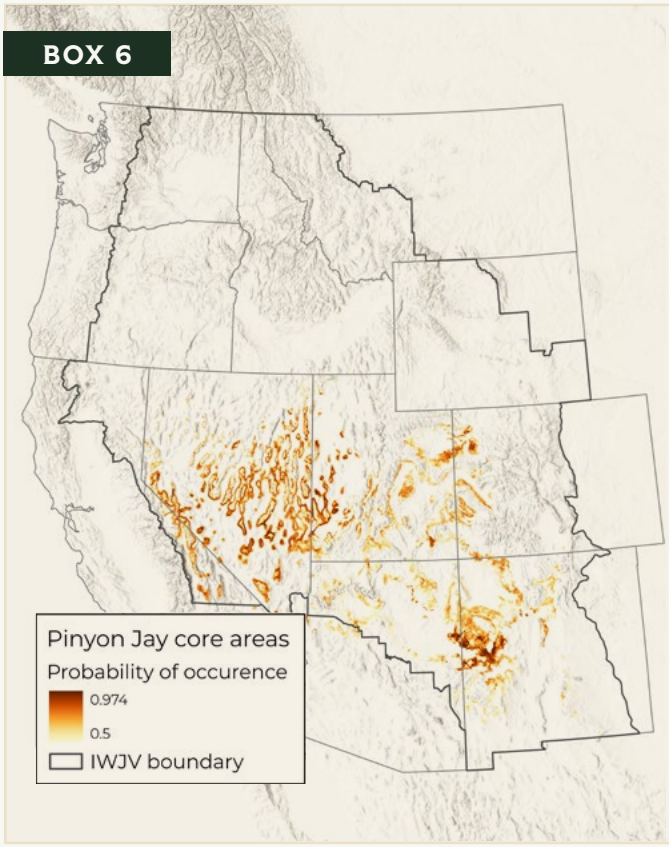


A. Pinyon-juniper woodland in southern Colorado after silvicultural treatments aimed at improving woodland resilience and reducing fire risk, BLM Tres Rios Field Office, Colorado. Photo: Ian Barrett, BLM Colorado State Office. **B.** Persistent pinyon-juniper woodlands with centuries-old single-leaf pinyon (*Pinus monophylla*) tree, Sierra Front Wildfire Crisis Landscape, Humboldt-Toiyabe National Forest, California. **C.** Bert Fire burns in pinyon-juniper woodlands, Kaibab National Forest, Arizona. Photo: Kaibab National Forest. **D.** Pinyon Jay (*Gymnorhinus cyanocephalus*) in front of a pinyon pine. Photo: Sally King.

Biodiversity hotspots

A. Yellow-bellied Sapsuckers (*Sphyrapicus varius*) rely on live trees like this aspen for sapwells. Photo: Keith Williams. **B.** Fire-induced aspen ecosystems are rich in biodiversity because of the varied habitats they provide. Photo: Coconino National Forest. **C.** Cottonwood galleries, like this one along Deep Creek in the Curlew National Grassland, provide habitat features not found in adjacent drylands. **D.** Meadows and riparian areas within forested ecosystems, like Zedd's Meadow in the Fishlake National Forest, Utah, provide outsized wildlife benefits. Photo: U.S. Forest Service.

BOX 6



Core areas for Pinyon Jays (*Gymnorhinus cyanocephalus*) within the IWJV boundary

Modeled probability of occurrence of Pinyon Jays is shown within the IWJV boundary. These data emphasize areas with a high likelihood of Pinyon Jay presence or likely hotspots for this species. Only areas with >50 percent probability of occurrence are shown. Data was provided by Jason Tack (USFWS) and is currently in preparation for publication.

Threats to Dry Conifer Forests & Woodlands

Western forests demand more and more attention as they go up in flames, impacting wildlife habitat, ecosystem services, and other values. Although fire has always been an integral part of western landscapes, recent years have seen more frequent and severe fires due to fire suppression and prohibition of Indigenous burning, changing forest structure, climate change, historical land management, and invasive species. Beyond fire-related mortality, climate change has exacerbated drought, insect, and disease outbreaks for some species, contributing to additional mortality. As disturbance occurs, some areas experience limited regeneration of desirable forest species while invasive species spread. In the wildland-urban interface (WUI), development can lead to habitat loss and fragmentation, and managers face unique challenges to keep people and infrastructure safe. In this section, we address these topics across forest types and discuss how they inform management approaches in dry, frequent-fire forests and pinyon-juniper woodlands. We acknowledge that many of these threats are complex and interrelated but address them separately to discuss the nuances of each.

Landscape Changes

In an era of rapid ecosystem change, forests of the Intermountain West face increasing climate variability and extremes, challenging their resilience and managers' ability to respond. Increased temperatures, greater variation in precipitation, lower snowpack, a greater number of mega droughts lasting more than a decade, and more extreme precipitation events are expected in the future [27, 28]. Drought is expected to be particularly persistent in the Southwest[29]. Wildfire area in the West is estimated to have already doubled and is only expected to increase[30]. Species and forest type migration, adaptation, and extirpation are also predicted to occur [31]. These changes interact with or exacerbate the threats discussed below and must be explicitly addressed in the planning and implementation of forest management so that management goals are compatible with future conditions.

Fire Suppression, Changes in Forest Structure, & Increasing Wildfire

In recent years, fire activity has increased in the West as a result of historical and contemporary fire suppression, land management, climate, and climate change. Contemporary fires cover more area, occur throughout a longer fire season, and are more severe than fires of the past[32]. In dry, frequent-fire forests, after colonization by Euro-Americans, fire suppression and prohibition of Indigenous burning were widespread in many parts of the West[33]. Additionally, favorable climate conditions promoted tree establishment and growth, but because fire did not remove small trees or other biomass, forest density increased[34]. Dry, frequent-fire forests were historically low-density with widely spaced large trees and low and patchy surface fuels, which made them resistant and resilient to wildfire. Today, dense forests contain a greater number of small trees and more surface and canopy fuels, which are prone to high severity, stand-replacing fire[35].

In pinyon-juniper woodlands between 1984 and 2013, the total area burned by wildfire increased, and fire rotations decreased. As a result, in some regions, the percentage of area burned in pinyon-juniper woodlands is higher than the percentage burned in other land cover types[36]. Although the causes of increased fire activity in pinyon-juniper woodlands during this period are not well understood, researchers believe that the continuity of canopy and fine fuels as a result of high tree density, invasive annual grasses, and climate change could be contributing factors[37]. Research has documented widespread, although variable, increases in tree density through infill of existing woodlands[38]. The causes of infill are not well understood[39], but they likely result from a combination of tree population dynamics, climate change, recovery from historical management, and enhanced atmospheric carbon dioxide[40]. These trends have raised concerns about the vulnerability of woodlands to wildfire and the potential for loss of wildlife habitat, recreational opportunities, Tribal and cultural values, and economic opportunities, especially in proximity to human communities.

[27] Rupp et al. 2016, Vose et al. 2017, [28] Easterling et al. 2017, Mote et al. 2018, [29] Wehner et al. 2017, [30] Abatzoglou et al. 2016, Abatzoglou and Parks 2016, Abatzoglou et al. 2021, [31] Aitken et al. 2008, [32] Abatzoglou and Kolden 2013, Abatzoglou and Parks 2016, Parks et al. 2023, [33] Parks et al. 2015, [34] Hessburg et al. 2005, [35] Taylor and Skinner 1998, Heyerdahl et al. 2001, Hessburg et al. 2005, Falk et al. 2011, Hagmann et al. 2021, [36] Board et al. 2018, [37] Board et al. 2018, [38] Miller et al. 2019, Filippelli et al. 2020, [39] Romme et al. 2009, [40] Romme et al. 2009, Shriver et al. 2024

Tree Mortality

Local to regional forest mortality due to drought, insects, and disease is causing increasing concern because it affects a broad range of forest types. Although these disturbances have historically driven forest stand and ecosystem dynamics, climate change is expected to exacerbate the scale, severity, and impacts of such disturbances and their interactions with each other[41]. Already, widespread forest mortality at the magnitude of millions of acres is occurring. As a result of climate-induced drought and insect and disease outbreaks, an estimated 350 million two-needle pinyons in the Colorado Plateau were killed in the early 2000s[42]. Mountain pine beetle outbreaks have affected millions of acres across multiple forest types from Alaska to Mexico, with higher potential for even more outbreaks over the next century, especially as drought exacerbates their effects[43]. High tree density appears to exacerbate mortality under some circumstances[44]. Predicting mortality and subsequent effects in a dynamic and warming climate will prove challenging[45]. Developing management strategies to bolster resilience to intensifying disturbances will be important to achieving forest and woodland management goals into the future.

Limited Regeneration

Limited regeneration after mortality-causing disturbance, like wildfire or drought, may lead to ecosystem type conversions, particularly under the warmest and driest conditions. Regeneration after disturbances is an important component of natural forest dynamics and contributes to the resilience of forests to their disturbance regimes. In dry forests and woodlands, regeneration after disturbance is expected to be slow, often timed with periods of mild and wet weather[46]. However, in some forest types, natural regeneration post-disturbance in a climate change- and human-affected era has been even more limited than expected. Lack of regeneration has occurred locally to regionally in dry, frequent-fire forests and pinyon-juniper woodlands, likely due to naturally slow establishment coupled with climate change effects on seedling establishment and reduced seed sources due to large and severe wildfires[47]. As such, the resilience of ecosystems to disturbance and climate change itself may have diminished. When stand-replacing fires or other disturbances occur, ecosystem type conversions could result in areas where regeneration does not occur, with potentially large-scale implications for ecosystem services like carbon sequestration and loss of forest aesthetics and values[48]. Additionally, Pinyon Jays and other birds are important in dispersing seeds for pinyon species[49], and the effect of their decline on regeneration is unknown.

[41] Adams et al. 2009, Bentz et al. 2010, McDowell et al. 2016, Vose et al. 2018, Wasserman and Mueller 2023 (Fig.3), [42] Adams et al. 2009, Meddens et al. 2014, [43] Wulder et al. 2006, Bentz et al. 2009, Bentz et al. 2010, Kolb et al. 2016, [44] Flake and Weisberg 2018, Restaino et al. 2019, Shriver et al. 2022, [45] Clark et al. 2016, [46] White 1985, League and Veblen 2006, Redmond and Barger 2013, Redmond et al. 2018, [47] Stevens-Runman et al. 2017, Davis et al. 2019, Shriver et al. 2022, Davis et al. 2023, Phillips et al. 2024, [48] Coop et al. 2015, Tepley et al. 2017, Walker et al. 2018, Coop et al. 2020, [49] Pesendorfer et al. 2016

Invasive Weeds

Across the West, invasive weeds are growing their footprint. As weeds invade, they threaten native biodiversity by displacing native understory vegetation, degrading wildlife habitat, and ultimately altering ecosystem processes and functions[50]. There has been substantial focus on this issue in western rangelands, with growing momentum to defend and grow weed-free core rangeland areas through management actions[51]. However, in forests, invasive weeds have received less attention[52]. Although forests are thought to be more resistant to shade-intolerant invasive weeds, future climate-related disturbances and lack of tree regeneration may increase available habitat for invasive weeds, especially after forest die-offs[53]. Additionally, disturbance caused by management activities could also increase invasive weed susceptibility[54]. Concern about postfire increases in invasive weeds, such as invasive annual grasses commonly seen in rangeland systems, is mounting[55]. For quality habitat for birds and other wildlife, as well as ecosystem function, addressing invasive weeds is a critical component of forest and woodland management.

Land Use Change & Development

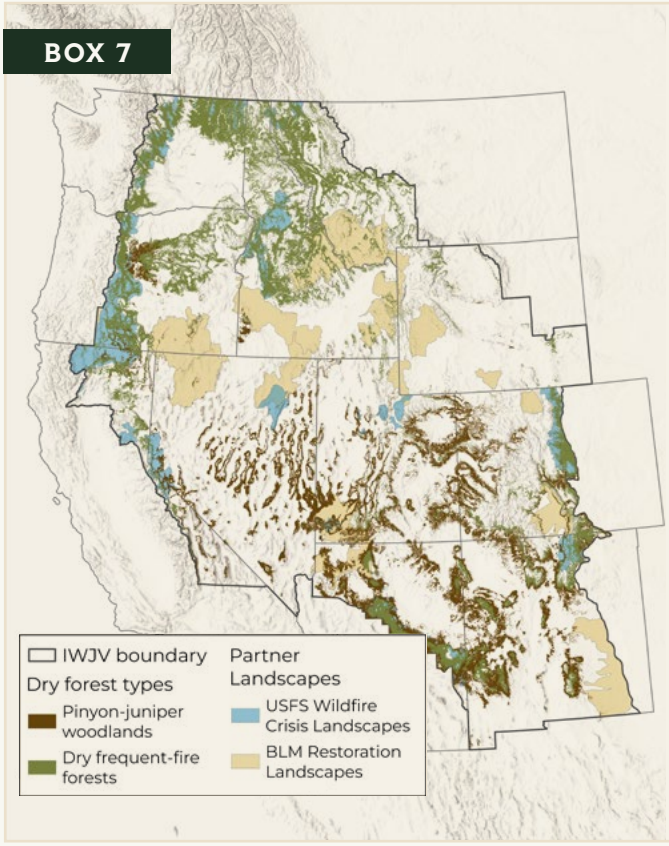
Land use trends in the Intermountain West have created new challenges for managing lands near human communities. The WUI is the area where human development intersects with or is near large areas of wildland vegetation[56]. As more people live, work, and recreate in the WUI, the unique resource management challenges in this area need additional attention. States in the Intermountain West have some of the highest proportion of houses within the WUI: between 40 and 80 percent[57]. These states also have some of the highest population growth in the WUI area between 1990 and 2020, with increases between 25 and 85 percent[58]. Beyond higher wildfire risk to human communities due to proximity, the WUI faces higher human-caused ignition rates, challenges to wildfire suppression, habitat loss and fragmentation, high concentrations of invasive species, and other concerns relevant to human communities[59]. Land managers must contend with the complexities of management in the WUI, searching for conservation outcomes that balance the needs of ecosystems, wildlife, and people.

[50] Litt et al. 2013, Coates et al. 2016, Chambers et al. 2017, Fusco et al. 2019, [51] Maestas et al. 2022, [52] Kerns et al. 2020, [53] Abatzoglou and Kolden 2011, Peeler et al. 2018, Kerns et al. 2020, [54] Kerns et al. 2020, [55] Peeler et al. 2018, [56] Mockrin et al. 2023, [57] Volker et al. 2018, Mockrin et al. 2023, [58] Volker et al. 2018, Mockrin et al. 2023, [59] Radeloff et al. 2005, Syphard et al. 2007, York et al. 2011, Hamilton et al. 2016

Priority Geographies

As IWJV's priority forest types cover millions of acres within our geography, we must prioritize our investments. Within the priority ecosystems outlined above, we will prioritize work where existing partnerships are strong and durable, established partner priorities exist, and the potential to improve bird habitat is high. Within dry, frequent-fire forests, early focus will be on areas partners have already identified as important for forest restoration, management, and wildfire risk reduction. Initial work may prioritize BLM Restoration Landscape[60], USFS Wildfire Crisis Strategy Landscapes[61], and areas identified in state or Tribal forest plans or other collaborative plans (Box 7). In pinyon-juniper woodlands, priority values that will drive the geographies we work in include Pinyon Jay core habitat, importance to Tribal and local communities, wildfire risk, and potential for woodland resilience and health improvements. Emerging partnerships focused on pinyon-juniper woodlands will also likely drive investment. Additionally, the IWJV will apply our common ground partnership approach in geographies where Pinyon Jay and woodland priorities overlap with sage-grouse and sagebrush ecosystem priorities because of the opportunity for cross-value and cross-boundary landscape-scale planning, prioritization, and conservation success.

BOX 7



Partner priority landscapes within the IWJV boundary

Polygons show USFS Wildfire Crisis and BLM Restoration Landscapes. Dry, frequent-fire forest data were derived following the methods in Parks et al. 2023 using the LANDFIRE Biophysical Settings dataset and clipped to the IWJV boundary. Pinyon-juniper woodlands were identified using the National Forest Types Dataset and clipped to the IWJV boundary.

[60] BLM Restoration Landscapes, [61] USFS Wildfire Crisis Strategy Landscapes

Conservation Strategies & Practices

IWJV's conservation strategies and practices in western forests serve the vision for our work in this habitat: to integrate wildfire risk reduction and bird habitat conservation, restore appropriate fire to the landscape, strengthen forest climate resilience, and prevent the expansion of invasive weeds (Box 3). These strategies leverage our IWJV approach—building partnerships, growing capacity, bridging science and implementation, and engaging in innovative communications—toward this vision. Specifically, the IWJV's work in western forests supports our partners in integrating current knowledge, science, and data on bird and wildlife effects of forest management into their work; growing capacity to implement forest management practices that have long-term habitat benefits to birds and other wildlife; and communicating the outcomes and needs of this work to relevant audiences.

Conservation Strategies

We use the following conservation strategies to guide our investments of staff time and resources across spatial scales, disciplines, management entities, and topics:

1. Develop partnerships across professional and jurisdictional boundaries

Building relationships with partners in forest ecosystems continues to be a priority for the IWJV. Through work prior to this Implementation Plan, we have developed strong foundations of new partnerships with researchers, state and federal agencies, Tribal Nations and entities, and others working in forest ecosystems. However, to achieve a vision of catalyzing collaborative conservation efforts that integrate bird conservation into forest management, our team will continue to build connections with partners across professional and jurisdictional boundaries. A primary focus of initial work will be on broadening our partnership to identify new and different stakeholders with common interests.

Additionally, the IWJV will work to connect groups across disparate professional communities with perceived tradeoffs among values or priorities. For example, the decline of the Pinyon Jay has led to concern that removing conifers expanding into sagebrush ecosystems to improve habitat for the sage grouse may have negative consequences for woodland-obligate Pinyon Jays. The IWJV will bring a neutral, science-driven perspective to such issues and leverage our partnership approach to identify common-ground solutions.

2. Facilitate science development to fill key knowledge gaps on forest management, bird habitat, and other ecosystem services

Forest managers working to integrate multiple values into their work, including wildlife habitat, rely on actionable and accessible information to inform prioritization and planning. In many forest ecosystems, a growing body of knowledge is available that can inform management and help agencies fulfill "best available science" mandates[62]. However, numerous knowledge gaps create barriers to achieving wildlife-focused management goals in our priority forest types (Box 8).

The IWJV has a track record of facilitating priority science development that informs wildlife conservation efforts[63]. Building on this experience, the IWJV will work with public, private, and Tribal partners to identify additional gaps in knowledge relating to bird and wildlife conservation within dry forest and woodland ecosystems that represent barriers to implementation success. Where important gaps in knowledge are identified within IWJV priority forest ecosystems and geographies, we will work with external science partners to catalyze, fund, develop, and communicate priority science. To support this work, we will continue to prioritize expanding our research partner network, including both Western scientists and Indigenous scientists or knowledge holders, where appropriate.

3. Facilitate the development of a pinyon-juniper woodland research and monitoring network

There is a growing need for information on the spatial extent and distribution of threats to pinyon-juniper woodlands and on management practices that can address these threats (Box 8). Managers and conservation partners are increasingly interested in managing for woodland health, fuels reduction, and wildlife habitat goals. However, a major barrier to action is a lack of robust information on the practices that can achieve such goals and where they might be appropriate at landscape scales. To address this knowledge gap, information is needed at the scale at which management occurs, across regions and ecosystems, and for multiple management approaches ranging from silvicultural treatments to pinyon-juniper removal to no treatment. Small-scale projects without coordination will fail to advance our knowledge of pinyon-juniper systems quickly enough and will risk duplication of efforts. Thus, a coordinated, transdisciplinary, cross-boundary approach that leverages ongoing research and management is needed to rapidly gain information on the spatial extent of pinyon-juniper values and threats and the management strategies needed to meet pinyon-juniper woodland ecosystem management goals.

The IWJV is well positioned to facilitate such an effort because of our robust and growing research and management network; partnership approach; track record in facilitating high-priority science; and reputation as a neutral, science-driven organization. Leveraging these attributes, we will work with key research and management partners to kickstart, fund, and coordinate a research and monitoring network to identify and fill key knowledge gaps for managers. Success for this long-term effort would be the development of spatially explicit management guidelines and appropriate, place-based strategies.

[62] Doremus et al. 2004, Wright 2010, Kitchell et al. 2015, [63] Donnelly et al. 2016, Donnelly et al. 2017, Jones et al. 2018, Donnelly et al. 2020, Donnelly et al. 2022, Kleinhesselink et al. 2023

4. Bridge science and implementation to ensure existing knowledge can be used to strengthen on-the-ground forest management

Bridging knowledge and action is often a challenge in conservation. Much existing science does not address the specific needs of managers[64]. Adoption of management-relevant information often lags behind its development[65]. Many institutional and capacity-related barriers to using this knowledge in land management decisions exist within research and management communities[66]. Science-to-implementation efforts, which transfer science, data, technology, best practices, and other technical information to end-users who influence land management, are often needed to ensure that existing knowledge can be used to strengthen on-the-ground forest management[67].

Through our Science to Implementation Team, the IWJV can support our partners in integrating science, data, technology, and other information into their work[68]. Our team will focus on understanding partner needs and applying our service-oriented approach to bridging science and implementation. Across IWJV priority forest types, our team will work with research partners to support managers with a variety of technical needs, including spatial targeting of forest and woodland management for wildlife habitat benefits and other values, outcome evaluation of management practices, and science synthesis and translation of management-relevant topics.

5. Increase community-based capacity to implement forest management with bird habitat benefits in priority ecosystems and geographies

As forest management activities focused on wildfire, fuels reduction, and ecosystem resilience scale up, successfully implementing strategic forest management and restoration will require additional capacity. Critical functions like partnership facilitation, bridging science and implementation, planning and implementing projects, monitoring and evaluating outcomes, engaging the public and citizen scientists, and more will fall short without additional people power connected to local communities.

The IWJV has a proven record of establishing and supporting critical community capacity for conservation[69] which we will apply to our emerging work in forest ecosystems. As we develop partnerships with state and federal agencies, Tribal Nations and entities, nonprofit organizations, universities, and others, we will seek out strategic opportunities to support capacity positions that meet the needs of our partners and fill capacity gaps that are difficult for other organizations to fill. Capacity gaps include coordinating across pinyon-juniper woodland management efforts, implementing public or private lands forest management focusing on bird habitat, or transferring a growing body of information on Pinyon Jays to managers.

[64] 2025 IWJV Implementation Plan Science to Implementation Chapter, [65] Olsen et al. 2024, [66] 2025 IWJV Implementation Plan Science to Implementation Chapter, [67] 2025 IWJV Implementation Plan Science to Implementation Chapter, Olsen et al. 2024, [68] 2025 IWJV Implementation Plan Science to Implementation Chapter, [69] See the Sage Capacity Team

6. Elevate forest management work at the nexus of wildlife conservation, forest health, climate resilience, and human livelihoods through strategic communications

Supporting our partners in highlighting innovative and successful conservation efforts through collaborative communications efforts is a strength of the IWJV[70]. Using a variety of communication tools and tactics, we will highlight conservation projects and management practices in western forests that reduce wildfire risk and benefit wildlife and people. In the early development of this programmatic area, our strategic communications will focus on promoting science-informed active management through storytelling that supports ongoing forest management efforts or catalyzes additional efforts. We will utilize our science-to-implementation and communications capacity to create external-facing communications campaigns, develop technical transfer products, and design targeted distribution strategies. To establish and expand the reach of our forest communications, we will leverage existing relationships with communications professionals at public, Tribal, and non-governmental organizations while seeking new partnerships with effective communicators and communication outlets relevant to our strategies. Our Communications Team will use caution when approaching controversial practices or decisions that may cause divides between our partners. Determining the IWJV's communications approach will include detailed planning, vetting, and collaborative production.

7. Seek additional opportunities to apply the IWJV approach to multi-benefit conservation efforts in forests

As our work in forest ecosystems grows, the IWJV will continue seeking additional opportunities for multi-benefit conservation wins in forest ecosystems. We strive to be nimble, relevant, and responsive by seeking opportunities to add value to our partners' work. Our initial priority will primarily be developing funding sources and refining our focus. As we see success in supporting partners in achieving forest management goals, the IWJV will seek additional partnership and funding opportunities that will allow us to expand our reach in western forests. Additionally, we will conduct internal scoping to identify potential new priority forest ecosystems, such as biodiversity hotspots like aspen and riparian forest ecosystems, and topics, like water and carbon implications of wildfire and forest management, which may help to catalyze additional forest bird habitat conservation.

[70] 2025 IWJV Implementation Plan Communications Chapter

Conservation Practices

Under the above conservation strategies and our vision for western forests (Box 3), we support a suite of conservation practices across spatial scales. Our work spans scales– from individual projects to watersheds to ecoregions–emphasizing efforts that integrate across spatial scales, disciplines, management entities, and threats. In forest ecosystems, we support a suite of practices, where appropriate, including:

Integrating wildlife habitat and fuels management through…

- Ecological forestry practices focused on restoring, mimicking, or maintaining ecological complexity, spatial heterogeneity, and natural processes.
- Fuels reduction practices that reduce fire intensity or severity where ecologically appropriate, especially at the landscape scale or with long-term habitat benefits to birds (e.g., thinning, removal of understory or midstory fuels).
- Spatial targeting of treatments, especially to balance costs and benefits to birds and other wildlife with other ecological, social, cultural, and economic objectives.
- Strategic conservation easements to protect wildlife and other ecological, cultural, and economic values, where appropriate.

Restoring appropriate fire to the landscape through…

- Prescribed fire and Indigenous or cultural burning in appropriate forest types.
- Appropriate silvicultural practices needed to prepare dry, frequent-fire forests for frequent low intensity fire.

Strengthening forest resilience through…

- Ecological forestry and fuels reduction practices, like those described above, that increase forest resilience to climate change effects, including drought, wildfire, and insect and disease outbreaks.
- Postfire rehabilitation, such as seeding or planting with native species, especially when native species have a low likelihood of regeneration postfire or post-disturbance.

Preventing expansion of invasive weeds through…

- Invasive species management as appropriate, especially postfire or post-treatment, including herbicide treatments, targeted grazing, and seeding or planting native species.
- Prioritization and planning of treatments to minimize the risk of invasive weeds (e.g., using methods that reduce disturbance in low resistance or resilience sites).

Success in Western Forests

In dry forests and woodlands, integrating wildfire risk reduction and bird habitat conservation, restoring appropriate fire to the landscape, strengthening forest climate resilience, and preventing the expansion of invasive weeds (Box 3) will not happen without partnerships. No single entity can meet these goals alone, necessitating an "all lands, all hands" approach. Under our efforts, we would consider success to be outcomes like:

- Through our science-to-implementation efforts, forest or woodland managers becoming better equipped with evidence-based approaches to forest management and explicitly considering wildlife habitat values in planning and implementation.
- Through our capacity building efforts, increasing the pace and scale of active forest management by expanding the workforce to deliver conservation.
- Through strategic communications, increasing acceptance of active management of western forests, including prescribed fire.

Ultimately, success will be the conservation and restoration of forest bird habitat through partnerships.