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procera), Pacific Silver Fir (*Abies amabilis*), Lodgepole Pine, and Mountain Hemlock (*Tsuga mertensia*). In the Cascades, Engelmann Spruce and Subalpine Fir appear but are not dominant trees. The forest here is slightly but appreciably taller than the Rocky Mountain type, with canopy trees reaching 50–100 ft. (15–30 m) in height.

In Montane Spruce-Fir Forest, shrub and herbaceous layers are typically sparse or absent due to late-lingering snow and the dense canopy. Shrubs that occur include White Rhododendron (*Rhododendron albiflorum*), serviceberries (*Amelanchier* spp.), Five-leafed Bramble (*Rubus pedatus*), gooseberries (*Ribes* spp.), buckbrushes (*Ceanothus* spp.), and willows (*Salix* spp.). In areas that have experienced avalanches, blowdowns, or other major disturbance, grassy meadows can be found.

WILDLIFE: The wildlife is a blend of species from the **BOREAL CONIFER FOREST** and species of adjacent montane conifer habitats. The mammals include most of the classic boreal species such as Moose, Snowshoe Hare, American Red Squirrel, Southern Red-backed Vole, American Ermine, American Marten, Fisher, and the elusive Canada Lynx. The lynx ranges as far south as Colorado, where populations were reestablished in the 1990s. Both Moose and Canada Lynx are absent from the Sierra Nevada–Columbia Plateau subhabitat.

Many species of boreal birds are found in this habitat, including Spruce Grouse, Boreal Owl (IS), Great Gray Owl (Sierra subhabitat, IS), American Three-toed and Black-backed Woodpeckers, Canada Jay, Black-capped Chickadee, Golden-crowned Kinglet, Pine Grosbeak (IS), Evening Grosbeak, and White-winged and Red Crossbills. These occur alongside more typical Rocky Mountain



Top: Listening for the alarm calls of squirrels and songbirds is a good way to locate the cute but ferocious American Marten. © MISSY MANDEL PHOTOGRAPHY

Right: Pine Grosbeak brightens the Montane Spruce-Fir Forest with a flash of color and a cheery song. © BEN KNOOT, TROPICAL BIRDING TOURS

Boreal Owl is most vocal in March and April, when deep snows make this mountain habitat extremely difficult to access. © PHIL CHAON

species like Northern Pygmy-Owl, Steller's Jay, Clark's Nutcracker, Mountain Chickadee, and Cassin's Finch. In winter, Gray-crowned, Black, and Brown-capped Rosy-Finches come down to this habitat from higher elevations, especially during inclement weather. Flocks of hundreds can sometimes appear at bird feeders after a winter storm.



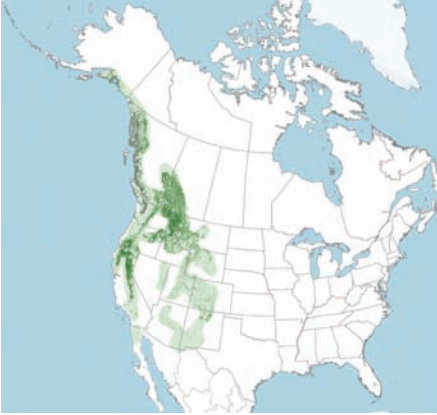
This forest can have snow on the ground during any month of the year, and many locations experience frosts throughout the summer. Additionally, the steep mountain slopes leave little room for pooled groundwater and wetlands. For that reason, amphibians and reptiles are almost completely absent.

CONSERVATION: Nearctic Montane Spruce-Fir Forest is slow-growing, and unlike most western conifer habitats, it typically experiences low-frequency, high-intensity fires. With warmer temperatures due to climate change, stands of this forest have suffered massive die-offs due to Mountain Pine Beetles, a pest that would historically have died off in winter. These dead trees create large swaths of forest that are highly susceptible to sweeping wildfires, from which the forests need centuries to recover. In general, this habitat is not valuable for timber and is relatively free of human habitation and development. Most current threats come from disease and fire exacerbated by climate change.

DISTRIBUTION: This is a high-elevation habitat. The Rocky Mountain Spruce-Fir Forest subhabitat is found throughout the Rocky Mountains and n. Cascades from British Columbia and Alberta south to n. New Mexico. It occurs as far east as c. Montana in montane islands, and as far west as the Olympic Mountains in w. Washington. The Sierra Nevada-Columbia Plateau Spruce-Fir Forest subhabitat occurs in the Sierra Nevada of California as far south as Sequoia National Park, and extends north through the Cascades and slowly transitions to the Rocky Mountain subhabitat in n. Oregon, where trees from both forest subhabitats can be found. As is typical of montane ecosystems, the elevation at which Montane Spruce-Fir Forest occurs increases closer to the equator. At the northern end of the range in British Columbia, these forests occur as low as 3300 ft. (1000 m), while at the southern limit in New Mexico, this habitat occurs as high as 11,000 ft. (3350 m). Upslope, this habitat is replaced by **HIGH-ELEVATION PINE WOODLAND** or **ALPINE TUNDRA**, and downslope, it is usually replaced by **MONTANE MIXED-CONIFER FOREST**. In the Olympic Mountains, this habitat occurs only on drier east-facing slopes; on west-facing slopes it is replaced by **TEMPERATE RAINFOREST**.

WHERE TO SEE: Yellowstone National Park, Wyoming, US; Waterton Lakes National Park, Alberta, Canada; Cameron Pass, Colorado, US.

Ne1D NEARCTIC MONTANE MIXED-CONIFER FOREST

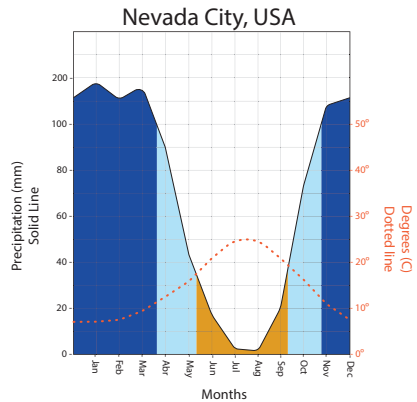


IN A NUTSHELL: A mid-elevation temperate conifer forest with many co-dominant tree species. **Global Habitat Affinities:** HIMALAYAN PINE FOREST. **Continental Habitat Affinities:** PONDEROSA PINE FOREST; MADREAN PINE-OAK WOODLAND. **Species Overlap:** MONTANE SPRUCE-FIR FOREST; PINYON-JUNIPER WOODLAND; LODGEPOLE PINE FOREST; ASPEN FOREST AND PARKLAND.

DESCRIPTION: A widely distributed and highly variable habitat of w. North America, Montane Mixed-Conifer Forest is the quintessential western forest of towering conifers, with the smell of vanilla coming off sun-warmed Ponderosa Pine and the distant drumming of woodpeckers. Anyone who has spent time hiking in the mountains of the w. Nearctic region has enjoyed these vast and inviting forests.

The canopy is fairly open at the lowest elevations, where this habitat grades into **PONDEROSA PINE FOREST**, and becomes more closed farther upslope. While the height of the canopy is generally 65–120 ft. (20–35 m), some of the larger trees can surpass heights of 200 ft. (60 m). The **Ne1D-1 Rocky Mountain Mixed-Conifer Forest** subhabitat tends to be shorter overall and lacks the gargantuan trees found in the **Ne1D-2 Sierra Nevada–Columbia Plateau Mixed-Conifer Forest** subhabitat. With a sparse midstory and a variable shrub layer, these forests are quite open and easily traversed, making them a pleasant place for hiking and wildlife observation.

One of the hallmarks of the Montane Mixed-Conifer Forest is the diversity of conifer species present. Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa Pine (*Pinus ponderosa*) are the two most widespread components of the canopy, found at all but the lowest elevations. In the Rocky Mountain Mixed-Conifer Forest subhabitat, other important co-dominant trees are Lodgepole Pine (*Pinus contorta*), Grand Fir (*Abies grandis*), White Fir (*Abies concolor*), Blue Spruce (*Picea pungens*), and Western Redcedar (*Thuja plicata*). The Sierra Nevada–Columbia Plateau Mixed-Conifer Forest subhabitat has a different set of co-dominant trees, with Sugar Pine (*Pinus*



lambertiana), Jeffrey Pine (*Pinus jeffreyi*), Western White Pine (*Pinus monticola*), Incense Cedar (*Calocedrus decurrens*), and White Fir all occurring widely. The Giant Sequoia (*Sequoiadendron giganteum*) is found in the Montane Mixed-Conifer Forest of the c. Sierra Nevada. This most massive of trees changes the structure of the forests, as little understory and large canopy gaps surround these living giants.

In Montane Mixed-Conifer Forest, the midstory is typically very sparse and comprises smaller individuals of the dominant tree types. Depending on frequency of fire and canopy density, the shrub layer can be absent to dense. The shrub layer is highly diverse over this habitat's range, with well over 100 species represented. Shrubs typically found throughout the range include Big Sagebrush (*Artemisia tridentata*), manzanitas (*Arctostaphylos* spp.), buckbrushes (*Ceanothus* spp.), ninebarks (*Physocarpus* spp.), dogwoods (*Cornus* spp.), Huckleberry Oak (*Quercus vaccinifolia*), and Gambel Oak (*Quercus gambelii*). Stands with a more closed canopy can completely lack herbaceous or shrubby ground cover, with little but fallen conifer needles covering the forest floor.

The high variability in species composition and structure means the fire regime is also highly variable. Historically, frequent low-intensity fires were more common in the Sierra Nevada, while the Rocky Mountains experienced a full spectrum of fire regimes. Fire suppression has led to denser forests and more shade-tolerant species like White Fir. This also tends to result in high-intensity fires when they do occur.

Nearctic Montane Mixed-Conifer Forest includes a wide array of tree species. © BEN KNOOT, TROPICAL BIRDING TOURS





Above: Steller's Jay is a raucous and obvious resident in many montane habitats.

© BEN KNOOT, TROPICAL BIRDING TOURS

Right: White-headed Woodpecker is a specialty bird in the Sierra Nevada–Columbia Plateau Mixed-Conifer Forest subhabitat. © BEN KNOOT, TROPICAL BIRDING TOURS



WILDLIFE: Bordering a variety of habitats that all share aspects of vertebrate communities, Montane Mixed-Conifer Forest is home to the majority of forest-dwelling mammal species

of the west. Widespread large mammals include Elk, White-tailed and Mule Deer, American Black Bear, Puma (aka Mountain Lion, Cougar, or Panther), and Gray Wolf. Other small predators such as Fisher, Gray Fox, Long-tailed Weasel, and Bobcat are all found locally. While mice and rats are present, the most noticeable rodents in this habitat are squirrels and chipmunks, which feed heavily on the variety of cones readily found here. Abert's, Western Gray, American Red, Douglas's, and Northern Flying (IS) Squirrels, and Least and Yellow-pine Chipmunks are all common.

The bird communities are similarly diverse. Game birds like Mountain Quail, Dusky Grouse (IS), and Sooty Grouse are readily found. The American Goshawk is the top avian predator in this habitat. Northern Saw-whet Owl, Northern Pygmy-Owl, Long-eared Owl, Cooper's Hawk, and Red-tailed Hawk are also regularly found here. In the Sierra Nevada, this forest is the principal habitat of the California Spotted Owl (IS). Common resident birds like Brown Creeper, Pygmy and Red-breasted Nuthatches, Mountain Chickadee, and Steller's Jay are readily seen around campgrounds and picnic areas. This forest has a high diversity of woodpeckers: White-headed (IS), Hairy, Downy, Pileated, and Black-backed Woodpeckers, along with Red-breasted, Red-naped, and Williamson's Sapsuckers, can be found exploiting mixed-aged and burned forests. In the summer, inundated with breeding migrant birds, Montane Mixed-Conifer Forests come alive with song. Olive-sided (IS), Hammond's (IS), and Western Flycatchers; Golden-crowned Kinglet; Cassin's Vireo; Yellow-rumped, Townsend's, and Hermit Warblers; Western Tanager; and Black-headed Grosbeak all bring an extra splash of life and color.

Reptiles and amphibians are generally sparse, as is typical of montane environments in the west. However, rubber boas, California Mountain Kingsnake, Sharp-tailed Snake, Western Fence Lizard, and western alligator lizards (*Elgaria* spp.) all occur in the Sierra Nevada–Columbia Plateau subhabitat.

CONSERVATION: Both historically and currently, these forests have been among the most heavily logged habitats in North America. This, combined with changing fire regimes and fire suppression, has led to widespread destruction of one of the most common habitats in w. North America.

The Giant Sequoia (*Sequoiadendron giganteum*) is among the most iconic and endangered tree species of this habitat. Many of the most massive Giant Sequoias were logged during the 19th century, and many more have been lost as a result of fire suppression. The conservation damages have been twofold. First, “ladder fuels,” including brush, leaf litter, branches, and dead trees, which would regularly burn under natural regimes, have accumulated, resulting in massive, high-intensity fires in the early 21st century. These fires kill mature trees that would otherwise survive, and they frequently destroy the topsoil also. The 2020 Castle Fire in c. California was responsible for the loss of nearly 20% of remaining sequoias. Second, fire suppression has also eliminated the gentle, understory-clearing fires needed for Giant Sequoias to reproduce. Thick-barked mature Giant Sequoias easily survive low-intensity fires, and their serotinous cones open only after fire and germinate only in open, sunny environments. Recruitment (successful regeneration) of Giant Sequoias has been low for the past century. Drought is also a major concern.



Giant Sequoias are the largest trees on the planet.

NOAA/WIKIMEDIA COMMONS

The threatened California Spotted Owl has also declined due to the pressures of logging and fire. Additionally, this subspecies is facing increasing competitive pressure from invasive Barred Owls (see sidebar 1).

Thankfully, this is a widespread habitat with relatively few specialized species and little endemism—as such, it is generally of lower conservation concern. Much of this habitat is found in large national parks and other public lands. The best time to conserve a habitat is when it is still intact and abundant, and conservation of this habitat, hopefully, will be a priority before the situation becomes dire.

DISTRIBUTION: Montane Mixed-Conifer Forests are distributed widely throughout the temperate regions of the w. Nearctic. Ranging as far north as s. British Columbia, Canada, and south through the w. United States to n. Baja California, n. Sonora, and Chihuahua, Mexico, these forests can be found in all but the driest mountains and wettest coastal ranges. They reach their eastern extent in isolated patches in c. Montana and are bounded to the west by the Pacific Ocean. Montane Mixed-Conifer Forest typically grows at elevations between 2000 and 6000 ft. (600–1800 m), though it can be found significantly higher or lower at the extreme ends of its range. At the upper limits, it transitions to **MONTANE SPRUCE-FIR FOREST**, **LOGGEPOL PINE FOREST**, or **HIGH-ELEVATION PINE WOODLAND**. At its lower elevational limit, it is most commonly bordered by **PONDEROSA PINE FOREST** but also by **PINYON-JUNIPER WOODLAND**, **CALIFORNIA OAK SAVANNA**, **PACIFIC CHAPARRAL**, and **TEMPERATE RAINFOREST**. There are often broad ecotones at these elevational boundaries.

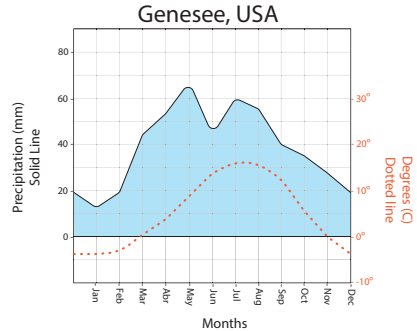
WHERE TO SEE: Yosemite National Park, California, US; Rocky Mountain National Park, Colorado, US.

Ne1E PONDEROSA PINE FOREST



IN A NUTSHELL: An open, grassy woodland dominated by Ponderosa Pine found at lower elevations in the mountain west. **Global Habitat Affinities:** MEDITERRANEAN DRY PINE FOREST; MIDDLE EASTERN DRY CONIFER FOREST. **Continental Habitat Affinities:** MONTANE MIXED-CONIFER FOREST; MADREAN PINE-OAK WOODLAND; PINYON-JUNIPER WOODLAND. **Species Overlap:** MONTANE MIXED-CONIFER FOREST; MADREAN PINE-OAK WOODLAND; LODGEPOLE PINE FOREST.

DESCRIPTION: Another archetypal forest of the west, Ponderosa Pine Forest is possibly the most abundant forest habitat in w. North America. Found in foothills and lower montane zones, this habitat is generally pleasant, mild, and fairly dry. Annual precipitation is around 15–20 in. (400–500 mm), though it can be slightly higher along the Pacific coast and Sierra Nevada. In the western part of the range, most of the precipitation falls as snow during the winter months, but in the Rocky Mountains, most of the precipitation comes as late summer monsoon thunderstorms.



Structurally, Ponderosa Pine Forest can range from a closed-canopy forest with little to no understory to an open, grassy savanna woodland. Historically, the open, grassy Ponderosa Pine woodland was the most common form this habitat took, but frequent, low-intensity fires are required to maintain this form, and many examples have become overgrown over the past century. Even the densest of Ponderosa Pine Forests should still feel quite open and provide a long line of sight. Ponderosa Pine Forests vary significantly in height; warmer, drier forests reach only 30–45 ft. (9–14 m), while those in the northern and especially western parts of the habitat's range can be towering, reaching heights of 70–120 ft. (20–35 m) with occasional trees over 200 ft. (60 m) tall.

The canopy is not particularly diverse and is always heavily dominated by Ponderosa Pine (*Pinus ponderosa*). Douglas-fir (*Pseudotsuga menziesii*), Limber Pine (*Pinus flexilis*), Two-needle Pinyon (*Pinus edulis*), Single-leaf Pinyon (*Pinus monophylla*), White Fir (*Abies concolor*), and various junipers (*Juniperus* spp.) can occasionally be found in the canopy but rarely as a major component.



Ponderosa Pine Forest is usually quite open, making it a pleasant habitat in which to camp and hike.

© BEN KNOOT, TROPICAL BIRDING TOURS

The understory in this habitat also tends to be negligible. Sapling Ponderosa Pines are often the most noticeable component. Small oaks can be an obvious part of the understory—particularly Gambel Oak (*Quercus gambelii*) in the east and California Black Oak (*Quercus kelloggii*) in the west. Other common shrubs include Antelope Bitterbrush (*Purshia tridentata*), ninebarks (*Physocarpus* spp.), snowberries (*Symphoricarpos* spp.), Bearberry (*Arctostaphylos uva-ursi*), Big Sagebrush (*Artemisia tridentata*), and buckbrushes (*Ceanothus* spp.). Historically, shrubs were almost completely absent, as the fire-return interval in this habitat was two to five years. A dense understory is a clear sign of an unhealthy Ponderosa Pine Forest.

In all but the densest Ponderosa Pine Forests, the ground layer is full of grasses and grasslike sedges. The grassy understory is the most diverse vegetative component of this habitat and varies widely throughout the range. Bluejoint (*Calamagrostis canadensis*), sedges (*Carex* spp.), fescues (*Festuca* spp.), Bluebunch Wheatgrass (*Pseudoroegneria spicata*), and gramas (*Bouteloua* spp.) are all major components of Ponderosa Pine Forest ground cover.

WILDLIFE: As largely transitional habitat, Ponderosa Pine Forests have a high abundance of wildlife from both higher montane forests and lower shrub habitats. Puma (Mountain Lion), American Black Bear, Gray Wolf, and Coyote are all present in this habitat. Smaller mammals like North American Porcupine, Bushy-tailed Woodrat, Rock Squirrel, various chipmunks, and Mountain Cottontail are also common. Abert's Squirrel is a Ponderosa Pine specialist, and the Kaibab Squirrel (IS) subspecies is endemic to this habitat. The open, grassy aspect of this forest makes it especially valuable as grazing habitat for Elk and Mule Deer, which are abundant here. Historically, Indigenous peoples used controlled burns to improve Ponderosa Pine Forests for grazing species.



Above: Despite its name, American Black Bear comes in a wide variety of color morphs including white, blond, cinnamon, and silver.

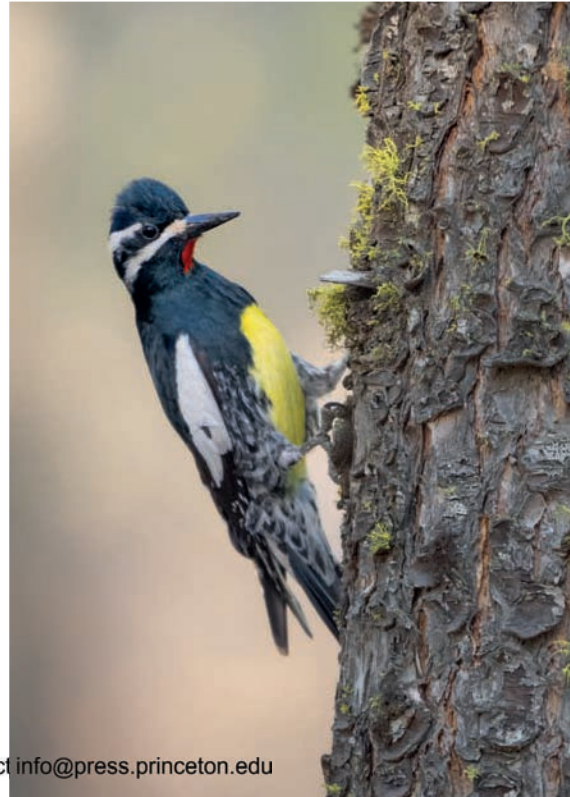
© DAVE SPANGENBURG

Right: Male (pictured) and female Williamson's Sapsuckers look so different from each other they were thought to be separate species for decades.

© BEN KNOOT, TROPICAL BIRDING TOURS

This traditional habitat management was adopted by cattle ranchers in the 19th and early 20th centuries before widespread fire suppression began. The large, loose sheets of bark found on Ponderosa Pines are great roosting habitat for bats, and Long-legged Myotis, Long-eared Myotis, Arizona Myotis, Big Brown Bat, Hoary Bat, and others are particularly abundant.

Ponderosa Pine Forest has few true obligates but sees a variety of birds from adjacent habitats. These forests also have a mix of forest and open-country species due to their savanna-like structure. Steller's Jay, Mountain Chickadee, Pygmy Nuthatch, Violet-green Swallow, Western Bluebird, Mountain Bluebird, Brown-headed Cowbird, Chipping Sparrow,



Grace's Warbler is strongly tied to Ponderosa Pine Forests in the s. Rockies. © PHIL CHAON

Red Crossbill, and Pine Siskin are all abundant. A wide array of woodpeckers—Downy, Hairy, Lewis's, and White-headed Woodpeckers as well as Northern Flicker and Williamson's Sapsucker (IS)—are frequently encountered. Among the Neotropical migrants utilizing this habitat are Broad-tailed Hummingbird (IS), Western Flycatcher, Western Wood-Pewee, House



Wren, Plumbeous Vireo, Western Tanager, and Yellow-rumped Warbler. Grace's Warbler (IS) is an abundant breeding bird in southern Ponderosa Pine Forests. Flammulated Owl (IS) breeds almost exclusively in Ponderosa Pine Forest. This small owl feeds heavily on insects and migrates to Mexico and Guatemala during the winter. Thanks to its propensity for tall trees and a soft low hoot that is difficult to pinpoint, Flammulated Owl can be devilishly hard to see, even in areas where it is abundant.

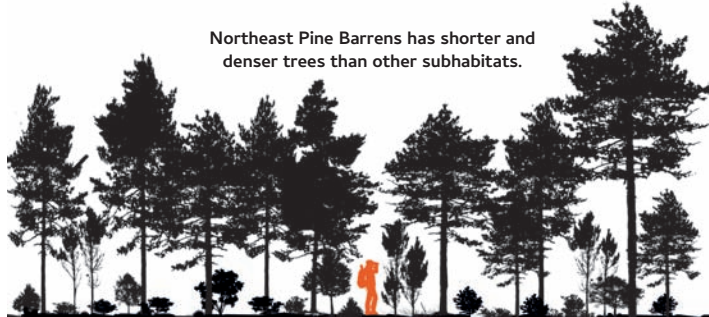
CONSERVATION: Ponderosa Pine Forest is widespread and supports few true specialist or endemic species. It faces many of the same problems confronting most western coniferous habitats—a long history of logging and a future with increased risks for fire, drought, and disease. Overgrown forests face elevated risks of fire and insect outbreaks and would benefit from a frequent low-intensity fire regime. Unlike most conifer forests in the west, Ponderosa Pine Forest suffers from overgrazing, which can be damaging for native grasses, allowing invasive species to intrude.

Flammulated Owl breeds primarily in this habitat and is a species of special concern. This owl requires large, mature trees with cavities for nesting. Areas with heavy logging rotations do not have trees of adequate size to support Flammulated Owls, American Goshawks, woodpeckers, and a variety of other species. Maintaining mixed-age stands with large trees, cavities, and snags should be a management priority for this habitat.

DISTRIBUTION: Generally found in foothill and lower montane environments, Ponderosa Pine Forest is arguably the most common forest type in the w. United States, stretching from Canada's Rocky Mountains in s. British Columbia to n. Mexico's Sierra Madre. Ponderosa Pine Forests are distributed in bands along the western regions of the Sierra Nevada and Cascade Mountains, as well as in multiple locations throughout the Rocky Mountains, including the Laramie and Bighorn Mountains of Wyoming, and in the Black Hills of South Dakota. The Ponderosa Pine woodlands within these areas occur in belts of varying widths, ranging from 5 to 25 mi. (8–40 km) wide, at elevations spanning from 500 to 9500 ft. (1500–2900 m). Ponderosa Pine Forest is replaced by **MONTANE MIXED-CONIFER FOREST** at higher elevations. At lower elevations, it grades into several habitats, including **PINYON-JUNIPER WOODLAND**, **SAGEBRUSH SHRUBLAND**, **FOOTHILL OAK SHRUBLAND**, and **CALIFORNIA OAK SAVANNA**.

WHERE TO SEE: Kings Canyon National Park, California, US; Kaibab National Forest, Arizona, US.

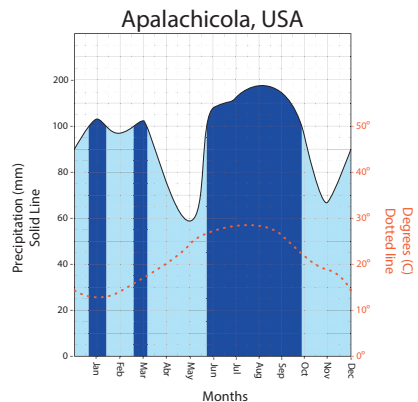
Ne1F EASTERN PINE SAVANNA



IN A NUTSHELL: An open, grassy pine woodland or savanna with poorly drained soils occurring on flat coastal plains and sc. US mountain ranges.

Global Habitat Affinities: **INDO-MALAYAN PINE FOREST.** **Continental Habitat Affinities:** **PONDEROSA PINE FOREST.** **Species Overlap:** **TALLGRASS PRAIRIE; TEMPERATE DECIDUOUS FOREST; TEMPERATE MIXED FOREST** (especially Appalachian Pine-Oak Forest); **FLORIDA SCRUB.**

DESCRIPTION: The Eastern Pine Savanna is a broad umbrella habitat that encompasses four major subhabitats with overlapping features. Throughout most of the range of Eastern Pine Savanna, winters are mild, and the temperature rarely drops below freezing. Summers are hot and humid, with daily highs around 90°F (32°C). Most of the rain falls in the spring and summer months, with 43–68 in. (1100–1750 mm) accumulating annually. In the Longleaf Pine zone, especially, precipitation from tropical storms and hurricanes in the warm months is an important seasonal feature. In the Northeast Pine Barrens, the winters are colder, and there is often long-lasting snow accumulation. Summers are somewhat milder but still hot and humid, especially in New Jersey, Delaware, and Maryland.



Throughout much of their range, Eastern Pine Savannas are open-canopied woodlands or savannas occurring on the low-lying coastal plains and in the Mississippi River valley of the se. United States. The tall, narrow-trunked pines that dominate the **Ne1F-1 Longleaf Pine Savanna** and **Ne1F-2 Shortleaf Pine Savanna** subhabitats generally grow to a height of 70 ft. (22 m), though occasionally as tall as 130 ft. (40 m). Under historical fire regimes, trees are widely spaced (100 ft./30 m apart) and do not form a solid canopy, allowing high light conditions that support an open understory of grasses and small shrubs. However, with fire-suppression practices, dense shrubby undergrowth encroaches, and it can make moving through unmanaged



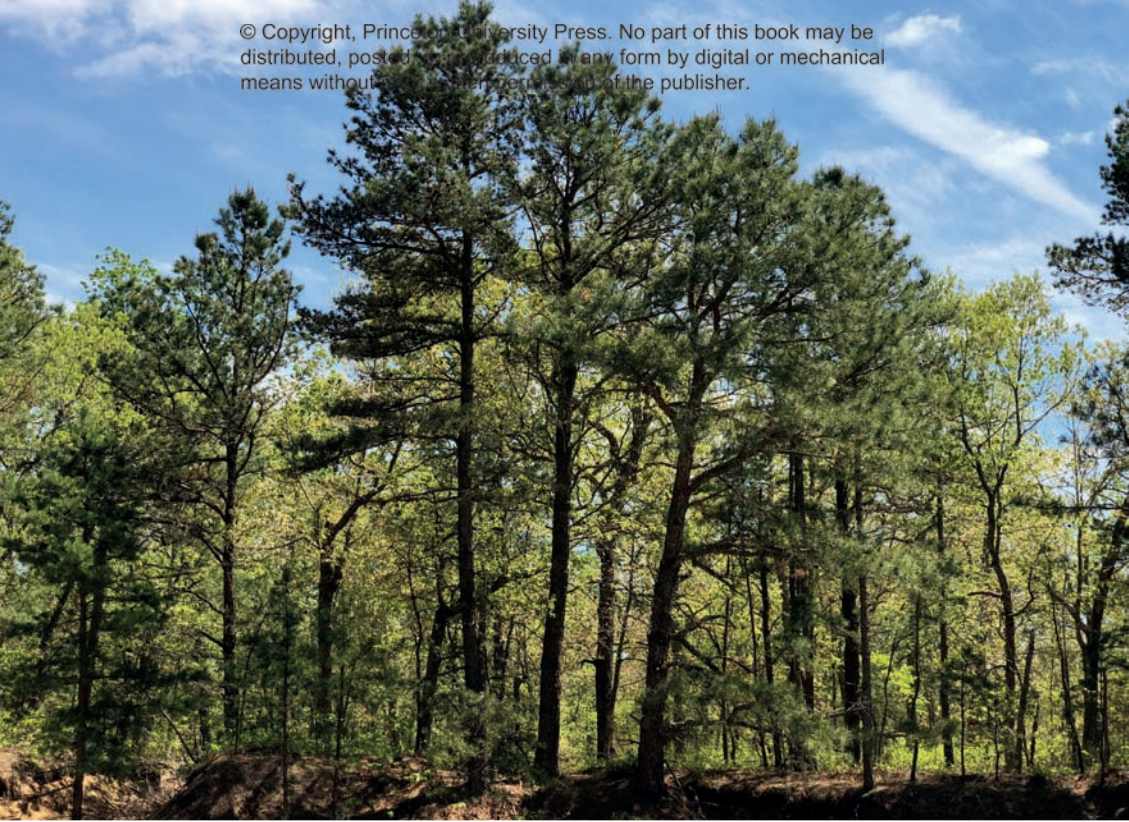
Pygmy Rattlesnake is a gorgeous but unobtrusive resident of the Longleaf Pine Savanna subhabitat.

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Regular fires are needed to maintain the open understory of Longleaf Pine Savanna.

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Northeast Pine Barren is the most restricted of the Eastern Pine Savanna subhabitats.

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savannas difficult. The **NE1F-3 Northeast Pine Barrens** subhabitat has a shorter and denser canopy and features a dense understory even under natural fire regimes. Because the soil is often poorly drained, all three subhabitats are dotted with wet grasslands, pitcher-plant bogs, and cedar swamplands. Swamplands dominated by Atlantic White Cedar (*Chamaecyparis thyoides*) are an especially important feature of the Northeast Pine Barrens.

The primary canopy tree is a major defining feature of each of these three major subhabitats. In Longleaf Pine Savanna the dominant canopy tree is Longleaf Pine (*Pinus palustris*), a fire-tolerant and slow-growing species. Shortleaf Pine Savanna is characterized by abundant Shortleaf Pine (*Pinus echinata*), and Northeast Pine Barrens mostly by Pitch Pine (*Pinus rigida*). Throughout Eastern Pine Savanna habitat, Slash Pine (*Pinus elliottii*), Sand Pine (*Pinus clausa*), Pond Pine (*Pinus serotina*), and Virginia Pine (*Pinus virginiana*) are all also present, though rarely co-dominant. Loblolly Pine (*Pinus taeda*) is a fast-growing but fire-susceptible species that often outcompetes and displaces Longleaf Pine in woodlands where fire is suppressed. Loblolly is also common around the wetter, boggy sections of Longleaf Pine Savanna and often replaces both Shortleaf and Longleaf Pine in managed **TREE PLANTATIONS**.

The midstory of Eastern Pine Savanna is generally sparse and includes Sweetbay Magnolia (*Magnolia virginiana*), Southern Wax Myrtle (*Myrica cerifera*), Sweetgum (*Liquidambar styraciflua*), and Red Maple (*Acer rubrum*). Shortleaf Pine Savanna and Northeast Pine Barren subhabitats often have a diverse array of oaks (*Quercus* spp.) and hickories (*Carya* spp.), which create a significant midstory and occasionally join the canopy, especially in the Ouachita and Ozark Mountains.

The shrub layer is variable, and density is largely dependent on the frequency of fire. Saw Palmetto (*Serenoa repens*) or Dwarf Palmetto (*Sabal minor*) is present in all but the northernmost Eastern Pine Savannas. The shrub composition varies widely across the range, but Shining Fetterbush (*Lyonia lucida*), Gallberry (*Ilex glabra*), tupelo or gum trees (*Nyssa* spp.), and various blueberries (*Vaccinium* spp.) are usually common.

The herbaceous layer of the Eastern Pine Savanna is by far the most diverse vegetative component. In frequently burned areas, the ground cover is dominated by three-awns (*Aristida* spp.), Little Bluestem (*Schizachyrium scoparium*), muhly grasses (*Muhlenbergia* spp.), and a variety of sedges (*Carex* spp.). Eastern Pine Savannas have a wide variety of orchids, including many rare and endangered species like Giant Orchid (*Pteroglossaspis ecristata*), Yellow Fringeless Orchid (*Platanthera integra*), and Eaton's Ladies-tresses (*Spiranthes eatonii*).

The poorly drained, acidic soils of the Eastern Pine Savanna are perfect conditions for the formation of **Pocosins**, or evergreen shrub bogs. These peat-forming wetlands (see **BOREAL BOG AND FEN**) are an important component of Eastern Pine Savannas and support the vast majority of Nearctic carnivorous plant species, including a diverse array of pitcher plants (*Sarracenia* spp.), sundews (*Drosera* spp.), and bladderworts (*Utricularia* spp.). The famous Venus Flytrap (*Dionaea muscipula*) is found nowhere else.

NE1F-4 Caribbean Pine Forest is a subhabitat that includes the s. Florida rocklands, Bahamian pineyards, and w. Cuban pine forests. This subhabitat is dominated by Slash Pine (*Pinus elliottii*) or Caribbean Pine (*Pinus caribaea*). Secondary canopy and understory components are frequently similar to those of Caribbean Hardwood Hammock (see **COASTAL HAMMOCK, CHENIER, AND WOODLOT**), and Gumbo-limbo (*Bursera simaruba*) and Poisonwood (*Metopium toxiferum*) are common here.

WILDLIFE: In much of the e. Nearctic, the mammal communities, especially of large and conspicuous mammals, are similar. Virginia Opossum, White-tailed Deer, Bobcat, American Black Bear, Striped Skunk, and Common Raccoon are all abundant and noticeable in Eastern Pine Savanna. The less widespread Nine-banded Armadillo favors this habitat, especially areas with well-drained, sandy soils. Invasive feral hogs are a common feature and cause great damage to sensitive understory plants and terrestrial fauna.

The bird community is more distinctive. Red-cockaded Woodpecker (IS), Brown-headed Nuthatch (IS), and Bachman's Sparrow (IS) are three pinewoods specialists that are rare to absent in other habitats. (All three birds are absent from the Northeast Pine Barrens subhabitat.) The endangered Red-cockaded Woodpecker nests in mature Longleaf and Loblolly Pine stands, where it excavates a nest cavity in a living tree. Under these nest cavities, the woodpecker drills a number



The otherworldly Venus Flytrap is found only in wet areas of Longleaf Pine Savanna.

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The endangered Red-cockaded Woodpecker is one of the only woodpeckers to nest in trunks of living trees.

© SAM WOODS, TROPICAL BIRDING TOURS



Brown-headed Nuthatch is often detected by its squeaky rubber ducky-like call.

© SAM WOODS, TROPICAL BIRDING TOURS

of sap wells, the sticky pitch from which helps deter snakes and other nest predators. Among the common e. Nearctic birds, Wild Turkey, Mourning Dove, Barred Owl, Red-bellied and Pileated Woodpeckers, White-breasted Nuthatch, Eastern Bluebird, Eastern Towhee, and Eastern Meadowlark are particularly abundant. This habitat is one of the few areas still containing stable populations of Northern Bobwhite. In summer, returning migrants make up a significant percentage of the avifauna. The abundant insect life provides food for Swallow-tailed and Mississippi Kites, Common Nighthawk, Chuck-will's-widow, Eastern Wood-Pewee, Great Crested Flycatcher, White-eyed Vireo, Blue-gray Gnatcatcher, Common Yellowthroat, Northern Parula, Prairie Warbler, Pine Warbler (IS), Indigo Bunting, Blue Grosbeak, and Summer Tanager. The Caribbean Pine Forest subhabitat is home to several regional endemics including the Olive-capped Warbler, Bahama Warbler, and West Indian Woodpecker. The critically endangered (potentially extinct) Bahama Nuthatch is found exclusively in this subhabitat. Kirtland's Warblers frequently winter in Caribbean Pine Forest in the Bahamas.

Reptiles and amphibians are perhaps the most exciting vertebrates found in Eastern Pine Savanna habitat. The endangered Gopher Tortoise remains mostly in Longleaf Pine Savanna, where it excavates large burrows, which are utilized by more than 300 other species of reptiles, mammals, invertebrates, and even birds: Bachman's Sparrows have been observed disappearing into Gopher Tortoise burrows when escaping predators. Among the more than 30 species of snakes in this habitat, the spectacular Scarlet Snake, imposing Eastern Diamondback Rattlesnake, dainty Pygmy Rattlesnake, comical Eastern and Southern Hognose Snakes, and endemic Pine Woods Snake (IS) are all regularly seen. Eastern Indigo Snake, the largest snake in the Nearctic, is also found here, though it is endangered. Eastern and Slender Glass Lizards, a pair of bizarre, legless, snakelike lizards, can be seen hunting for insects among the dry pine needles. There are dozens of amphibian species, with Reticulated and Frosted Flatwoods Salamanders, Striped Newt, Ornate Chorus Frog,

Pine Barrens Tree Frog (IS), and Carpenter Frog among the specialists. In 2018, a new species of aquatic salamander was described that lives in boggy flatwoods of sw. Alabama and nw. Florida; at over 24 in. (60 cm) in length, the Reticulated Siren is one of the largest salamanders in the world.

CONSERVATION: Eastern Pine Savanna is a habitat of high conservation concern and one of the most endangered habitats in North America. The combination of widespread habitat destruction, poor forest management, high diversity, and high levels of endemism create a system with many immediate threats. Across the habitat's range, less than 10% of each of the subhabitats remains intact. Major threats include urbanization, logging, insect and disease outbreaks, and fire suppression. Pine savannas are currently home to several hundred threatened or endangered plant species and dozens of rare insects. They are also the principal habitat for endangered birds like Bachman's Sparrow and Red-cockaded Woodpecker, as well as rare herps like Pine Woods Snake, Eastern Indigo Snake, Pine Barrens Tree Frog, and Reticulated and Frosted Flatwoods Salamanders.

Shortleaf Pine Savanna is the most widespread of the three major subhabitats but has also received the least ecological attention in terms of management and preservation. While it is still found in abundance, many remaining blocks of this subhabitat are highly degraded and largely interspersed with low-diversity tree plantations. High-quality Longleaf Pine Savanna is very rare, with less than 5% remaining. However, this habitat has received significant conservation attention, as management for Red-cockaded Woodpecker has focused on restoring Longleaf Pine Savanna. The management practices benefiting the woodpecker, especially frequent burns, tend to benefit other rare and declining pine savanna specialists as well. The Northeast Pine Barrens are the most heavily modified of the main subhabitats, absent throughout most of their former range, with very little remaining in any condition. However, nearly all the remnant Northeast Pine Barrens are found in well-protected areas with active management, and the future prospects for this habitat are good.

Caribbean Pine Forest is severely threatened by development and climate change. Most of the habitat in the s. Florida rocklands has been destroyed for commercial development. The largest remaining tracts in the Bahamas were severely damaged by Hurricanes Matthew (2016) and Dorian (2019). During these large storms, the last few Bahama Nuthatches were likely killed.

DISTRIBUTION: The Longleaf Pine Savanna subhabitat is found in low-lying areas of the se. US coastal plain, from Virginia south into much of peninsular Florida, west along the Gulf of Mexico to e. Texas, and north along the Mississippi River valley through Arkansas to far s. Illinois. The Shortleaf Pine Savanna subhabitat has extensive overlap with the Longleaf Pine Savanna. It tends to predominate farther inland and on sandier, more well-drained soils. This is a major habitat in the Ouachita and Ozark Mountains in Arkansas, Oklahoma, and Missouri. Shortleaf Pine also extends north into New Jersey on sandy soils relatively close to the coast. There is a long ecotone along the Atlantic coast where Shortleaf Pine Savanna blends into the Pitch Pine-dominated Northeast Pine Barrens. Extending up the Atlantic coast, the Northeast Pine Barrens subhabitat remains only in isolated pockets found in New Jersey, New York's Long Island, and Cape Cod, Massachusetts. The Eastern Pine Savannas are broadly bounded to the north by **TEMPERATE DECIDUOUS FOREST** and to the west by **TALLGRASS PRAIRIE**. The Northeast Pine Barrens are bordered to the west by Temperate Deciduous Forest and **TEMPERATE MIXED FOREST**. Caribbean Pine Forest is found in southern peninsular Florida, the Florida Keys, the Bahamas, and c. and w. Cuba. The montane pine forests found in e. Cuba and on Hispaniola are not included in this habitat.

WHERE TO SEE: **LONGLEAF PINE SAVANNA**—Apalachicola National Forest, Florida, US; Croatan National Forest, North Carolina, US. **SHORTLEAF PINE SAVANNA**—Poison Springs State Forest, Arkansas, US. **NORTHEAST PINE BARRENS**—New Jersey Pinelands National Reserve, New Jersey, US.

Ne1G HIGH-ELEVATION PINE WOODLAND



IN A NUTSHELL: Open, high-elevation coniferous forests growing on dry, rocky soils in the w. Nearctic.

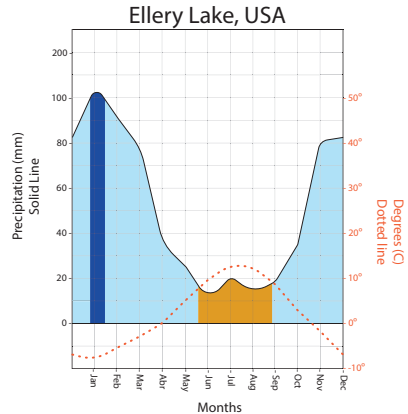
Global Habitat Affinities: EUROPEAN SUBALPINE

TIMBERLINE WOODLAND. Continental Habitat Affinities: MONTANE SPRUCE-FIR FOREST. **Species Overlap:** MONTANE SPRUCE-FIR FOREST; LODGEPOLE PINE FOREST; ALPINE TUNDRA; GLACIER AND SCREE.

DESCRIPTION: These sparse woodlands are found near timberline on dry, rocky ridges and slopes in the mountains of the w. Nearctic and are populated by only the hardiest of trees. The trees are short in stature, rarely exceeding 35 ft. (11 m) in height, and in persistent and intense winds are often reduced to the stunted form known as *krummholz*. In the zone where these woodlands are found, winters are long, and temperatures regularly go as low as -10°F (-23°C). In the hot, dry summer, daytime temperatures reach 90°F (32°C), though nighttime temperatures can still dip below freezing. Precipitation is generally scarce, with average rainfall ranging from 10 in. (250 mm) in Great Basin Bristlecone Pine woodland in Nevada to 35 in.

(900 mm) in Foxtail Pine woodland in California. This habitat is a stark and emblematic feature of the high-mountain west, and spending time here usually requires a hike through some stunning mountain scenery. While the vegetation presents no obstacles, the steep slopes and loose, rocky soil can make exploration difficult.

High-Elevation Pine Woodlands are open stands composed of five species in the white (five-needled) pine group that are often referred to as the “high five”: Great Basin Bristlecone Pine (*Pinus longaeva*), Rocky Mountain Bristlecone Pine (*Pinus aristata*), Foxtail Pine (*Pinus balfouriana*), Whitebark Pine (*Pinus albicaulis*), and Limber Pine (*Pinus flexilis*). With increasing elevation, tree size diminishes and distance between trees increases. Often these trees can grow only where they are sheltered from the wind by rocks or snow. Slow growth occurs at the base of the tree, which is often large and thick, and the vegetation is often shrublike and dense. The upper parts of these trees are gnarled and frequently devoid of bark, often appearing dead. These woodlands are generally monotypic, as each species has a disjunct range, though Limber Pine is occasionally mixed with the more restricted species. In parts of the n. Rocky Mountains and the Cascades, Alpine Larch (*Larix lyallii*) will also form open monotypic stands at the edge of timberline. However,





Certain Great Basin Bristlecone Pines are the longest-lived individual organisms known, reaching ages of 4,800 years or more. © RICK GOLDWASSER/WIKIMEDIA COMMONS (CC BY 2.0 DEED)

these larch woodlands lack the large-seeded cones of the high five and also lack most of the animals found in High-Elevation Pine Woodland.

There is no notable midstory, and the ground cover is mostly bare rock, with only 5–25% vegetative ground cover on average. The sparse ground cover comprises small woody shrubs such as manzanitas (*Arctostaphylos* spp.), mountain mahoganies (*Cercocarpus* spp.), junipers (*Juniperus* spp.), gooseberries and currants (*Ribes* spp.), and bitterbrush (*Purshia* spp.). Herbaceous ground cover is diverse, due to the wide elevational and geographic ranges covered by this habitat, but usually includes a few grasses, especially fescues (*Festuca* spp.). The high five are all considered keystone and foundational species that heavily influence the structure, diversity, and stability of high-montane communities and are major sources of food for alpine animals.

Some of these pines are impressively ancient—all high five species have specimens known to be over 1000 years old. Foxtail and Rocky Mountain Bristlecone can reach over 3000 years of age, and an individual Great Basin Bristlecone Pine, at a staggering 4900 years old, is considered the oldest single organism on the planet.

High-Elevation Pine Woodlands are extremely susceptible to fire, and even low-intensity fires cause widespread tree death. The wood of these trees is incredibly dense and resinous, which is an effective defense against most insects, but ignites quite easily.

WILDLIFE: A sparse and rocky habitat, High-Elevation Pine Woodland is home to relatively few animals. American Pikas live among the boulder-piled slopes, as do Yellow-bellied Marmots. American Ermine and Wolverine will utilize this habitat. Golden-mantled Ground Squirrel, American Red Squirrel, and Least Chipmunk all feed on the sizable seeds of Whitebark and Limber Pines.



Above: Clark's Nutcracker plays an important role in the propagation of High-Elevation Pine Woodland.

© BEN KNOOT, TROPICAL BIRDING TOURS

Left: Abundant cones with large seeds are a key food source for Golden-mantled Ground Squirrel in this harsh environment. © BEN KNOOT, TROPICAL BIRDING TOURS



Throughout the year, squirrels create large middens of pine nuts as a winter food source. In the fall, these stockpiles are often raided by American Black Bear and Brown (Grizzly) Bear, both of which reap a large caloric windfall at the squirrels' expense.

The bird communities at these elevations are made almost entirely of granivorous (seed-eating) species that survive on the ample pine nuts. Pine Grosbeak, Cassin's Finch, Red Crossbill, Gray-crowned Rosy-Finch, and Dark-eyed Junco are all regularly found in this habitat. Clark's Nutcracker is a major seed disperser in High-Elevation Pine Woodlands, and the survival of Whitebark Pine is especially dependent on it. An individual nutcracker will

fervently cache upward of 90,000 seeds in a single year, often in far-flung locations. While the birds remember the location of most seeds, forgotten pine nuts germinate to form woodlands on isolated peaks and after fires.

CONSERVATION: Many of the stands of ancient trees lie within protected federal lands, and because most of this habitat is found in remote and hostile environments, it is almost completely free from development. Yet, these slow-growing, long-lived woodlands are heavily threatened, despite their perceived toughness. Non-native White Pine Blister Rust has been decimating this habitat throughout the w. Nearctic, as have large outbreaks of Mountain Pine Beetle. These outbreaks have been especially damaging to Whitebark Pines, with many populations experiencing greater than 50% mortality. As a result, Whitebark Pine was listed as endangered in Canada in 2010 and the United States in 2022. Climate change and the continued march of lower-elevation habitats upslope also threaten to displace or consume these ridgetop species. High-Elevation Pine Woodlands are extremely dry and susceptible to increasing drought.

DISTRIBUTION: High-Elevation Pine Woodlands are scattered across the w. Nearctic, largely in the United States. The ranges of the individual tree species vary; the highly restricted Foxtail Pine is found in a few disjunct sites in California, while the widespread Whitebark Pine occurs in the Rocky Mountains, Cascade Range, Sierra Nevada, and the Great Basin ranges, from British Columbia south to Arizona and New Mexico. These forests grow only at higher elevations, occurring as low as 6000 ft. (1800 m) and as high as 12,000 ft. (3650 m). At their lower elevational limit, they are replaced by **MONTANE SPRUCE-FIR FOREST**, **MONTANE MIXED-CONIFER FOREST**, or **PINYON-JUNIPER WOODLAND**. At their upper elevational limit, they transition to **GLACIER AND SCREE**, areas of permanent snowpack, or **ALPINE TUNDRA**.

WHERE TO SEE: Ancient Bristlecone Pine Forest, California, US; Crater Lake National Park, Oregon, US; Lincoln National Forest, New Mexico, US.



NEIGH JACK PINE FOREST



IN A NUTSHELL: A woodland found on sandy soils in the upper Great Lakes states and Canada, dominated by Jack Pine and shaped by frequent fire. **Global Habitat Affinities:** **MAGHREB PINE FOREST**. **Continental Habitat Affinities:** **EASTERN PINE SAVANNA**; **LODGEPOLE PINE FOREST**. **Species Overlap:** **BOREAL CONIFER FOREST**; **TEMPERATE MIXED FOREST**; **TALLGRASS PRAIRIE**.

DESCRIPTION: Jack Pine Forest is a relatively restricted habitat found almost entirely on sandy soils in the upper Great Lakes region. While Jack Pine (*Pinus banksiana*) has a broad range and is an important component in **BOREAL CONIFER FOREST** and many northern **TREE PLANTATIONS**, this specific habitat is an early successional one, closely tied to fire.

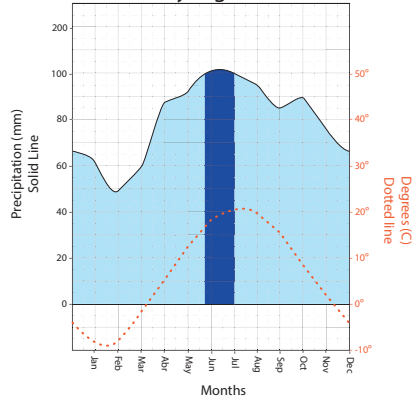
The canopy of this forest is almost entirely Jack Pine. Commonly acknowledged as a pioneer species in forest succession, Jack Pine is a small, short-lived species intolerant of shade. Jack Pines

typically live less than 100 years and are rarely more than 50 ft. (17 m) tall. Large mature trees of this size are usually fully integrated into **TEMPERATE MIXED FOREST**. Jack Pine Forest habitat is short, even-aged, and with low to moderate (20–65%) canopy cover. Trees are often patchily distributed, with small grassy openings between them. Other sandy-soil-loving trees may join the mix, especially Red Pine (*Pinus resinosa*) and Northern Pin Oak (*Quercus ellipsoidalis*).

The shrub layer here is sparse, and walking through these forests is generally quite easy. Serviceberries (*Amelanchier* spp.), Lowbush Blueberry (*Vaccinium angustifolium*), Common Juniper (*Juniperus communis*), and Sand Cherry (*Prunus pumila*) are all co-dominant shrubs in this habitat.

The ground here is usually open and sandy, covered with many lichens, low forbs, creeping shrubs, and grasses. The silvery, cloudlike forms of Reindeer Lichen (*Cladonia rangiferina*)

Grayling, USA



Regular disturbance is needed to maintain healthy Jack Pine Forest. © BEN KNOOT, TROPICAL BIRDING TOURS





Abundant in Jack Pine Forest during the summer, Common Nighthawks will congregate around ponds to drink and bathe. © PHIL CHAON

are an especially common sight. Typical ground-cover plants include Wintergreen (*Gaultheria procumbens*), Bearberry (*Arctostaphylos uva-ursi*), Grove Bluegrass (*Poa alsodes*), False Melic Grass (*Schizachne purpurascens*), sedges (*Carex* spp.), Sweetfern (*Comptonia peregrina*), and Bracken Fern (*Pteridium aquilinum*).

WILDLIFE: The mammals found in Jack Pine Forest broadly overlap with those found in **TEMPERATE MIXED FOREST**. White-tailed Deer, Eastern Cottontail, North American Porcupine, Bobcat, Gray Fox, and American Black Bear are all present.

The birdlife is significantly more divergent from surrounding areas. The open nature of this habitat is favorable for grassland and savanna species like Sharp-tailed Grouse, Short-eared Owl, Upland Sandpiper, Common Nighthawk, and Grasshopper, Vesper, and Clay-colored (IS) Sparrows. Other common birds include Northern Harrier, American Kestrel, Brown Thrasher, Nashville Warbler, Pine Warbler, Eastern Towhee, Brown-headed Cowbird, and Indigo Bunting. Brewer's Blackbird is also found here, well east of its principal range. Most importantly, Jack Pine Forest is the sole breeding habitat for the threatened Kirtland's Warbler. This bird prefers young stands of Jack Pine between 5 and 15 years old and no older than 20. These pine stands are usually 5–15 ft. (2–5 m) tall and have live branches near ground level. Kirtland's Warbler is a ground-nesting species, and these low branches provide important cover for nests and recently fledged birds. Due to the isolated and fleeting nature of Jack Pine Forest, Kirtland's Warblers breed colonially in high densities. Anecdotally, there have been a notable number of records of vagrant male Kirtland's Warblers in Jack Pine habitats in New York, Quebec, and Maine, far east of their normal breeding range.

Jack Pine Forest holds populations of reptiles associated with more southerly habitats, particularly Eastern Hognose Snake and Common Five-lined Skink.



The endangered Kirtland's Warbler nests only in young Jack Pine Forest.

© BEN KNOOT, TROPICAL BIRDING TOURS

CONSERVATION: Jack Pine Forest is rare and, due to the suppression of natural fires in its range, needs frequent management action to maintain it. By the mid-20th century, this habitat had nearly vanished. The passage of the US Endangered Species Act of 1973 and the strong link between Jack Pine Forest and Kirtland's Warbler eventually turned the tide for both bird and habitat.

There were as few as 167 male Kirtland's Warblers in 1974 when the species became one of the first listed under the Endangered Species Act. Early restoration efforts focused on the bird's breeding

habitat, by clear-cutting, burning, and planting Jack Pines in order to create young, even-aged stands. Controlling Brown-headed Cowbird parasitism and Blue Jay predation were also important management techniques. There are currently 188,000 acres (76,000 ha) reserved for Kirtland's Warbler habitat management in the Lower Peninsula of Michigan. Of this land, roughly 38,000 acres (15,000 ha) are maintained as young Jack Pine breeding habitat for the bird, with patches cyclically cleared and subsequently aging into mature timber. In 2018, the global population of Kirtland's Warbler was estimated at 2300 pairs, and the species was removed from the US endangered species list. However, Kirtland's Warblers still rely entirely on active management to create appropriate habitat, and without human intervention the species will quickly decline.

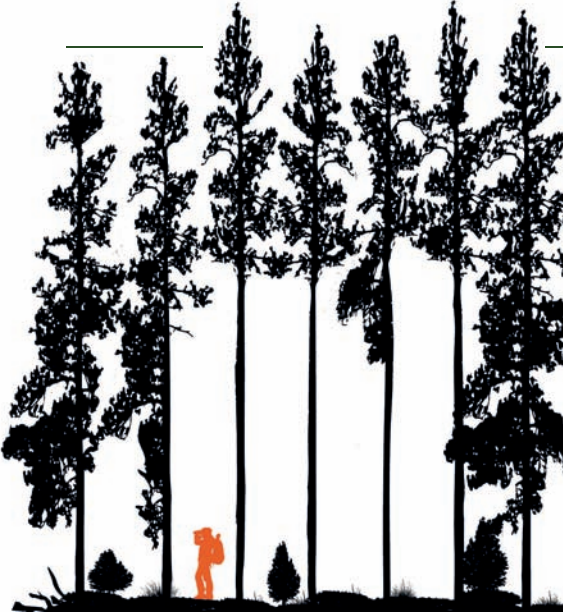
Modern management rarely uses prescribed burns due to difficulties controlling these fires and the relatively high levels of human habitation nearby. Jack Pine Forest is extremely rare as a naturally occurring habitat and mostly occurs as managed stands that blur the lines between natural habitats and **TREE PLANTATIONS**.

DISTRIBUTION: Jack Pine Forest habitat has largely disappeared over the past century due to fire suppression and today is found mostly in managed areas. Always patchily distributed, this habitat occurs in areas with regularly occurring fires at early seral stages. Currently, the habitat is largely restricted to the n. Lower Peninsula of Michigan; it also occurs in parts of Michigan's Upper Peninsula, Wisconsin, Minnesota, and adjacent Ontario. There are some sandy Jack Pine Forests found around e. Lake Ontario in New York and Quebec, though these are not regularly maintained. There are also small patches of analogous habitat in parts of Maine and New Brunswick, though they tend to lack the diagnostic faunal assemblage.

Interestingly, this habitat largely existed on the se. US coastal plain during the last ice age. It is likely that Kirtland's Warbler evolved during this period, wintering in the Bahamas and breeding in nearby coastal mainland sites. As the glaciers retreated, this habitat has migrated northward in patches of suitable sandy soils. Kirtland's Warblers have followed in turn.

WHERE TO SEE: Huron National Forest, Michigan, US.

Ne11 LODGEPOLE PINE FOREST



IN A NUTSHELL: A successional forest composed of uniformly aged Lodgepole Pines found at middle elevations in the mountainous west. **Global Habitat Affinities:** None.

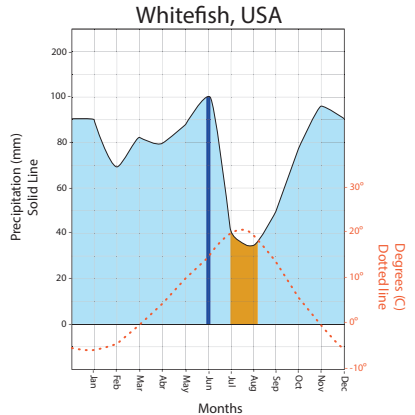
Continental Habitat Affinities: MONTANE MIXED-CONIFER FOREST; MONTANE SPRUCE-FIR FOREST. **Species Overlap:** ASPEN FOREST AND PARKLAND; MONTANE MIXED-CONIFER FOREST; MONTANE SPRUCE-FIR FOREST; HIGH-ELEVATION PINE WOODLAND.

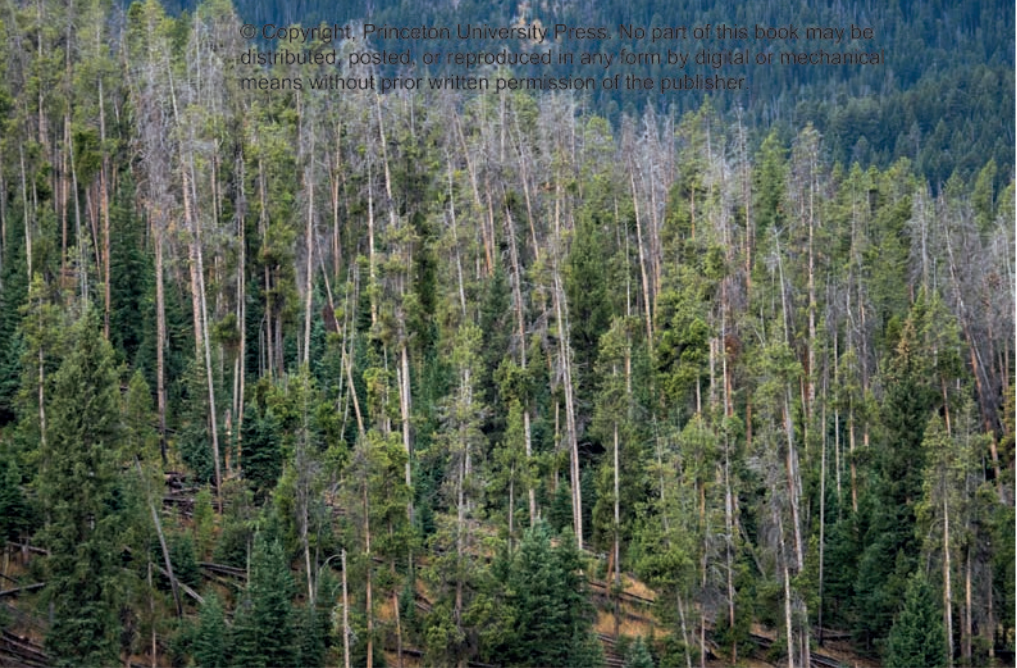
DESCRIPTION: Lodgepole Pine Forest is a common habitat in mountainous areas of the w. Nearctic. It generally occurs at 8500–10,000 ft. (2600–3000 m) in areas where the climate is wet and cool with a very brief frost-free period in summer.

Lodgepole Pine Forest is a near monoculture that colonizes after major fires or other large-scale disturbances. Characterized by dense stands of even-age Lodgepole Pines (*Pinus contorta*), this forest has few other canopy trees. The postfire forests, often called “dog-hair stands,” can reach incredible densities of 20,000 trees per acre (50,000/ha). If soil conditions are favorable, small pockets of other early successional trees like Quaking Aspen (*Populus tremuloides*) may be found.

The shrub and forb layers are also sparse and depauperate. Manzanitas (*Arctostaphylos* spp.), blueberries (*Vaccinium* spp.), buckbrushes (*Ceanothus* spp.), and Meadowsweet (*Filipendula ulmaria*) are the most common shrubs and can be abundant in early successional stages of this forest. Despite the relatively sparse understory, this habitat can be surprisingly difficult to move through. Exposed to frequent fire and high winds, the forest floor is often a maze of fallen trunks. Younger generations of Lodgepole Pines grow on top of old burns. Short forests with the burned trunks of previous generations still intact and standing are a common landscape feature.

Lodgepole Pine has fire-adapted serotinous cones, which open and release seeds only after exposure to fire or other heat. If left undisturbed, Lodgepole Pine Forest is replaced by **MONTANE**





In Lodgepole Pine Forest, the vast majority of trees are the same age and size. © BEN KNOOT, TROPICAL BIRDING TOURS

SPRUCE-FIR FOREST or **MONTANE MIXED-CONIFER FOREST**. But with the increased frequency and scale of fires in the w. Nearctic, the extent of Lodgepole Pine Forest has increased.

WILDLIFE: The high elevation, lack of floristic diversity, sparse understory, and intense fire associated with this habitat mean it is relatively wildlife-poor. There is enough food to support a variety of small mammals, especially during years with significant cone production. Conspicuous small mammals include American Red and Douglas's Squirrels, Least Chipmunk, Golden-mantled Ground Squirrel, and Snowshoe Hare. Elk, Mule Deer, and Bighorn Sheep will use Lodgepole Pine Forest for cover but spend significant periods of time here only in areas with developed understory. The same is true of American Black Bear, while smaller predators like American Marten and Long-tailed Weasel make use of this habitat throughout the year, and Wolverine uses it for hunting and denning in winter.

The bird communities of Lodgepole Pine Forest are similar to those of surrounding habitats but lack species that need dense understory or larger trees. Widespread species like American Robin, Hermit Thrush, Western Wood-Pewee, Canada Jay, Ruby-crowned Kinglet, Yellow-rumped Warbler, Dark-eyed Junco, Red Crossbill, and Pine Siskin are found here, as are high-elevation species like Clark's Nutcracker and Pine Grosbeak. In older stands, American Goshawk and Boreal Owl sometimes occur.

One notable feature of Lodgepole Pine Forest is the abundance of standing dead trees, which provide excellent habitat for cavity-nesting birds. With frequent fire and large die-offs caused by Mountain Pine Beetle, this habitat is heavily used by American Three-toed (IS) and Black-backed Woodpeckers. Other woodpecker species are also common, and secondary cavity nesters like Mountain Bluebird, Black-capped Chickadee, Merlin, and even Northern Hawk Owl take advantage of available cavities, normally a scarce resource.

Reptiles and amphibians are almost entirely absent from this habitat.

CONSERVATION: This is a habitat of low conservation concern for birds. The avian diversity is quite low, and all species are generalists or shared with adjacent habitats in some configuration.



Above: Red Crossbill has a bill specially adapted to remove pine seeds. The bill varies in size depending on the type of cone the local population is consuming.

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Left: American Three-toed Woodpecker is common in large stands of dead or burned Lodgepole Pine.

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Lodgepole Pine Forest aggressively colonizes areas after fire, and as mega-fires have increased in w. North America, this habitat has expanded in turn. Assessments predict this habitat to be quite resilient to climate change.

Historically, this forest was an important source of timber, as Lodgepole Pines tend to be very straight and uniform. The trees were heavily used for fence posts, railroad ties, utility poles, and as the name implies, the construction of houses.

DISTRIBUTION: This habitat occurs at middle elevations in the Rocky Mountains of Canada and the United States, from Alberta and British Columbia south through Colorado, and in the e. Cascades south through Oregon, along the Sierra Nevada, and on isolated mountaintops to s. California and Nevada.

WHERE TO SEE: Glacier National Park, Montana, US; Yellowstone National Park, Wyoming, US.

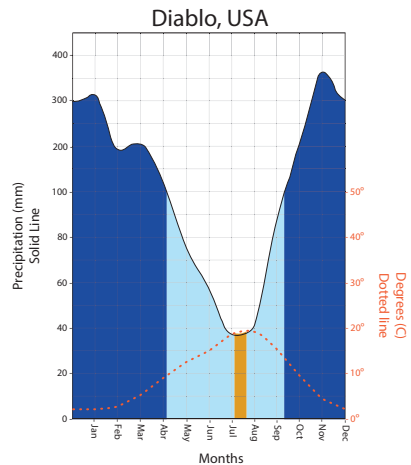
Ne1J NEARCTIC TEMPERATE RAINFOREST



IN A NUTSHELL: An extremely wet and mossy Pacific coastal coniferous forest with towering trees. **Global Habitat Affinities:** NEOTROPICAL MAGELLANIC RAINFOREST; NEOTROPICAL VALDIVIAN RAINFOREST. **Continental Habitat Affinities:** None. **Species Overlap:** MONTANE MIXED-CONIFER FOREST; MONTANE SPRUCE-FIR FOREST.

DESCRIPTION: Nearctic Temperate Rainforest, a towering forest laden with epiphytes, hugs a narrow strip along the Pacific coast of North America from c. California to Alaska. It is dominated by a few massive conifer species and has little midstory and a thick understory layer of ferns, mosses, and evergreen shrubs. Temperate Rainforest grows in a wet, stable climate, rarely colder than 32°F (0°C) and only occasionally warmer than 75°F (25°C) in a given year. Average precipitation is around 80 in. (2000 mm) per year, but some areas, such as the Olympic Peninsula of Washington, receive upward of 170 in. (4300 mm) annually. This habitat has two distinct seasons—a long, wet rainy season from October to May, and a short, dry, foggy summer from June to September. During the dry season, this forest receives 7–12 in. (180–300 mm) of precipitation from fog alone. Despite the heavy fog, this habitat is best visited from April to September, outside the worst of the winter rains.

The Temperate Rainforest is perhaps the most dramatic of the Nearctic habitats. The multilayered canopy, regularly soaring upward of 300 ft. (90 m), is dominated by Douglas-fir (*Pseudotsuga menziesii*), Sitka Spruce (*Picea sitchensis*), Western Hemlock (*Tsuga heterophylla*), Alaska Cedar (*Callitropsis nootkatensis*), and Western Redcedar (*Thuja plicata*). From the Oregon-California border south, Coast Redwood (*Sequoia sempervirens*) is co-dominant with Douglas-fir. The massive Coast Redwood can reach 380 ft. (115.8 m) in height and 29.2 ft. (8.9 m) in diameter,



placing it among the largest trees on earth. The towering canopy trees are often laden with epiphytic mosses, lichens, and ferns. Infrequently, small trees will sprout from the soils harbored on massive limbs high in the canopy.

Underneath is a sparse midstory layer made up of conifer saplings and smaller shade-tolerant deciduous trees like Bigleaf Maple (*Acer macrophyllum*), Vine Maple (*Acer circinatum*), and dogwoods (*Cornus* spp.). The forest floor, replete with fallen logs, usually supports a dense assemblage of Western Sword Fern (*Polystichum munitum*), Lady Fern (*Athyrium filix-femina*), rhododendrons (*Rhododendron* spp.), Salmonberry (*Rubus spectabilis*), Evergreen Huckleberry (*Vaccinium ovatum*), Devil's Club (*Oplopanax horridus*), Salal (*Gaultheria shallon*), and mosses. This thick, often saturated understory is mostly 3–6 ft. (1–2 m) tall and can be difficult to walk through.

These forests very rarely burn. In the drier, Coast Redwood–dominated forests, low-intensity fires would periodically clear out the understory. Redwood germination is associated with these fires, but the species is not a fire obligate.

WILDLIFE: The Temperate Rainforest is home to a large array of the Nearctic's charismatic megafauna. The diminutive Columbian Black-tailed Deer is common throughout the range, and Roosevelt Elk is found in large herds in the habitat's southern extent. Puma (Mountain Lion), Bobcat, and American Black Bear are common throughout, and Gray Wolf and Brown (Grizzly) Bear are still common in the British Columbia and Alaska stretch of the Temperate Rainforest. This stretch is also home to the Kermode Bear, a large subspecies of American Black Bear famous for having a spectacular white color morph, and the massive Kodiak subspecies of Brown Bear,

Coast Redwoods, the tallest trees on earth, dominate the southern Nearctic Temperate Rainforests.

© DAVE SPANGENBURG



which can reach 10 ft. (3 m) in length and upward of 1500 lb. (680 kg). Watching these bears fatten themselves on salmon along the Frazer Lake on Kodiak Island, Alaska, is one of the great North American wildlife spectacles. Apart from the megafauna, the Temperate Rainforest is also home to smaller predators like Fisher, American Marten, Gray Fox, and American Ermine. Other common mammals include Humboldt's Flying Squirrel (IS), American Red and Douglas's Squirrels, Townsend's Chipmunk, Common Raccoon, and numerous vole species, including the Red Tree Vole (IS), which spends its entire life in the canopy eating Douglas-fir needles.

The Temperate Rainforest's relatively limited set of birds includes a few specialties and some widespread but uncommon species. Many of the smaller songbirds utilize the upper stratum of the canopy and are best detected by ear. Band-tailed Pigeon, Brown Creeper, Golden-crowned Kinglet, Townsend's and Hermit Warblers, Red Crossbill, and Pine Siskin can all be found feeding hundreds of feet up in the massive canopy and are best looked for along the forest edge, where they will often venture to lower levels. Lower down within the forest is a nice variety of raptors, woodpeckers, corvids, and songbirds, including American Goshawk, Merlin, Red-breasted Sapsucker, Pileated and Hairy Woodpeckers, Northern Flicker, Western Flycatcher, Canada and Steller's Jays, Common Raven, American Crow, and Chestnut-backed Chickadee. Ruffed Grouse, Dusky Grouse, Pacific Wren, and Hermit, Swainson's, and Varied (IS) Thrushes are all common in the understory and perhaps more than any other set of birds contribute to the unique and haunting soundscape of this habitat. The two most famous avian residents are the endangered Northern Spotted Owl (IS) and Marbled Murrelet (IS), which are icons of the early 1990s campaign to protect this habitat. The Marbled Murrelet, the last species of bird in the United States to have its nest discovered, was found nesting on broad limbs high in the redwood canopy during the 1970s. These diminutive and fascinating seabirds nest exclusively in old-growth Temperate Rainforest but are most easily observed out on the open ocean.

The Temperate Rainforest region is also notable for the high diversity of endemic salamanders, including 19 species that are found almost exclusively in this habitat. This hub of amphibian diversity includes three endemic families—Dicamptodontidae (Pacific giant salamanders), Rhyacotritonidae (torrent salamanders), and Ascaphidae (tailed frogs). The Wandering Salamander is commonly found on the forest floor but may also live its entire life high up in the trees. One individual was spotted 200 ft. (60 m) up in a Coast Redwood, walking alongside a Marbled Murrelet nest.

The Olympic Peninsula forest is a small center of endemism, home to Olympic Marmot, Olympic Torrent Salamander, Olympic Mudminnow, and a dozen or so endemic insects.

The ethereal whistles of Varied Thrush are a common sound in Nearctic Temperate Rainforest.

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Marbled Murrelet nests on large limbs high in old-growth Nearctic Temperate Rainforest—the first nests were discovered in 1974!

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The Northern Spotted Owl was closely tied to the fight to save old-growth Nearctic Temperate Rainforest.

© PHIL CHAON



CONSERVATION: The massive timber of the Nearctic Temperate Rainforest made it a valuable commodity during the 19th century and most of the 20th, when huge tracts (especially of Coast Redwood forests) were lost to logging. Less than 10% of the historic Temperate Rainforest remains in California, Oregon, and Washington. Since the latter half of the 20th century, there has been a concerted public effort to conserve old-growth Temperate Rainforest, and most of the remaining old-growth tracts are found on protected public lands. Some of these massive tracts, including the Tongass National Forest of se. Alaska and the Great Bear Rainforest of British Columbia, cover millions of acres. These areas are still open to logging, and major timber sales do occur.

Apart from logging, these forests are particularly susceptible to drought. Climate-change-driven variations in average rainfall and maximum average temperature pose a major threat. Irregularities in the fog belt are of particular concern for Coast Redwoods.

Marbled Murrelet and Northern Spotted Owl are two endangered flagship birds associated with the movement to conserve this habitat. While their habitat is now largely protected, these populations continue to decline, probably because of other factors. Marbled Murrelet declines are

SIDEBAR 1

INVASIVE SPECIES: BARRED OWL

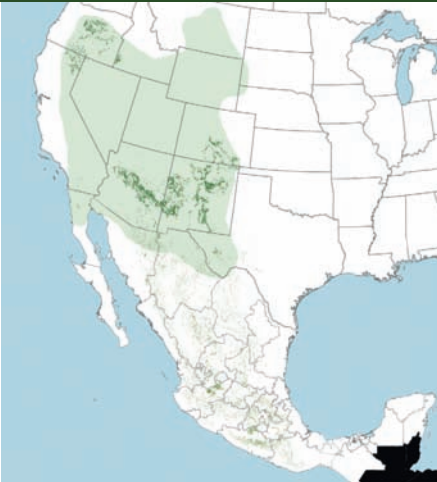
The term “invasive” is generally applied to species of organisms translocated by humans from their natural range of distribution to another. However, invasive species can also be native organisms that become harmful to the environment following anthropogenic changes to habitats. Removal of predators, changes to fire regimes, and introduction of foreign species can lead to major changes in the role of native species. One surprising example from the late 20th century comes from the westward expansion of the Barred Owl, a large and adaptable species of forested areas of e. North America. Barred Owls were not found west of the Great Plains until the early 20th century. It is theorized that a combination of fire suppression and planting of large trees in prairie environments allowed Barred Owls to spread across the plains and through the Canadian **BOREAL CONIFER FOREST**. Upon reaching forested environments in the west, Barred Owls have rapidly moved down the Pacific coast from British Columbia as far south as c. California. The arrival of Barred Owl has been one of two major sources of decline of its smaller congener the Northern Spotted Owl. Larger, more aggressive, and more generalist, Barred Owls have negatively impacted Spotted Owls through competition for territories and resources as well as occasional hybridization and direct mortality. The effects of the Barred Owl’s expansion on small mammals, amphibians, and other prey species remains poorly understood. In areas where lethal Barred Owl removal has taken place, there has been a corresponding increase in the survival rates of Northern Spotted Owls.

associated with rising ocean temperatures and declines in prey species. Increased human presence is also associated with larger corvid populations and increased nest predation. Northern Spotted Owl declines are largely associated with displacement by invasive Barred Owls (see sidebar 1). Efforts to remove Barred Owls are underway in some areas, with promising results.

DISTRIBUTION: The Temperate Rainforest stretches for nearly 2000 mi. (3200 km) along the Pacific coast of North America, from c. California through coastal Oregon, Washington, and British Columbia to the eastern end of Alaska's Kodiak Archipelago. Found in a series of Pacific coastal mountain ranges, it is bounded to the west by the Pacific Ocean and to the east by **MONTANE MIXED-CONIFER FOREST**. Water is the key limiting factor in this habitat, and Temperate Rainforest does not occur in any areas without sufficient rain and fog or with unfavorably high average temperatures. Temperate Rainforest is a fairly contiguous habitat where it occurs, only occasionally interrupted by intertidal **SALT MARSH**, **WESTERN RIPARIAN WOODLAND**, **ROCKY COASTLINE**, or **SANDY BEACH AND DUNE** habitats.

WHERE TO SEE: Humboldt Redwoods State Park/Redwoods National Park, California, US; Olympic National Park, Washington, US; Great Bear Rainforest, British Columbia, Canada; Tongass National Forest, Alaska, US.

Ne1K PINYON-JUNIPER WOODLAND



At higher elevations this habitat is dominated by pinyon species and is a taller and denser woodland.



At lower elevations this habitat is dominated by junipers and is open and savanna-like.

IN A NUTSHELL: An open woodland of pinyons (pines) and junipers found in arid habitats; includes elements of grassland and xeric shrub communities. **Global Habitat Affinities:** **MAGHREB JUNIPER OPEN WOODLAND; MIDDLE EASTERN JUNIPER FOREST.** **Continental Habitat Affinities:** **PONDEROSA PINE FOREST; OAK-JUNIPER WOODLAND.** **Species Overlap:** **SAGEBRUSH SHRUBLAND; PONDEROSA PINE FOREST; CHIHUAHUA DESERT GRASSLAND; CHIHUAHUA DESERT; OAK-JUNIPER WOODLAND.**

DESCRIPTION: Pinyon-Juniper Woodland is one of the major habitats of the Great Basin and broader intermountain west of the United States (and into Mexico). Occurring in a narrow elevational band, at 5000–8000 ft. (1500–2400 m), in dry mountains and foothills, this habitat

(continued...)

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