# Important Issues and Concepts

CHAPTER 6

Protecting wildlife habitats and vegetation communities is key in establishing and maintaining an ecologically robust and healthy interconnected system of natural areas and, in turn, protecting regional biodiversity, air and water quality, and other ecosystem services. Although plant communities and wildlife habitat are visible and tangible units, they are in turn affected by a variety of external processes and functions. When prioritizing conservation actions and identifying desired future conditions, it is important to consider the role that climate, fire, hydrology, pollination, anchor habitats, and habitat connectivity play in achieving conservation goals for ecosystems, watersheds, and the entire greater Portland-Vancouver region.

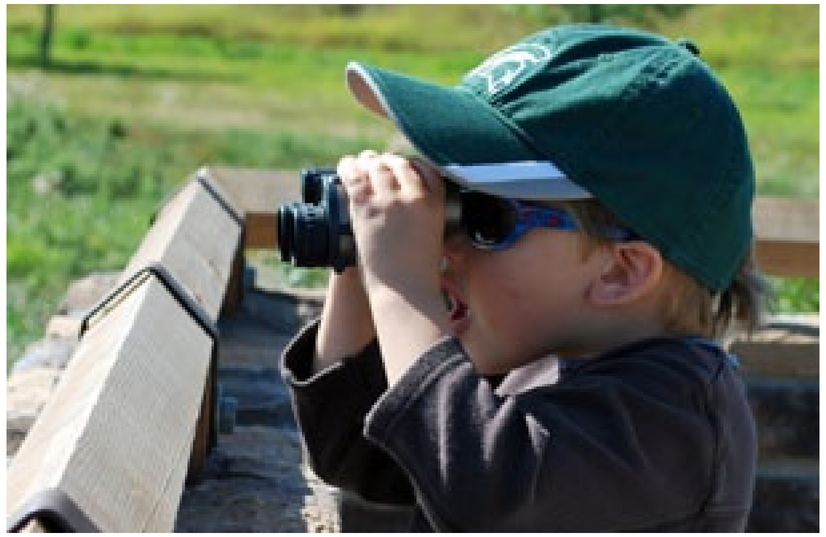
## Climate Change[1]

*Mike Houck, Urban Greenspaces Institute and Kaitlin Lovell, City of Portland*

Climate change will affect all aspects of conservation within the greater Portland-Vancouver region. That climate change already is occurring has been well documented. Over the last century, the Pacific Northwest has seen an increase in average temperature (by 1.5 degrees Fahrenheit), the loss of snowpack in the Cascades, and shifts in the timing and volume of stream flows. Projected changes to aquatic systems include changes in hydrology, water supply, and stream flows; reduced water quality; degradation of wetland ecosystems; and an increase in breeding grounds for waterborne diseases. The region can expect to have reduced air quality, along with higher average annual air temperatures and more frequent extreme heat events.

Current models predict that the region's terrestrial resources also will experience negative effects from climate change; these effects include increased incidents of short-term drought, increases in the frequency and intensity of wildfires, and more frequent landslides. There are likely to be shifts in the quantity and quality of fish and wildlife habitat and refugia for sensitive species. Generally, specialist species and species that require specific habitats or ecosystem processes may be more adversely affected by climate change than generalist species. It is likely that certain species' ranges will be further constricted, or

[1] This discussion is excerpted from a more in-depth piece written for the *Regional Conservation Strategy* (Chapter 5).



they will become locally extirpated; this is likely to be the case for species that rely on spatially limited habitats such as wetland, prairie, or oak savanna and species that depend on cold water, are not mobile, are capable of only limited mobility, have already been isolated, or already are at the edge of their range. The loss of these species will reduce the region's biodiversity. Conversely, generalist species, common species and habitats, and highly mobile species could benefit from climate change. Species that can migrate and are already in a hospitable environment are likely to expand their ranges.

There are also likely to be changes in interspecies interactions and life history timing, such as predator-prey relations, pollinator-pollen dependence, other food web dynamics, and, potentially, the timing of species' life cycles. Other impacts on the region's native fish and wildlife species may include loss of genetic diversity, shifts in species' gender balance, shifts in migration patterns and habitat range, an increase in invasive species, and increased fragmentation of biodiversity corridors and habitats.

#### Strategies for Maintaining the Resilience of Natural Systems

The cumulative and synergistic effects of climate change on both natural and built systems may be dramatic. According to the state of Oregon's framework on adaptation for fish and wildlife, immediate action is needed to proactively adapt to the predicted consequences of climate change. Potential impacts to climate change, both negative and positive, must be evaluated through the lenses of uncertainty; cumulative, synergistic effects; and scale, both temporal and geographic. The greater Portland-Vancouver region needs to produce a suite of solutions that are applied systematically to a range of problems. Above all, our responses should be based on the precautionary principle, which advises that, in the face of uncertainty, when an action could result in harm to human health or the environment, precautionary measures should be taken even if some effects have not been fully established scientifically. With these factors in mind, the following should be incorporated into all of the region's climate adaptation strategies:

- Protect the best and restore the rest. We should protect the region's best functioning natural systems and strategically restore degraded systems.
- Manage natural resources to allow for dynamics in the landscape—i.e., ensure that floodplains are allowed to expand in order to absorb the expected more frequent high flow events, fire regimes are allowed to function, and other changes in the landscape are allowed that accommodate the needs of natural systems.
- Protect and restore the natural diversity of habitat types and species. Apply ecosystem-based approaches to establish an effective network of terrestrial and aquatic habitats.
- Mimic natural systems and integrate their components into the built environment where possible and practicable.
- Integrate regional growth management strategies with local land use and water planning to proactively mitigate for and adapt to climate change.
- Develop and use the best available science.
- Incorporate back-up strategies and redundancy. Redundancy is a positive attribute of ecosystem management because it confers resilience. Multiple approaches should be pursued to ensure success. Fortunately, there are multiple ways to restore stream flows, reduce water temperature, and protect habitat.
- Use adaptive management. Incorporating monitoring and research into ecosystem management, continuously evaluate performance, and adjust responses accordingly.
- Seek solutions that yield multiple benefits. Adopt integrated approaches to maximize benefits.
- Share results and success stories. Strengthen communication within and between the environmental management and research communities through the Urban Ecosystem Research Consortium and Portland State University's expanding urban ecosystem research initiatives and improve communication with the general public through The Intertwine Alliance.
- Link the climate change adaptation strategies in this document and the *Regional Conservation Strategy* to the *Oregon Conservation Strategy,* Washington's Comprehensive Wildlife Conservation Strategy, and recommendations outlined in Oregon's guidance for adapting to climate change for the state's fish and wildlife.
- Build strong partnerships and coordinate across political and jurisdictional boundaries. This can be accomplished in part by increasing the diversity and number of partners in The Intertwine Alliance.

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http://www.ecy.wa.gov/climatechange/

Conservation in a Changing Climate
U.S. Fish and Wildlife Service
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http://wdfw.wa.gov/conservation/climate_change

## Fire

*Jonathan Soll, Metro*

Fire has played a pivotal role in shaping the vegetation of the western United States—nowhere more so than in the Willamette Valley and southern Puget Trough. Frequent fires (purposefully) set by people were responsible for the vast extents of prairie and savanna in the Willamette Valley and southern Puget Trough observed in the early and mid-19th century, and natural and anthropogenic fire was central in shaping the forest landscape. The end of widespread anthropogenic fire, the implementation of active fire suppression, and the replacement of fire by timber harvest as the primary method of regenerating forest has had profound impacts on the condition and distribution of fire-dependent habitats and the composition and structure of forests throughout the greater Portland-Vancouver region.

#### Effects of Fire on Prairie, Savanna, and Oak Woodland

Low-intensity fire helps maintain the structure of prairie, savanna, and oak woodland habitats by killing or suppressing small trees and shrubs, but it has little effect on large oaks, pines, and firs, which generally are able to withstand even moderate-intensity fire. Thus, historically, fire in what is now the greater Portland-Vancouver region resulted in a mosaic of prairie, savanna, and open woodland; these habitats occupied significant portions of the region when it was first surveyed and mapped around 1850. By exposing mineral soil, fire can create a favorable environment for the establishment of annual and perennial forbs among perennial grasses. However, the presence of non-native grasses in modern habitats complicates the use of fire in restoration; this is so because perennials such as velvet grass (*Holcus* sp), reed canarygrass (*Phalaris arundinaceae*), and bentgrass (*Agrostis* sp) and annuals such as cheatgrass (*Bromus* sp) and dog-tail (*Cynosurus* sp) can capitalize on the additional nutrients and growing space to increase their cover following fire, unless supplemental treatments are part of the restoration plan.

Although data are scarce, observations of the response of prairies and savanna to the cessation of fire suggest that frequent fire (i.e., every 1 to 10 years) must have played an important role in maintaining these habitats. Mid-nineteenth century residents of the region reported rapid development of shrubs and oaks in prairie and savanna. Evidence of the role of fire in maintaining prairies and savanna also exists in the many examples of formerly open-grown oak or fir trees that now are surrounded by younger, dense forests. These changes, together with the wholesale conversion of prairie and oak habitats to agriculture, Douglas fir forestry, and residential development, have resulted in the loss of more than 98 percent of former prairie and 85 percent of all oak habitat types in the Willamette Valley. Most of the remaining oak habitat in the Willamette Valley remains threatened with conversion to Douglas fir. The situation is most severe in the greater Portland-Vancouver region.

### Effects of Fire on Upland Forests

Before 1850, conifer-dominated forests also were shaped by fire. At that time fires covering many thousands of acres initiated and modified stand development in both the Coast and Cascade ranges and foothills. Vegetation data collected in the 1850s show that 16 percent of the region's forests had recently been burned. It is likely however, that even high-intensity, stand-replacing-type fires burned erratically, leaving unburned trees and patches of different ages in a mosaic across large landscapes. Full canopy closure following fire appears to have developed over several decades (creating valuable shrub habitat), and many biological legacies were retained from the burned forest, including large standing living, damaged, and dead trees and large fallen trees that served as habitat for a variety of species, from bacteria and insects to salamanders and woodpeckers. In drier forest types, especially those adjacent to prairie and savanna, it is likely that low-intensity fires kept stands relatively open, favored large individuals of fire-resistant species such as Douglas fir and Ponderosa pine, and helped maintain a diverse shrub community.

### Implications of the Modern-day Lack of Fire

The lack of fire in the modern landscape threatens the region's biodiversity and creates challenges for regional resource managers, in part because fire also represents a risk to valuable infrastructure, human lives, and livelihoods. However, without fire or management approaches that effectively mimic its impact, we will be unable to maintain a rich diversity of prairie, savanna, and open oak woodland habitats. In all habitats, the buildup of fuel loads in areas with a history of burning or a high chance of ignition creates a risk of higher intensity, so-called catastrophic wildfire, with the possibility of substantial losses of mature forest from the region's conservation portfolio and damage or destruction of valuable property.

### Strategies to Address the Need for Fire in the Landscape

- **Strategic use of prescribed fire.** In places where the risks associated with prescribed fire are reasonable (i.e. in larger, more isolated locations and where fire control infrastructure is good), resource managers should partner with local fire districts, federal agencies, and professional fire crews to execute safe, effective prescribed fires.

- **Community wildfire protection plans.** Cooperation between agencies and the public to develop and implement plans that address fire from many perspectives are an important element of capacity building and public outreach and education efforts.

- **Improved landscaping practices.** Creating fire-resistant landscapes around natural areas can reduce the chances of fires spreading into or from natural areas and increase the safety and effectiveness of fire control measures when fires occur.

- **Forest management with fire in mind.** Plans such as those developed by the City of Portland for Forest Park that integrate fire resistance and resilience into resource management plans will increase the likelihood that entire natural areas will not be lost to fire, and that, when fire does occur, it will provide benefits rather than be destructive.

- **Research fire alternatives.** Resource managers and academics should continue to develop, test, and report on alternatives to prescribed fire.

### Likely Effects of Climate Change

Although the future climate remains uncertain, models currently forecast wetter winters and drier warmer summers. Such a scenario would increase fire risk and heightens the need for the strategic measures identified above.

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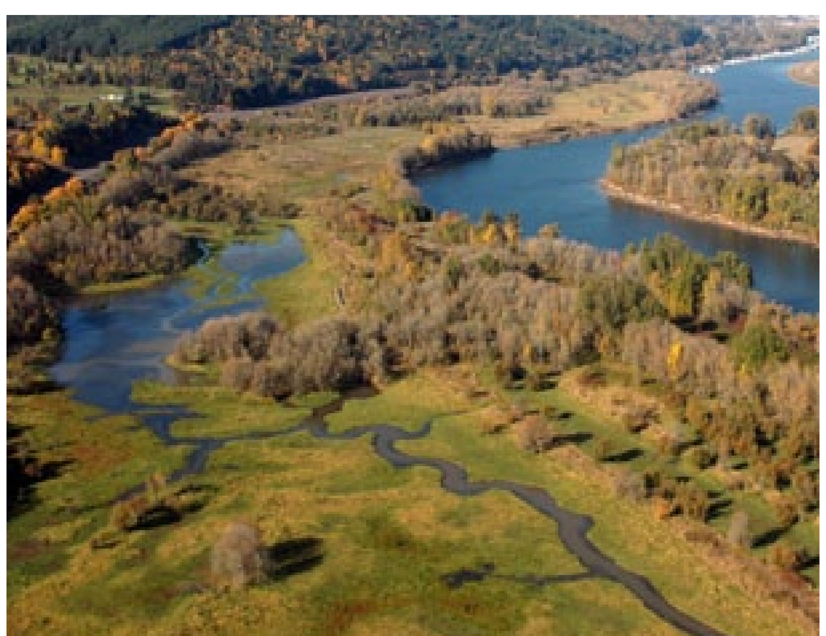
## Floodplains and Hydrology

*Lori Hennings, Metro, and Leslie Bach, The Nature Conservancy*

Floodplains are low-lying lands adjacent to streams or rivers that become inundated during periods of increased streamflow caused by heavy rainfall and rapid snowmelt. Floodplains sometimes extend a significant distance from the main channel to outlying areas along the stream, depending on topography. The degree to which a given floodplain is active depends on season, climate, precipitation, soil characteristics, and local topography. Legally, floodplains are defined by the Federal Emergency Management Agency based on the expected extent of water in flood that reaches a particular elevation, typically that of a 100-year or 500-year flood event.



In practical terms, floodplains store floodwater, thus reducing the intensity of flooding downstream and increasing the quantity of water available late in the season. By passing water through the ground, floodplains contribute to water quality protection and cooling.

The hydrologic cycle (or the hydrology of an area) is synonymous with the water cycle and describes the occurrence, pattern, timing, distribution, movement, and properties of water and its relationship with the environment. When hydrologic patterns are altered, so too are water bodies and floodplains.

In general, small streams high in a watershed lack floodplains and have limited riparian areas. Further downstream, where the topography is generally less steep, small floodplains may form and riparian areas widen. Stream channels are formed, sustained, and changed by the interaction of the underlying geology and landform with the water, sediment, and organic material they carry. During the dry season, water tables near the surface sustain stream flow. When streams join to form larger rivers and these rivers reach low elevations with relatively flat topography, large floodplains may form that are subject to periodic water inundation. Annual flooding plays a major role in the productivity of and biological interactions in river-floodplain systems.

The diverse plant and animal communities that live in or depend on floodplains are adapted to and may depend upon unique hydrologic conditions. Floods disturb vegetation, deposit sediments, and store surface and groundwater to create changing but more or less stable conditions, because the disturbance is regular. The dynamic equilibrium of floodplain inundation and draining may be disrupted by human activities, causing a loss of important functions.

### Altered Hydrology

Under pre-settlement conditions, lowlands in the greater Portland-Vancouver region were subject to high water and frequent, widespread flooding in winter and early spring, with flows tapering through fall. Many areas of the region had extensive active floodplains, especially the lower elevation portions of the Tualatin, Molalla-Pudding, and lower Columbia rivers, the confluence of the Columbia and Willamette rivers, and the mainstem Willamette near the southern edge of the region.

More recently, urbanization, agriculture, and timber harvest have altered historical floodplains and stream channel morphology, primarily through the loss of vegetation and soil permeability but also because dams, floodwalls, and levees have disconnected historical floodplains from the river. Dams are designed to store and release water in a controlled way, which can result in significantly altered flow and temperature patterns, reduced fish survival, and fish passage problems. Perhaps less appreciated are the changes to the low-water end of the hydrological spectrum. Dams operations can result in higher flows and changing temperature gradients during the spring and summer, which also affect fish behavior and riparian and floodplain vegetation. One consequence of failing to achieve adequately low flows is the failure to successfully establish cottonwood gallery forests.

Vegetation in floodplains slows and stores rainwater and upstream runoff, thus reducing the delivery of water downstream and allowing water to seep into the soil and recharge groundwater. Significant loss of vegetation loss allows water to run off quickly, causing erosion that widens and deepens stream channels as they accommodate high flows. This effect is exacerbated by the presence of impervious surfaces such as roads, parking lots, and buildings. The result sometimes is "flashier" streams, in which high water moves through the system quickly, causing localized flooding, while in the dry season the stream has low flow or dries out completely. The impacts of vegetation loss and impervious surfaces can alter stream structure and composition, increase pollutant loads, simplify habitat, and disrupt the river's connection to its floodplains. Such changes are cumulative within watersheds. In fact, studies have shown that increasing the amount of impervious (i.e., hardened) surface in a watershed reduces the number of aquatic macroinvertebrates in stream systems.

### Ongoing Threats

Altered hydrology, which can be caused by man-made barriers and development in floodplains and elsewhere in the watershed, can render a stream incapable of dispersing water, soil, and nutrients to the floodplain. Such changes do more than reduce the ability of floodplains to provide valuable water quality protection; they also can lead to greater flood damage to property and infrastructure. Solutions to the problem of altered hydrology are not easy, particularly in light of expected increases in the human population of the region. The impacts of altered hydrology are nearly ubiquitous, and most land use changes will not allow a return to natural hydrologic processes and conditions. This underscores the need to avoid further floodplain development wherever possible.

### Strategies to Improve Hydrology and Floodplain Function

- Continue thoughtful land use planning in and near urban areas. Plan new urban areas to minimize hydrologic alterations. Use zoning, stream corridor protection, and site design to protect streams, floodplains, wetlands, and wildlife habitat.
- Plan at watershed scales to protect and restore ecological processes and functions.
- Avoid development in floodplains (present and future). If such development is unavoidable, reduce impacts by limiting development to the higher elevations of the floodplain, reducing impervious footprint, and creating onsite stormwater storage.

■ Prioritize and reconnect isolated habitats by acquiring strategic properties and removing buildings, impervious surfaces, berms, levees, and floodwalls.

■ Retrofit developed areas for stormwater detention; develop and implement strategies to reduce the area of effective impervious surfaces and increase vegetation cover.

■ Increase riparian corridors and stream channel complexity through plantings, maintenance of native vegetation on stream and riverbanks, and the addition of large woody debris.

■ Engage in projects that help mimic natural flow conditions—e.g., "sustainable flow" dam management, water conservation, and purchase of floodplain easements and water rights for instream use.

■ In upper and middle watershed areas, use forest practices that leave riparian areas intact, reduce habitat fragmentation, and reduce sediment and chemical loads.

■ In mid-elevations, implement strategic land use planning and work with rural landowners, ranchers, and farmers to implement best management practices to increase vegetation and the width of riparian corridors, and to reduce the effects of agriculture on streams, rivers, and floodplains.

Stream and floodplain restoration can be complicated in human-influenced landscapes. Taking these approaches can add up over time to help stabilize hydrology and improve stream and floodplain conditions.

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## Pollinators and Pollinator Conservation

*Mace Vaughan, Xerces Society*

Pollination is the transfer of pollen within or between flowers, resulting in the production of seeds. In most cases pollen transfer is accomplished either by the wind or by an animal. More than 75 percent of plant species require insects to successfully move pollen between plants. The non-native European honey bee (Apis mellifera) is the most well-known insect pollinator, yet North America is home to more than 4,000 species of native bees, along with countless other pollinators such as butterflies, various beetles, flies, solitary wasps, hummingbirds, and other animals. Of these species, bees are considered among the most important to temperate North American terrestrial ecosystems.

### Importance of Protecting Pollinators

Pollinators are essential to our environment and economy. The ecological service that pollinators provide is necessary for the reproduction of nearly 75 percent of the world's flowering plants. Fruits and seeds that are derived from insect pollination are a major part of the diet of approximately 25 percent of birds and mammals, from red-backed voles to bears. In addition, insect pollinators are direct food for other wildlife species; for example, more than 90 percent of bird species require insects as a primary food source during at least one stage of their life. The conservation of biological diversity benefits from a framework that guides conservationists to work at multiple levels of the food chain. Pollinator conservation provides such a framework by focusing on the foundational elements of all terrestrial food webs—i.e., native plants and invertebrate communities.

Pollinators also play a key role in agriculture, enabling production of more than two-thirds of the world's crop species, whose fruits and seeds together provide more than 30 percent of our foods and beverages. The United States alone grows more than 100 crops that either require or benefit from pollinators. The economic value of insect-pollinated crops in the United States was estimated to be $20 billion in 2000. Oregon and Washington are among the world's largest producers of insect-pollinated crops, such as berries, tree fruit, alfalfa seed, and vegetable seed.

In many places, the essential service of pollination is at risk. Pesticide use and the loss, alteration, and fragmentation of habitat contribute to pollinator declines, especially in landscapes with high levels of urban or agricultural development. On October 18, 2006, the National Academy of Sciences released the report Status of Pollinators in North America, which called attention to the decline of pollinators and urged nonprofit organizations to collaborate with land managers to promote and sustain these important species.

### Native Pollinators in the Region

Located at the north end of the Willamette Valley and the south end of Puget Trough, the greater Portland-Vancouver region is home to at least 250 native bee species. Declines of a few of these species are well documented. The western bumble bee (Bombus occidentalis)—formerly one of the most common bumble bee species in Oregon—has declined dramatically in recent years and now is at immediate risk of extirpation throughout the western United States. Although an exotic disease has been implicated in the decline of the western bumble bee, pollinator biologists also recognize other factors, such as pesticide use and the loss, fragmentation, and degradation of natural habitat.

Beyond bees, the greater Portland-Vancouver region is home to other imperiled pollinators, such as the Fender's blue butterfly (Icaricia icarioides fenderi), whose dependence on the threatened Kincaid's lupine (Lupinus sulphureus subsp kincaidii) makes it critically vulnerable to extinction. (The lupine's range has become restricted to a handful of locations in western Oregon and

Washington.) In addition, several hummingbird species in the greater Portland-Vancouver region have experienced ongoing declines. Studies suggest that hummingbirds may require contiguous corridors for movement, even if the corridor is narrow.

The greater Portland-Vancouver region is home to a wide variety of pollinators. Bee species in the region include the mining, long-horned, bumble, sunflower, mason, leafcutter, sweat, carder, carpenter, and cuckoo bees. Butterfly species in the region include the swallowtail, painted lady, admiral, skipper, blue, ochre ringlet, duskywing, copper, hairstreak, and fritillary butterflies. Although the region's urban areas do not host the same diversity of pollinators as rural landscapes do, they are still places where beneficial insects can be abundant and conserved, and urban habitats play a role in pollinator habitat connectivity.

### Pollinator Conservation

Pollinator conservation is the protection, enhancement, and creation of high-quality habitat that supports important pollinators. Such habitat includes (1) diverse and abundant native shrubs and wildflowers that provide nectar and pollen for pollinators, (2) nesting habitat, such as areas of bare or semi-bare ground for ground-nesting bees, hollow pithy stems and beetle-riddled snags for tunnel-nesting bees, and snags, brush piles, rock piles, and abandoned rodent nests for bumble bees, and (3) larval host plants for butterflies and moths.

The time is right for pollinator conservation in the Portland-Vancouver region. Over the past 3 years, the widespread declines in honey bee colonies from colony collapse disorder have been covered extensively in the media. The decline of both honey bees and native bee and other insect pollinator species makes it imperative that natural resource agencies work with diverse public and private partners to actively incorporate the needs of wild native pollinators into land management efforts and goals.

It is likely that the region's open habitats such as meadows, prairies, oak savanna, and forest understories have been proportionately most affected by changes since 1850. Both wet and dry prairies have been nearly eliminated from the region, and the amount of early successional forest dominated by shrubs and flowering plants also has been reduced, as a result of changes in forest management and the dominance of invasive species in many unmanaged semi-natural areas. This has likely led to a commensurate decline in pollinator species that depend on the diverse flora of these once common habitats.

Implementing pollinator conservation measures means creating landscapes that support a greater diversity and abundance of bees, butterflies, hummingbirds, and other pollinators. A robust system of natural areas in the region can serve as pollinator refuges and source habitats for adjacent landowners, gardeners, and farmers. The end result should be a landscape with an abundance of native plants known to provide pollen and nectar for bees; nectar for butterflies, flies, wasps, and hummingbirds; host plants for butterflies; and ultimately, a landscape with greater biodiversity.

#### Strategies for Pollinator Conservation

- Manage natural areas for the greatest diversity and abundance of pollinator-friendly plants, nest sites, and butterfly larval host plants. Land managers need to continue efforts to remove invasive species that eliminate diverse flowering plant communities. Although some invasive species (e.g., Himalayan blackberry) provide limited resources for pollinators, they do so at the expense of diverse native plant communities that can supply nectar and pollen for a greater variety of animals over a longer period of time.

- Develop incentive programs and partnerships that help the region's landowners to create pollinator-friendly, flower-rich habitats in natural and working landscapes.

- Educate urban and rural landowners on how to eliminate, minimize, and/or mitigate the impacts of insecticide use on pollinators.

- Emphasize the role of backyard habitat, green roofs, bioswales and other dispersed vegetation in pollinator connectivity.

- Educate urban landowners about the diversity of bees and other pollinators in the region.

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(Probably the best single volume on pollination and plant/pollinator relationships)

How to Reduce Bee Poisoning from Pesticides

H. Riedl, E. Johansen, L. Brewer, and J. Barbour. 2006. Oregon State University. Corvallis, OR. 25 pp.

(This publication discusses methods and techniques to protect bees from hazards associated with pesticide application. Tables provide specific information regarding toxicity of insecticides, miticides and blossom and fruit thinning agents to honey bees; to alfalfa leafcutting bees; to alkali bees; and to bumble bees.)

*The Butterflies of Cascadia*
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## Patch Size and Anchor Habitats

*Lori Hennings, Metro*

Habitat area, or patch size, is one factor that determines the conservation value and wildlife use of a given area. Although patch size requirements vary from one species to the next, there is wide agreement among conservation biologists that conserving relatively large areas that meet the needs of many species is an important part of a successful regional conservation approach. In fact, relatively large patches are sometimes referred to as "anchor habitats" because they not only sustain populations of many species over long time periods, but, if connected to smaller areas, can help repopulate areas where species have become locally depleted.

Large habitat patches tend to have fewer edge effects[1], support more wildlife species per unit of area, and can accommodate area-sensitive species that require relatively large home ranges. What constitutes a "large" habitat patch depends on factors such as the species in question, habitat type, setting (e.g., urban, agriculture, or rural), and geographic region.

The value of a habitat patch to a given species depends not just on size, but also on its shape and relationship to surrounding habitats. For example, the streaked horned lark—a grassland species that has declined precipitously in the region—uses a relatively small breeding territory, but it selects territories within much larger areas that lack tall structures such as trees or buildings. Some area-sensitive species may be able to use habitat patches that are individually too small by composing a home range made up of multiple habitat fragments. Pileated woodpeckers, particularly in the non-breeding season, may be one species in the region that does this.

The typical patch size of every natural habitat type in the region has, on average, been reduced compared to historical conditions. Vegetation maps generated from data collected during land survey work done by the General Land Office between 1851 and 1895 show large blocks of forest, wetland, prairie, and riparian areas. Forested habitats have lost extensive acreage, but wetlands, oak woodlands, and prairies have proportionately lost much more (see "Habitat Change in the Region, 1850-2010" in Chapter 2). The result has been widespread fragmentation of habitat and smaller, more isolated habitat areas.

Research suggests that the size of habitat patches may even influence human health. A Portland, Oregon, study found that Hantavirus, which is spread by rodents and can be deadly to humans, was less prevalent in habitat patches with higher small mammal diversity, and that larger patches had higher diversity. A study of Lyme disease in the eastern United States showed similar results.

According to local field research conducted by Portland State University and Metro, in this region 30 acres (12 hectares) seems to be the minimum size at which habitat patches provide some of the wildlife species typically associated with "large" patches. In general, patches of this size are where area-sensitive small mammal and bird species and improved habitat conditions begin to appear. Studies elsewhere suggest a lower, 25-to 30-acre threshold for some species; this is the case in studies of birds in eastern England, understory insectivorous birds in the Amazon, birds across multiple seasons in Georgia, and headwater-associated amphibians in northwestern California. Some species require much larger habitat patches, and anchor habitats that benefit a wide range of native species typically are much larger than 30 acres. For example, true interior old-growth forest habitat begins only at the center of a 100-acre circle.

Studies suggest that the following species in the region may be sensitive to habitat patch size during the breeding season:

- **Forested habitats:** Black-capped chickadee, black-headed grosbeak, brown creeper, Cassin's vireo, downy woodpecker, golden-crowned kinglet, hairy woodpecker, Swainson's thrush, hermit thrush, varied thrush, Pacific-slope flycatcher, pileated woodpecker, red-breasted nuthatch, red-eyed vireo, ruby-crowned kinglet, Steller's jay, Pacific wren, yellow-breasted chat, and several small mammal species, including the short-tail weasel, Oregon vole, northern flying squirrel, shrew-mole, white-footed mouse, Trowbridge's shrew, vagrant shrew, Douglas squirrel, western gray squirrel, and Townsend chipmunk.

- **Grassland/ savanna/oak habitats:** Northern harrier, short-eared owl, western meadowlark, streaked horned lark, and white-breasted nuthatch (also need large oaks).

[1] Edge effects also depend on shape; see Chapter 7, "Biodiversity Corridors," in the *Regional Conservation Strategy* for a more thorough discussion.





Large or anchor habitat patches benefit many of the region's most sensitive species and are vitally important to retaining the region's biological diversity. They are also likely than smaller habitats to be more resilient to the negative impacts of climate change. However, the value of even relatively large patches is enhanced by increasing overall landscape permeability: the more vegetation in urban areas, the more permeable the landscape. Anchor habitats in a more vegetated setting are likely to hold more species and more animals than large patches embedded within an entirely urban matrix. Smaller habitat patches, backyard trees and shrubs, street trees, rights-of-way, and green roofs all can provide valuable opportunities to increase landscape permeability, thus enhancing the value of anchor habitats.

### Strategies for Maximizing the Effectiveness of Large or Scarce Habitats

- Protect or expand existing patches.
- Limit the area of edge habitat through strategic restoration (e.g., strive for more round or rectangular shapes).
- Connect habitat patches with well designed and strategically located corridors.
- Enhance areas surrounding habitat patches by adding vegetation, especially shrubs and trees.

#### FOR MORE INFORMATION

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## Biodiversity Corridors and Connectivity[1]

*Nathan Poage, Clackamas Stewardship Council; Shannah Anderson, City of Portland; and Lori Hennings, Metro*

Biodiversity corridors are key landscape elements that provide and increase connectivity between habitat patches, thus allowing species to disperse from natal areas, escape predation, locate better habitat, find a mate, or access habitat they need at various times. Biodiversity corridors are not necessarily continuous and are best defined by functionality. Corridors often follow streams but may also consist of greenways, hedgerows, or other features that add more natural character to developed or agricultural landscapes.

Over time, the loss of habitat, forest structural diversity, and downed wood reduces connectivity, thus altering wildlife populations and contributing to local species extirpations. These losses are common in urban areas. Longer isolation means fewer species. Corridors help maintain genetic diversity, allow locally extirpated species to recolonize, and increase the likelihood of species persistence. Without explicit yet broad-scale planning, connectivity tends to be haphazard, accidental or absent.

### Characteristics of Effective Corridors

Corridor function is affected by length relative to target species movement abilities, the number of gaps or barriers and habitat quality, including corridor width. Surrounding matrix features (e.g., urban or rural) also influence corridor value. Several corridors are more effective than a single option.

Wide corridors can increase animals' movement rates between patches and accommodate larger animals and more species. The key is to provide connectivity between populations and prevent reproductive isolation. Selecting focal species for each habitat area and planning for the species with the most rigorous corridor requirements can accommodate the needs of a variety of species. More specific corridor needs for different classes of animals are described below.

### CORRIDOR NEEDS OF FISH

The greater Portland-Vancouver area provides habitat for dozens species of native fish, including at least seven anadromous salmonid species. Salmonids depend on stream corridors with cool water, dissolved oxygen, invertebrate prey, and instream features such as pools, riffles, gravel beds, and off-channel habitat. Large wood is an important aspect of habitat; its documented loss in urban streams degrades fish habitat quality.

It is important to provide cold-water refugia for fish in the region's major rivers, which both the Oregon Department of Environmental Quality (DEQ) and Washington Department of Ecology have identified as having water temperature problems. (In 2006, DEQ issued a total maximum daily load [TDML] for temperature, mercury, and fecal bacteria for the Willamette River). Remedies include creating off-channel cold water fish habitat, planting vegetation, reducing pollutants, improving fish passage, and reducing erosion and sediment inputs to streams. Fish passage projects offer excellent and sometimes inexpensive ways to improve wildlife connectivity. For example, a shelf or boulders in a culvert can allow small animals to pass during high water

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### CORRIDOR NEEDS OF TERRESTRIAL WILDLIFE SPECIES

Connectivity research varies widely by geographic area and species, but it is clear that narrow corridors, hedgerows, field margins, fencerows, and street trees can improve connectivity for some animals, such as songbirds, pollinating insects, and small mammals. However, it is likely that many of the region's species require wider movement corridors. In general, birds are most mobile and can travel along many types of corridors, mammals have a diverse range of corridor needs, and reptiles and amphibians have the most difficulty finding connectivity between habitats.

For many species, corridors link different habitat types (such as aquatic and terrestrial) that are important to the species' life history requirements. For species that are highly susceptible to human disturbance, corridors should be wider, limit or exclude trails, and be placed away from busy roadways. Some species such as butterflies and bluebirds depend on open habitat and may be best accommodated by early successional corridors embedded within a forested matrix.

Research suggests that large habitat patches, connectivity, native shrub cover, and downed wood significantly improve habitat conditions for many wildlife species. Mobile species with large home ranges may not use available habitat if they are behaviorally sensitive to human activity or built features. For homeowners, leaving the property somewhat "messy," with leaves, woody debris, and snags, can improve onsite wildlife habitat. Within identified corridors or where road kill is a known issue, removing barriers and installing appropriate wildlife crossings can help maintain wildlife diversity in the region.

#### Amphibians

Of all the classes of animals, amphibians may be the most vulnerable to extinction because of habitat isolation and climate change. Amphibians have small home ranges and cannot travel as freely as other animals. Corridor habitat quality is particularly important for this group. Most amphibians require aquatic habitat, terrestrial habitat near water, and ample woody debris. It may be difficult or impossible for these species to navigate an urban matrix without functional corridors. Stormwater detention facilities are emerging as a key factor in wetland connectivity and provide regular feeding and breeding habitat for a variety of native amphibians. Passage between habitats can be enhanced with appropriate wildlife under-crossings and by augmenting cover. However, it will be necessary to continue to assess the quality and value of these facilities as amphibian habitats.

#### Reptiles

Reptiles are a diverse group that may require upland habitat, riparian habitat, or both, depending on species. Woody debris and rocks provide important habitat and connectivity for many species. Western pond turtles and painted turtles are susceptible to isolation because of their low reproductive rates and their need for both slow-moving water and uplands. Because females travel upland for nesting and move slowly, roads present a major barrier and mortality issue. Conserving, restoring, and creating wetlands and important nearby upland habitat will benefit turtles and many other species. Careful placement of woody debris, rocky substrate, and native plants can significantly enhance connectivity for reptile species.

#### Birds

Birds travel extensively along riparian corridors but can also use stepping stones such as backyards, hedgerows, field margins, and street trees. Species that prefer large areas sometimes require wider movement corridors, while habitat specialists sometimes require specific vegetation structure or composition to move well between

[1] This discussion is excerpted from a more in-depth piece written for the *Regional Conservation Strategy* (Chapter 5).

patches. Some birds seem reluctant to cross vegetation gaps wider than 50 meters. Increasing the amount of habitat distributed throughout the landscape and strategically addressing gaps within corridors and the matrix can help these species' movement.

#### Mammals

Many mammal species require complex habitat structure, good connectivity, access to water, and—particularly for small mammals—woody debris and a duff layer. Larger species tend to have larger home ranges and require wide corridors. Bats need snags and crevices and tend to move and forage along riparian corridors, including intermittent streams; they often roost in artificial structures. Bat-friendly habitats can be provided in new and existing bridges and other structures at little or no extra cost.

### Threats and Challenges

Sound planning that includes consideration for maintaining habitat connectivity is a critical challenge for protecting regional biodiversity, especially in the face of looming climate change.

Corridor efficacy is reduced by trails, roads and bridges, and invasive vegetation. Trails often run along the same narrow riparian areas as biodiversity corridors, roads and bridges can increase mortality and prevent wildlife passage, and invasive vegetation reduces habitat quality and requires expensive intervention and management. Narrow corridors may present issues such as predation, poor habitat conditions, invasive species, competition with generalist species, and human disturbance. However, research suggests that in many instances, a narrow corridor may be better than none. Many potential disadvantages of corridors can be avoided or mitigated through the use of wider corridors.

### Strategies for Improving Connectivity

Tools to improve connectivity include conservation/protection, restoration, and invasive species control. These are described in more detail in Chapter 7 ("Major Categories of Strategies") of this *Biodiversity Guide* and in Chapter 7, "Biodiversity Corridors," of the *Regional Conservation Strategy* for the Greater Portland-Vancouver Region. Other strategies to improve connectivity include the following:

- Protect large habitat areas and connections between them.
- Create wide rather than narrow biodiversity corridors.
- Identify and remove barriers to the movement of fish and wildlife.
- Increase the natural component of urban and other developed landscapes through native landscaping, green streets and other approaches.
- Combine biodiversity corridor protection or creation with other, non-ecological objectives (i.e., remove or avoid creating barriers to wildlife movement during road construction).

### FOR MORE INFORMATION

The following two citations both have comprehensive bibliographies.

*Wildlife Corridors and Permeability: A Literature Review*
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*Wildlife Crossings: Providing Safe Passage for Urban Wildlife*
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Additional resources can be found through the Washington Wildlife Habitat Connectivity Working Group: http://waconnected.org/