HABITAT:
CONSERVATION SUMMARIES FOR STRATEGY HABITATS

Photo © (left) Edward J. O'Neill; (right) Martin Nugent

Strategy Habitats were determined in a two-step process. First, maps of current vegetation were compared to those of the year 1850 to determine vegetation types that had high degrees of loss since European settlement. Vegetation types with a high degree of historic loss were evaluated for historic importance at the ecoregional scale, ecological similarity, amount of remaining habitat managed for conservation values, known limiting factors, ecological similarity and importance to Strategy Species. For more information on the methods used to develop the vegetation maps and determine Strategy Habitats, see Appendix IV.

Using 1850 provides a reference point to determine changes in vegetation since European settlement. It is a single point in time, so it does not

Key to ecoregion abbreviations:

BM = Blue Mountains
CP = Columbia Plateau
CR = Coast Range
EC = East Cascades
KM = Klamath Mountains
NBR = Northern Basin and Range
WC = West Cascades
WV = Willamette Valley

STRATEGY HABITATS	ECOREGIONS								COMMENTS
	BM	CP	CR	EC	KM	NBR	WC	WV	
Aspen Woodlands	X					X			
Coastal Dunes			X						
Estuaries			X						
Freshwater Aquatic Habitats	X	X	X	X	X	X	X	X	
Grasslands *(includes grass-dominated habitats such as upland prairie, Coastal bluffs, and montane grasslands)*		X	X		X		X	X	
Late Successional Mixed Conifer Forests			X		X		X		WC specifies Late Successional Douglas-fir Forests
Oak Woodlands			X	X	C[1]		X	X	Pine, Pine-Oak and Oak Woodlands are combined in KM
Ponderosa Pine Woodlands	X			X	C[1]				Pine, Pine-Oak and Oak Woodlands are combined in KM
Riparian Habitats	X	C[1]	X	X	X	X	X	X	Riparian and Wetlands are combined in CP
Sagebrush Habitats *(includes steppe and/or shrublands)*	X	X				X			
Wetlands *(includes all freshwater wetland types: ponds, marshes, wet prairies, vernal pools, bogs, lakes, swamps, etc.)*	X	C[1]	X	X	X	X	X	X	Riparian and Wetlands are combined in CP

C[1] = Combined

show how vegetation varied in the past due to fire, climate change or other factors. The 1850 maps represent a baseline for analysis and not a target to re-create. Returning to pre-settlement conditions is neither possible nor desirable. Instead, the baseline vegetation maps can provide insight into why certain species may be declining and can help determine priorities for restoration projects.

The number of Strategy Habitats per ecoregion range from four in the Columbia Plateau to seven in the Coast Range. Aquatic, riparian and wetlands were identified as Strategy Habitats for all eight ecoregions. Other common Strategy Habitats occurring in more than one ecoregion include grasslands, oak, ponderosa pine and sagebrush habitats. Strategy Habitats that occur in more than one ecoregion are usually affected by similar limiting factors, such as invasive species, conversion to other land uses, or altered disturbance regimes, particularly vegetation changes due to fire suppression

In this document, the term "fragmentation" is used to describe certain habitat characteristics at the landscape scale. Fragmentation can be thought of in two ways. First, habitat conversion results a matrix of unsuitable areas. For example, most of the grassland and oak woodland habitat in the Willamette Valley has been converted to agricultural, urban, and rural residential uses. The remnant grassland and oak woodland patches are small, isolated, and surrounded by unsuitable habitat for many species. Second, forest fragmentation has been defined as "the process of reducing size and connectivity of stands composing a forest." It may occur naturally through disturbance regimes or through human-caused activities. It may or may not be accompanied by habitat loss, depending on the specific forest habitat elements required by the species. It also may or may not serve as a barrier to movement, again depending on the requirements and mobility of individual species.

This section provides general descriptions, conservation overviews, issues and recommended approaches for Strategy Habitats. These are intended to be broad views of Strategy Habitats from a statewide perspective. Conditions will vary on the site, watershed, and ecoregional level based on differences in soil, climate, and management history. Local conditions will need to be considered when determining site-appropriate conservation actions.

Although this section presents a statewide perspective, Strategy Habitats were designated by ecoregion, based on historic habitat loss and other factors.

In addition, this section describes habitat data gaps and "Local and Specialized Habitats" that support particular species or represent important landscape features not adequately addressed through Strategy Habitats.

Photo © Bruce Newhouse

Photo © Dave Menke

Strategy Habitat: Aspen Woodlands

Ecoregions:

Aspen woodlands are a Strategy Habitat in the Northern Basin and Range and Blue Mountains ecoregions. However, aspen also can be found in the East Cascades ecoregion.

Characteristics:

Aspen forms woodland or forest communities, dominated by aspen trees with a forb, grass or shrub understory. Aspen generally occurs in areas which have additional moisture but are well drained, such as mountain slopes, rock outcrops and talus slopes, canyon walls, and some seeps and stream corridors. Aspen also can occur in riparian areas or in moist microsites within a drier landscapes. Characteristic understory grasses include Idaho fescue, pinegrass, Great Basin wildrye or blue wildrye, and shrubs include sagebrush, snowberry, serviceberry, and roses. Aspen habitats are dependent on disturbance, with fire and blowdown as the major disturbances. Aspen sprouts after fire and spreads vegetatively in large clones. With no disturbance, stands between 50-100 years old are replaced by other vegetation types. Aspen does not occur in the hottest, driest portions of the Northern Basin and Range ecoregion.

Conservation overview:

Aspen is on the edge of its range in Oregon and is more common further east in the Rocky Mountains and north into Canada. However, it is locally important in eastern Oregon, especially in the Northern Basin and Range and Blue Mountains ecoregions. In a landscape dominated by shrubs and grasses, aspen provide additional structure, useful as nest sites and hiding cover for wildlife. Aspen is a deciduous tree, and stands generally have high invertebrate prey diversity and densities. A suite of associated species, particularly songbirds, is entirely dependent on aspen. Aspen is important for birds in both migration and breeding seasons. It also provides fawning and calving habitat, hiding cover, and forage for mule deer and elk. Other wildlife that uses aspen include bats, black bear, beaver, rabbits, ruffed grouse, and blue grouse. Tree swallows, woodpeckers and other birds nest in cavities.

Aspen stands contribute to watershed health by serving as snowdrift banks. The stands accumulate snow in the form of drifts that melt slowly, releasing a steady source of water during warmer months that feeds springs and augments streams, benefiting terrestrial and aquatic species.

Throughout the west, there is concern about the loss of aspen habitats and the lack of aspen regeneration in remnant stands. Aspen stands often depend on natural fire to reduce competition from conifers and stimulate the growth of suckers from roots. In addition to the changes from fire suppression, uncontrolled grazing can prevent regeneration and invasive species degrade understories. Within a stand, the aspen trees are clones arising from an interconnected root system. While the root systems may last for thousands of years, individual trees may only live for 100-150 years. Many existing stands are reaching the end of their natural life cycle, and, without young aspen trees to replace them, the stands will be lost completely. Juniper encroachment is a significant threat to aspen between 5,000 and 7,000 feet.

Restoration of aspen habitats will require a landscape approach to restoration and management. One such large-scale approach is the Blue Mountain Habitat Restoration Project in Wallowa County. This project was funded in part by the Wildlife Conservation and Restoration Program, and partners include Wallow Resources, USFS, American Bird Conservancy, Blue Mountain Elk Initiative, Mule Deer Foundation, Rocky Mountain Elk Foundation, ODFW, and several private charitable foundations. The project is investigating cost-effective ways to maintain, enhance, and restore aspen habitats.

Limiting factors in Aspen Woodlands:

Factor: Altered fire regimes and juniper encroachment: Fire suppression has resulted in juniper encroachment and lack of reproduction in aspen clones.

Approach: Carefully reintroduce natural fire regimes using site-appropriate prescriptions (accounting for the area size and vegetation - characteristics that affect resiliency and resistance to disturbance). Use mechanical treatment methods (e.g., chipping, cutting for firewood) to control encroaching junipers, recognizing that reintroducing a disturbance regime may be necessary to reinvigorate aspen reproduction. Apply treatments with respect to time of season and location. If desired for songbird conservation, remove juniper tree skeletons following prescribed fire because they could be used as predator perches.

Factor: Lack of reproduction: In addition to fire suppression, historic overgrazing has limited reproduction in clones of aspen stands.

Approach: Changes in grazing timing and intensity have helped aspen reproduction in some areas. Use temporary ungulate exclosures to encourage reproduction at high priority sites.

Factor: Degraded understories: Invasive plants, introduction of non-native pasture grasses, and historic overgrazing has altered the understory of many aspen stands.

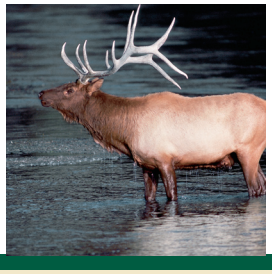
Approach: Control invasive plants using site-appropriate methods and reintroduce native bunchgrasses and flowering plants at priority restoration sites.

Factor: Fragmentation: While some aspen patches naturally occurred in isolated patches, habitat conversion has increased fragmentation and isolation of aspen.

Approach: Analyze historic and current aspen distribution at the watershed scale to plan restoration activities that increase connectivity of aspen patches.

Factor: Mapping limitations: Current mapping efforts do not adequately document aspen stands due to their small patch size. Lack of adequate maps affects ability to restore connectivity of aspen patches at a landscape scale.

Approach: Support efforts to map aspen and other important habitats at fine (less than 100 feet pixel) scales.



Blue Mountain Elk Initiative

The Blue Mountains ecoregion is home to some of the largest populations of Rocky Mountain elk in the world. These remarkable herds attract over 70,000 hunters, photographers and wildlife observers each year, individuals who bring millions of tourism dollars to the region. Native American tribes also have an ongoing interest in elk for harvest and as cultural symbols. Elk often are attracted to high-protein crops such as alfalfa, and damage to agricultural areas has been an ongoing situation for many years. Wildlife managers and land management agencies must balance many competing interests and issues regarding elk populations.

To address some of these issues, the Blue Mountain Elk Initiative (BMEI) was formed about 15 years ago. Members of the BMEI include county, state, tribal, and federal governments; non-governmental organizations (e.g., Rocky Mountain Elk Foundation; Oregon Hunter's Association; Oregon Farm Bureau; Oregon Small Woodlands Association); and business and industry representatives. BMEI focuses on improving management of elk habitat and reducing damage to private properties. BMEI collaboratively funds many projects to achieve these goals and BMEI-funded projects have improved over 1.5 million acres of elk habitat in the Blue Mountains ecoregion. Example projects include: riparian restoration; forage enhancement via prescribed burns, fertilization, seeding, and planting; invasive plant treatments; juniper removal; road closures; salt stations to help elk distribution; water developments; and fence construction. For more information, see *www.fs.fed.us/pnw/bmnri/initiatives.htm*.

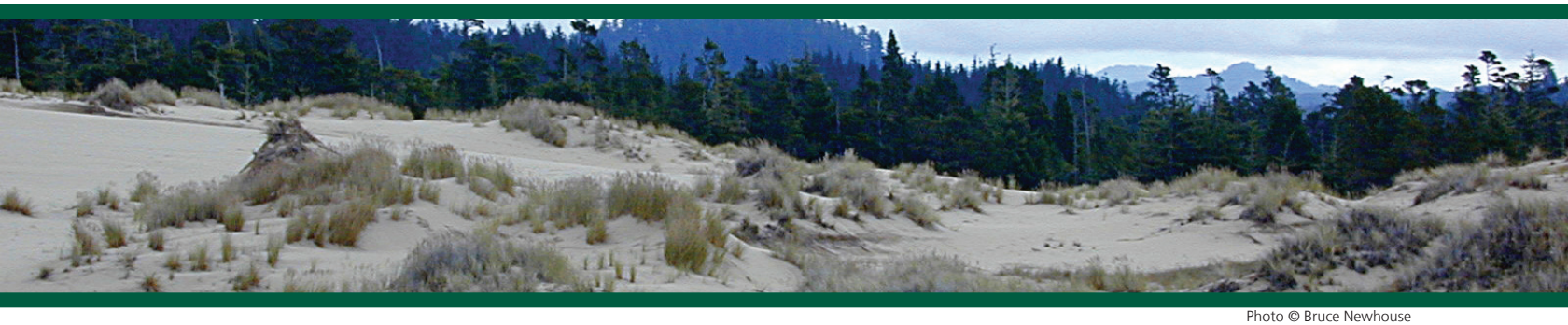


Photo © Bruce Newhouse

Strategy Habitat: Coastal Dunes

Ecoregions:

Coastal dunes are a Strategy Habitat only in the Coast Range ecoregion.

Characteristics:

Coastal dunes include beaches, foredunes, sand spits, and active to stabilizing back dunes. The vegetation varies from sparse to forested, as influenced by sand scour, deposition, movement, and erosion. Species composition is also influenced by salt spray, storm tidal surges, wind abrasion, and substrate stability. Beaches and sandspits are directly influenced by tidal action and are unvegetated. Foredunes generally have unstable sand and sparse to moderate vegetative cover including dunegrass, seashore bluegrass, grey beach peavine, large-headed sedge, beach morning glory, yellow sand-verbena and silver burweed. In dunes with greater sand stability, red fescue, seashore lupine, coastal strawberry, beach knotweed, and yarrow are dominant. With plant succession, dunes convert over time to shrublands dominated by salal and evergreen huckleberry and forests dominated by shore pine, then eventually Sitka spruce, western hemlock, and Douglas-fir.

Conservation Overview:

Coastal dune communities have been altered dramatically through the introduction and spread of non-native European beachgrass, which outcompetes native vegetation and stabilizes foredunes. The stabilized foredunes block movement of sand inland and artificially accelerate plant succession toward shrubland and forest. Dunes artificially stabilized by European beachgrass have contributed to commercial and residential development of sandy habitats that were once naturally active, moving systems.

Species that live in Coastal dune habitats prefer open, sandy habitats with a high degree of disturbance from winds and tides. Strategy Species associated with Coastal dunes include western snowy plover, pink sand-verbena, and Wolf's evening-primrose.

Limiting Factors in Coastal Dunes:

Factor: Beachgrass invasion: European beachgrass stabilizes dunes, resulting in changes in vegetative communities and loss of open sandy habitats.

Approach: Use mechanical and chemical treatment to control European beachgrass in priority areas, such as snowy plover nesting areas and near pink sand-verbena populations. Build on existing restoration efforts to control beachgrass.

Factor: Invasive plants: Stabilized dunes are vulnerable to invasive species such as Pampas grass, Scotch broom and gorse, which displace native plants and animals and accelerate succession.

Approach: Control key invasive plants using site-appropriate tools such as mechanical (mowing, girdling, pulling), chemical, and biocontrol (for gorse) treatments.

Factor: Increasing development: Stabilized dunes are being developed for residential housing.

Approach: Use voluntary cooperative approaches such as financial incentives, Candidate Conservation Agreements with Assurances, and conservation easements to maintain dune habitats. Work with agency partners to support and implement Statewide Land Use Goal 18, Beaches and Dunes.

Factor: Recreational impacts: In some areas, recreational use can cause disturbance to wildlife (e.g., snowy plover nesting areas and seal and sea lion haul-outs). Off-highway vehicles can impact vegetation and disturb wildlife.

Approach: Work with land managers to direct recreational use away from highly sensitive areas. Provide recreational users with information on coastal dune conservation issues and low-impact uses.

Photo © Dave Pitkin, U.S. Fish and Wildlife Services

Strategy Habitat: Estuaries

Ecoregions:

Estuaries are a Strategy Habitat only in the Coast Range ecoregion.

Characteristics:

Estuaries occur where freshwater rivers meet the salty waters of the ocean. They are influenced by tidal flooding, and as such experience frequent changes in salinity, water levels, sunlight, and oxygen. Estuaries have four main subsystems: marine, bay, slough, and riverine. The marine subsystem is at the river's mouth and is dominated by salt-water plants and animals. Bays are characterized by broad mud flats that are alternately covered by water and exposed to the air due to tidal flows. Sloughs are smaller side tributaries with little freshwater input. Sloughs consist of a mosaic of meandering channels, mud flats and salt marshes. The riverine portion of the estuary extends up the river as far as tides influence water flow and salinity. The river forms a single channel that is usually bordered by salt and brackish marshes. Variation in salinity, tidal inundation, and soils influences marsh plant composition and often results in zones of vegetation, primarily grasses, rushes, sedges, and forbs. Major bays in Oregon include the Alsea, Coos, Nehalem, Nestucca, Netarts, Siletz, Tillamook, Yaquina, and Youngs Bays.

Conservation Overview:

This highly complex, productive habitat is critical for many fish and wildlife species, including salmon, crabs and other shellfish, marine mammals and seabirds. By some estimates, estuaries support up to three-quarters of all harvested fish species, and this is largely due to the high productivity of seagrass beds. Seagrasses grow underwater in estuaries and have the highest productivity of any plant. Efforts to maintain and restore estuaries will benefit many wildlife and commercially important species. Strategy Species associated with estuaries include black brant and salt-marsh bird's beak. Estuaries also provide wintering habitat for waterfowl, migration stopover feeding areas for shorebirds, and mineral sources for band-tailed pigeons.

Estuarine habitats have been impacted by human development and uses, such as dredging, hydrologic modifications, and urbanization. Salt-marshes and other tidal wetland types have been diked, drained, and converted to pasture, resulting in substantial habitat loss.

In accordance with state planning laws, local government comprehensive plans and zoning ordinances have been prepared for all of Oregon's estuaries.

Limiting Factors in Estuaries:

By their nature, estuaries are complex systems with many habitat types. The limiting factors listed below focus on the bay, slough, and riverine subsystems of estuaries. The marine subsystem is currently being addressed through the Oregon Nearshore Strategy (in preparation, 2005), a comprehensive approach to marine species and habitat management in Oregon. Additional factors and approaches that could affect estuaries are covered in the freshwater wetlands, riparian, and aquatic sections of this chapter (for example, sedimentation, nutrient input, loss of habitat complexity).

Factor: Increasing development and land use conversions: Estuary habitat has been lost to a variety of causes, including: past diking and drainage; industrial and residential development; and aquaculture practices that reduce eelgrass beds and disturb winter waterfowl.

Approach: Continue to provide incentives to protect, maintain or restore estuaries. Where appropriate, work to remove dikes to restore tidal marshes. Continue successful education programs focused on the function and services provided by estuaries. Work with agency partners to support and implement existing land use regulations that preserve and restore habitats. Continue to develop and refine "best management practices" for aquaculture. Maintain or restore eelgrass beds as a habitat feature.

Factor: Alteration of hydrology: The amount and the timing of freshwater inputs into estuaries are critical in maintaining the hydrological regime that supports the delicate estuarine balance. When either the amount or timing of freshwater input is altered, several results are possible: inundation of floodplains; increased sedimentation; decreased residence time of water, which reduces the filtering benefits of estuaries; altered fish community dynamics; increased stress on juvenile fish, nekton or other animals. Compounding the problem, changes in hydrological regimes can make estuaries prone to invasive species.

Approach: Critically consider the effects of water diversions for other land uses (including agriculture, forestry, or residential use) and reservoir operations. Evaluate the potential impacts of these activities on floodplain dynamics and other functions of estuaries.

Factor: Degraded water quality: Water quality in estuaries is frequently degraded by heavy and varied use. In particular, estuaries are susceptible to increased bacterial loads. Dissolved oxygen levels are often an additional concern. Runoff from residential, agricultural, and forest land, failing septic systems, animal waste, and storm events can affect water quality.

Approach: Continue current efforts to consider impacts on estuarine water quality in land use planning. When necessary, Oregon Department of Environmental Quality develops Total Maximum Daily Loads and water quality management plans involving the input of all interested and affected partners. Continue coordination to ensure that plans and goals consider impacts on wildlife in addition to other goals (i.e., recreation).

Factor: Invasive plants: Common cordgrass and other invasive plant species potentially pose a great threat to Oregon's estuaries. Common cordgrass has been documented in two Oregon estuaries and is well-established in Washington and California. Where it occurs, it reduces mud flat habitats, disrupts nutrient flows, displaces native plants and animals, and traps sediments, which changes the beach profile and water circulation. Three other cordgrass species have invaded the Pacific coast and could potentially pose a threat to estuaries. Estuaries are one of the most vulnerable habitats for invasives due to ship traffic and release of ballast water.

Approach: Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Control key invasive plants using site-appropriate tools such as hand-pulling, covering with geotextile cloth, repeated mowing, flooding, and/or herbicides, focusing on spot treatment. Monitor estuaries for potential invasives, including other cordgrasses, and use site-appropriate methods to control newly-established species for which management can be most effective. Work with partners to implement existing ballast water regulations. Develop methods to treat ballast water.

Factor: Invasive invertebrates: Introduction of invasive marine invertebrates such as the green crab impacts native species, affects estuarine food webs, limits economically important Dungeness crab populations, and impacts mussel, oyster and clam mariculture operations.

Approach: Develop methods to control invasive invertebrate populations. Continue existing efforts to prevent further introductions and to inform the public about green crabs and other invasives.

Factor: Coordination of management: Many jurisdictions and agencies have management authority and interest in estuaries, which can make management more complex and difficult. In Oregon, several agencies (including Oregon Department of State Lands, Water Resources Department, and Department of Land and Conservation and Development) are responsible for estuary management, and many other agencies and organizations have strong interests in estuaries.

Approach: Coordination among agencies is a high priority. Because estuarine issues are complex, clear identification and communication of conservation issues should precede management actions, ensuring that all interests are considered.

Factor: Loss of habitat complexity: Whole, large-diameter trees that used to wash down major rivers during floods provided perches, wind protection, shade, and hiding places in estuaries for different species at different tide levels. These trees lasted many years. Reduced acreage of late successional conifer forest and barriers to water flows on some rivers have restricted new inputs of large-diameter logs. Additionally, wood has been removed for navigation, firewood and industrial use.

Approach: Use cooperative efforts and incentives to promote large-wood management in streams.

Collaborative conservation: Salt marsh restoration and the Tillamook Estuary Project

The word Tillamook means "land of many waters" in Chinook. Tillamook Bay is where several rivers - including the Miami, Kilchis, Trask, Wilson, and Tillamook - empty into the Pacific Ocean. The bay provides vital stopover habitat for waterfowl and shorebirds migrating along the Oregon Coast, and for wintering waterfowl. The bay also supports some of Oregon's most valued populations of chum, coho, and chinook salmon, which nourish and rear their young in the estuary. These water-

fowl and fish greatly benefit from protection, restoration and enhancement of vulnerable estuarine habitats. Successful restoration in estuaries often focuses on re-establishing historic hydrologic regimes. Because estuaries are natural buffers between coastal communities and storms, activities that restore estuarine habitats can also benefit communities. Therefore, carefully planned estuary restoration can greatly benefit fish, wildlife and community development. To ensure mutual benefits from restoration activities, close cooperation and communication among interests is essential. The Tillamook Estuaries Partnership (TEP) is a non-profit organization and designated National Estuary Project that strives to ensure collaborative enhancement of vital estuarine and upland habitats.

One example of TEP's collaborative approach to floodplain restoration is a wetlands acquisition project that allowed Tillamook County to acquire 375 acres of diked former tidelands at the confluence of the Wilson and Trask Rivers (on the upper end of Tillamook Bay). The wetlands project was very collaborative, involving many agencies and private partners. USFWS Coastal Wetland Planning, Protection, and Restoration Act (CWPRA) and NOAA Coastal and Estuarine Land Conservation Program (CELCP) grants funded the purchase, with the Oregon Watershed Enhancement Board providing matching state funds. The Trust for Public Lands undertook all landowner negotiations. TEP facilitated a management committee that developed a plan to guide restoration, monitoring, financing, and public access to the acquired properties. Tillamook County implements the plan and manages the restoration projects. Local stakeholders, including TEP, Oregon Department of Fish and Wildlife, the City of Tillamook, the Tillamook Bay Estuary and Habitat Improvement District, TC Soil and Water Conservation District, and Tillamook County, regularly meet to advise the county. With the help of this advisory committee, Tillamook County is managing the property to restore tidal wetlands and water quality while ensuring long-term habitat protection. In other activities, TEP helped the City of Tillamook acquire inter-tidal wetlands along Hoquarton Slough with the goal of long-term habitat conservation. TEP also undertakes an aggressive fish passage improvement program focused on tidegate and culvert replacements. TEP's Backyard Planting Program (funded by ODFW, OWEB, USFWS, and DEQ) recruits volunteer landowners to remove invasive species and re-plant native vegetation along their riparian buffers. In these and other activities, TEP continues to convene cities, state and federal agencies, and private organizations to enhance and restore estuarine habitat for fish and wildlife, ensuring careful evaluation and implementation of restoration options.

Photo © Tupper Ansel Blake

Strategy Habitat: Freshwater Aquatic Habitats

Ecoregions:

Freshwater aquatic habitats are a Strategy Habitat throughout the state (all eight ecoregions).

General Characteristics:

Freshwater aquatic habitats include rivers, streams, ponds, lakes and reservoirs, and are defined as occurring above the influence of tides and salinity fluctuations. Freshwater aquatic habitats typically contain water year-round, while wetlands may dry out through the season.

Oregon's freshwater aquatic habitats are both interconnected and highly diverse, including tributary streams and lakes at high elevations, major rivers, smaller meandering streams, springs, seeps, and many lakes and reservoirs. The headwaters of many of Oregon's streams and rivers are located in the Cascades mountain range, and many drainage basins empty into the Columbia River and eventually into the Pacific Ocean. In the southeastern portion of the state, many small closed basins contain streams that flow from the mountains into valleys without any outlet to the ocean. Numerous lakes occur throughout Oregon, formed by glaciation, lava flows, and human-made structures such as dams. Crater Lake and Waldo Lake are Oregon's two clearest lakes, both located in the West Cascades ecoregion. The eastern half of the state contains several playa lakes, formed when runoff from precipitation and mountain snowpacks flows into low-lying areas, then evaporates and leaves mineral deposits.

Conservation Overview for Freshwater Aquatic Habitat:

Water is crucial for all fish and wildlife, and high quality freshwater aquatic systems provide essential habitat to many at-risk species, including important spawning and rearing habitat for salmonids, breeding habitat for amphibians, and habitat for freshwater mussels and other invertebrates. In many locations, flow and hydrology have been impacted by barriers (e.g., roads, dams and culverts) and irrigation diversions that can reduce water flow and interfere with fish and wildlife migration. Channelization and development can restrict the natural ability of streams and riparian habitats to meander over time, limiting the quality and availability of these habitats, as well as affecting floodplain function. Large, cool freshwater pools, often associated with streams, are also in decline. Upland habitats have a critical role in watershed function and affect aquatic habitats by providing shade and filtering runoff and precipitation. These benefits can be particularly important in drier, low-elevation sites, where shading can protect streams from high temperatures during periods of low flow in the late summer.

In the Coast Range, abundant coastal lakes are highly sought out for development, and many are now surrounded by houses or pastures. The Rogue and Umpqua rivers were once internationally known commercial salmon fisheries, providing abundant high quality freshwater habitat. Today, strong sport fisheries continue in these watersheds. The West Cascades ecoregion has the highest water quality in the state and probably the fewest problems with water allocation and quantity. This high-quality water comes from the upper reaches of rivers and streams, which are typically managed as protected areas under public ownership. In many parts of the state, restoring flows and improving the quality of riparian habitats on lower rivers improves and maintains ecological connections to high-quality habitat associated with headwater streams.

In some parts of the state, urbanization, agriculture and forest practices have placed many demands upon aquatic systems. Since the 1960s, efforts to clean-up the Willamette River have greatly reduced pollutant levels. However, nonpoint source pollution, including runoff from urban and agricultural activities, continues to contribute to poor water quality in some areas. Water quality planning by Oregon Department of Agriculture and Oregon Department of Environmental Quality offer solutions and identify local partners.

Limiting Factors in Freshwater Aquatic Habitat:

Factor: Water quantity: Water is limited in some parts of the state. Low flows are associated with higher water temperature and have higher nutrient concentrations. Late summer is a time of particular

concern because of reduced late-season flows. For example, in the Northern Basin and Range, surface water is fully allocated to multiple uses (including dams and storage). Additionally, in the Willamette Valley, groundwater has become less readily available because of increased impervious surface, impacting natural hydrological regimes. Also, some streams have been diverted in pipes or re-aligned for drainage ditches, further altering hydrology.

Approach: Where possible, maintain flow following the natural hydrological cycle. Minimize release of unnaturally warm water in the fall and summer by altering intake/release structures. Improve irrigation efficiency. Lease water for instream use. Provide incentives and information about water usage and sharing at key times of low flow conditions (e.g., late summer). Increase interaction of rivers and floodplains. Reduce stormwater runoff and increase permeability in urban areas, allowing more water to seep into the ground. During restoration, remove pipes and provide stream channels to promote flow, nutrient and oxygen exchange. Where possible, provide sufficient room to restore meanders and other functions.

Factor: Water quality: Nonpoint source pollution sometimes contains fertilizers, pesticides or oil-based pollutants at levels high enough to cause significant lethal or sub-lethal effects in native fish and wildlife. Point source pollution from industrial practices also can contain high levels of contaminants. Both point and nonpoint source pollution are of particular concern in more highly populated regions. In some areas, particularly the Rogue and its tributaries, increasing use of recreational motor vehicles (jet boats) has the potential to degrade water quality with runoff, or to harass aquatic or riparian-associated wildlife.

Approach: Increase awareness of the impacts of urban runoff and pesticide applications; increase awareness and manage timing of applications of potential aquatic contaminants. Improve compliance with water quality standards and pesticide use labels (Oregon Department of Environmental Quality [ODEQ] and U.S. Environmental Protection Agency). Work on implementing Senate Bill 1010 (Oregon Department of Agriculture) and ODEQ Total Maximum Daily Load water quality plans. Carefully consider recreational vehicle use and timing on sensitive or "wild and scenic" water bodies.

Factor: Invasive species: Invasive species (e.g., bass, crappie, bluegill, yellow perch, brown bullhead, carp) can compete with or hybridize with native fish (e.g., steelhead, rainbow trout). For example, in the Columbia Basin, non-native carp can overgraze aquatic vegetation and stir up sediment, depriving native fish and amphibians of egg laying sites or preventing eggs from absorbing enough oxygen to develop. Alterations in hydrology can make the habitat more susceptible to invasive plants, invertebrates, or fish. Some of these invasive species can present problems when they compete with, forage upon, or hybridize with native fish and wildlife.

Approach: Restoration of aquatic habitats to conditions that support native fish and wildlife is the best strategy to prevent invasive species. Maintaining historic hydrological regimes ensures that habitat conditions best support native fish and wildlife. Work with multiple partners to restore flow and water input levels. Where necessary, work to minimize predation on sensitive native species. Where non-native fish threaten native Strategy Species, consider site-appropriate tools such as mechanical treatment, or chemical treatment in places and seasons where it will not harm native amphibians, fish or invertebrates. Educate and inform people about the problems that can be caused by non-native fish.

The Grande Ronde Model Watershed Program

In northeastern Oregon, the Grande Ronde Model Watershed Program is developing and implementing projects to restore proper watershed functions and provide spawning, rearing and migration habitat for endangered salmonids. The Program is a public policy group chartered by the Boards of Commissioners of Wallowa and Union Counties and designated by the Northwest Power Planning Council (now the Northwest Power and Conservation Council). Board Members include representatives of local government, state and federal agencies, private landowners, Tribes, conservation interests, public interest groups, educators, and Soil and Water Conservation Districts. The mission of the program is to oversee and develop the implementation, maintenance, and monitoring of coordinated resource management in the Grande Ronde and Imnaha Sub Basins. Monthly meetings of the Board guide the Program in its work with the Oregon Watershed Enhancement Board, the Bonneville Power Administration, the Governor's Office and partner across the watershed(s). Some major results achieved between 1994 and 2002 include more than 2,700 miles of riparian habitat improvements and over 50 fish passage improvements. Current plans in development include restoration projects on Catherine Creek, Bear Creek, End Creek, the Lostine River, Trout Creek, Wallowa River and Imnaha River, and others. These projects are tied directly to sub-basin Plans, watershed assessments, and the Oregon Plan for Salmon and Watersheds.

Factor: Water temperature: Water temperature often is too warm for native aquatic life because of alterations in stream flow, thermal pollution or reduced riparian cover. In the Blue Mountains, East Cascades and Columbia Plateau ecoregions, late summer is a time of particular concern for increased temperatures, partially due to reduced late-season flows. In the Northern Basin and Range ecoregion, conditions of low flow can lead to problems with increased levels of bacteria and pollutants. Determining optimal water temperatures is difficult because of a lack of understanding about historical temperature regimes.

Approach: Maintain or increase riparian cover. Where appropriate, re-vegetate degraded riparian areas. Minimize release of unnaturally warm water in the fall and summer by altering intake/release structures. Maintaining and restoring in-stream flow contributes greatly to maintaining favorable water temperatures.

Factor: Sedimentation: Sediment flows into streams from various human activities, covering eggs of some native fish and amphibians or making them more susceptible to infection, and potentially burying aquatic mollusks and freshwater mussels.

Approach: Reduce run-off of sediment from logging, agriculture, grazing, roads, urban and other activities that could disturb soil or destabilize streambanks. For example, work with Oregon Department of Agriculture to promote the implementation of area-wide water quality management plans under Senate Bill 1010 so that farmers and ranchers know which actions they can implement to address water quality problems in their watershed. Some of these strategies are terracing fields, filtering run-off before it enters aquatic systems, or installing sediment control basins to reduce erosion and practicing conservation tillage. Water quality credit trading programs to control sediment loads (and other pollutants) can help ensure good water quality levels. When constructing new roads, consider sediment removal capabilities in road design. Maintain and restore riparian and wetland vegetation to filter sediments.

Factor: Passage barriers: Fish and wildlife depend on natural flow regimes and substrates for migration, foraging, and hiding. Dams, road culverts, or log puncheons can alter or affect in-stream flow. The large dams on almost all of the Cascade rivers alter considerable amounts of the bottomland habitats, and impacts anadramous fish passage upstream and downstream. Misaligned culverts with the downstream end above the water level disconnect stream passage corridors and may force wildlife to cross roads where they are vulnerable to vehicles and predators. Under-sized or improperly sized culverts can alter the transport of sediment and wood creating an uneven distribution of habitat. These effects can degrade riparian habitat and impact riparian-associated fish and wildlife. Additionally, altered flow regimes can contribute to higher temperatures in some streams.

Approach: Where possible, work with landowners and agencies to restore natural flow conditions on streams impacted by barriers. Remove or replace culverts or other passage barriers with structures that mimic natural conditions as closely as possible (for example, open-bottom arch culverts). Determine potential effectiveness of providing passage around dams for fish and wildlife (amphibians, reptiles, mammals). Develop new habitat sites where possible. Eliminate passage barriers or improve passage at existing barriers to provide travel corridors for fish and wildlife.

Factor: Degraded riparian condition and loss of habitat complexity: Riparian vegetation often is lost as habitat is converted to other uses. Riparian habitat provides significant benefits to aquatic systems. For example, riparian vegetation maintains water

Habitat Diversity Leads to Species Diversity in the Klamath Basin

The Klamath Basin rests on an ecotone: different habitat types converge together, creating an environment where, over a long period of time, many unusual species may evolve and thrive. The drainage of the Klamath Basin has shifted over its geological history: it once drained into the Columbia River via the Snake River; then drained into the Great Basin to the east; and now drains to the south via the lower Klamath River. These dramatic shifts in drainage patterns created several distinct aquatic systems that isolated the fishes living in the basin. As a result, over a dozen unique fish species evolved in this environment. Some of these fish are found nowhere else in the world, including several found only in Oregon: the Klamath Lake sculpin, the slender sculpin, and four species of lamprey. Many of these endemic fishes are highly adapted to the shallow lakes and rivers of the Klamath, and adjusted to the wide variations in climate characteristic of the region. Moreover, the Klamath River and its tributaries once hosted the third largest salmon producing river system on the West Coast, and salmon still migrate in the river and its tributaries. Now, the Klamath basin also contains the southernmost bull trout population. The great variety of fishes is present today because of these extraordinary past geologic events.

quality by filtering nutrient runoff. Coarse woody debris associated with riparian habitat provides structure for shade, fish and wildlife hiding cover, bank stabilization, and breeding sites for some amphibians and invertebrates. In some areas, such as the Willamette Valley and Klamath Mountains, extensive riparian habitat historically occurred on oxbows and side channels but have since been converted to other uses. In other areas, such as the Northern Basin and Range, stream channel stability has been eroded. In the Willamette ecoregion, many river features (off-channel aquatic habitat, gravel bars, deep channel pools, etc.) have been lost as land uses have changed over time.

Photo © Steve Parrett, Oregon Water Trust

Approach: Use voluntary cooperative efforts and incentive programs to maintain and restore riparian habitats on private lands (i.e., Conservation Reserve Enhancement Program). Maintain riparian buffers and minimize impacts from road building on public lands. Maintain channel integrity and natural hydrology. Continue efforts to understand historical range of channel stability and function. Where possible, restore historic channel stability and connectivity to floodplains. Continue restoration projects promoting the placement of large woody debris. Minimize conversion of riparian vegetation and offset the loss of habitat through on-site restoration or long-term protection and management of remaining areas. Also, ensure that the rate of removal of riparian vegetation is not excessive so riparian vegetation can continue to provide shade, prevent erosion and preserve water quality. Where appropriate and compatible with existing land uses, permit beaver habitat usage to continue maintaining habitat complexity. Continue efforts, including Senate Bill 1010 planning, to mitigate for the effects of agricultural practices on riparian condition. See discussion on riparian habitats for more information.

Collaborative Conservation Project: Cattle rancher paid to conserve stream water for native salmonids

In 2003, the Oregon Progress Board reported that only 24 percent of streams had sufficient water to satisfy all uses throughout the entire year. Inadequate in-stream flows raise concerns among fish biologists that native salmonids and other aquatic organisms will be negatively affected. In addition, farmers and ranchers depend on local creeks and rivers for irrigation and face economic hardship when stream flows cannot support crop or livestock production.

Oregon's Crystal-Clear Waters: Waldo Lake and Crater Lake

Breathtaking clear blue waters in fresh mountain air await many visitors at Crater Lake and Waldo Lake each year. Ensconced by almost 20 miles of spectacular cliffs, Crater Lake is the deepest lake in the United States, reaching depths of up to 1,900 feet. Crater Lake is about 6,000 feet above sea level, and its waters cover approximately 20 square miles. At more than 5,000 feet elevation, Waldo Lake is similarly nestled among several miles of wilderness trails and peaks, reaching depths of up to 420 feet. Formed by melting glaciers, both lakes have exceptionally transparent water, with visibility up to 100 feet and outstanding water quality. Both lakes of these spectacular natural resources are nationally recognized for their exceptional characteristics. Both lakes face a few potential concerns about the effects of recreational use.

At about 100 years old, Crater Lake National Park is America's 5th oldest national park. A very well-established national park, about 90 percent of the area is managed primarily for wilderness. Visitors can enjoy spectacular views year-round, with camping and hiking at up to 8,000 feet, boat tours in the summer, and snowshoe hiking and cross country skiing in the winter. For more information about Crater Lake see: *www.nps.gov/crla*.

Waldo Lake is the second deepest and most clear lake in Oregon. Visitors can boat on the lake, and can camp and hike in the wilderness near the lake. In 1999 comprehensive strategies for monitoring and recreational planning at the lake were initiated, a process which identified several gaps in understanding recreational impacts at the lake. Two extensive surveys on recreation use and attitudes were undertaken to assess some of these gaps, as well as sediment sampling to determine potential effects of motorized boating at the lake. Management plans for the continued enjoyment of this natural resource are on-going. For more information about Waldo Lake see: *www.fs.fed.us/r6/willamette/manage/waldolake/*.

While water availability and allocation are on-going challenges in Oregon, one organization is striving to enhance stream flows by employing a market-based approach to reduce the amount of surface water landowners divert for irrigation. The Oregon Water Trust (OWT), a not-for-profit organization based in Portland, partners with willing farmers and ranchers throughout the state to enhance in-stream flows by offering them a suite of incentives to do just that.

For the past four years, Oregon Water Trust has leased water rights from Pat Voigt, a cattle rancher who owns property near Prairie City, Oregon. Standard Creek, a tributary to Dixie Creek, which feeds into the John Day River, runs through Voigt's property and irrigates pasture while providing his herd with drinking water. The creek is important spawning and rearing habitat for steelhead trout while downstream Dixie Creek hosts cutthroat trout. Inland stocks of steelhead east of the Cascades are listed by the state as sensitive, and mid-Columbia steelhead are federally listed as threatened. Oregon's only populations of westslope cutthroat are restricted to portions of the John Day Basin where habitat constraints have led to a contraction in the species distribution.

According to the terms of the agreement with OWT, Voigt temporarily shuts down his diversion of water from Standard Creek from July through September. In return OWT compensates him for the amount of water that he dedicates to in-stream use during this period, which is enough water to cover 348 acres up to a foot deep. The partnership between Voigt and OWT results in the protection of 3.5 miles of rearing habitat for steelhead and cutthroat trout in summer when water flows are seasonally low.

The John Day River and its tributaries such as Standard and Dixie Creeks are population strongholds for wild steelhead, serving as anchors for recovery efforts and a viable fishery. Decreased stream flows are just one of several factors limiting steelhead recovery in the John Day Basin. However, water reallocation agreements like the one brokered between OWT and Pat Voigt help to maintain favorable freshwater habitat for salmon and steelhead while meeting the financial needs of landowners.

Voigt, who is Chair of the Grant County Soil and Water Conservation District, expresses this view when he says "OWT has the right attitude and approach to make this agreement work. I am compensated well for leaving the water in the stream, and it lets me feel good about doing a part in the recovery of the steelhead."

Photo © Martin Nugent

Strategy Habitat: Grasslands

Ecoregions:

Grasslands are a Strategy Habitat in the Blue Mountains, Columbia Plateau, Coast Range, Klamath Mountains, West Cascades, and Willamette Valley ecoregions. However, grasslands such as alkali grasslands, perennial bunchgrass and montane grasslands also can be found in the East Cascades and Northern Basin and Range ecoregions.

General Characteristics:

Grasslands include a variety of upland grass-dominated habitats such as upland prairies, coastal bluffs and montane grasslands. In general, grasslands occur on dry slopes or plateaus and have well-drained sandy or loamy soils. Although dominant species vary across Oregon, perennial bunchgrass and forbs dominate native grasslands. In some areas, grasslands are similar to wet prairies and wet meadows in structure and share some of the same prairie-associated plants and animals. In all but the most shallow rocky soils, grasslands are maintained through disturbances such as periodic fire, soil upheaval by rodents, frostheave, wind, or salt spray.

Ecoregional Characteristics:

Blue Mountains: Bunchgrass grasslands occur primarily in the northeastern portion of the ecoregion, although other grassy habitats occur throughout the ecoregion. At low elevations, semi-desert grasslands are dominated by drought-resistant perennial bunchgrasses such as needle-and-thread, dropseed, threeawn and muhly, and may have scattered shrubs. Mid-elevation plateau grasslands include extensive bunchgrass prairies of Idaho fescue, junegrass and bluebunch wheatgrass. At high elevations, ridgetop balds and alpine parks are dominated by green or mountain fescue, needlegrass and/or bluegrass species. High elevation grasslands often are on south-facing slopes surrounded by subalpine conifer woodlands.

Columbia Plateau: Grasslands include river terrace grasslands, prairies, canyon slopes and rocky ridges. At low and mid-elevations, semi-desert grasslands are dominated by drought-resistant perennial bunchgrasses such as needle-and-thread, dropseed, threeawn and muhly, and may have scattered shrubs. Palouse grasslands occur in flat areas with deep soils and are dominated by bluebunch wheatgrass, Idaho fescue, other grasses and forbs. Canyon and foothill grasslands are found on the steeper, rocky slopes surrounding the major rivers in this region and are dominated by bluebunch wheatgrass, Idaho fescue, Sandberg's bluegrass, balsamroot, and other forbs.

Coast Range: Coastal bluffs and montane grasslands are dominated by low-growing vegetation, such as perennial bunchgrasses, forbs, mosses and/or dwarf shrubs. They occur within a matrix of conifer forests. Outer coastal bluffs and headlands are influenced by wind and salt spray, which limit the growth of woody vegetation. Montane grasslands include dry meadows and balds and occur on dry, south- or west-facing slopes with shallow sandy or gravelly soils. They are primarily influenced by periodic fire, soil upheaval by rodents and/or drought conditions.

Klamath Mountains: Grasslands are found in valley bottoms, often in a mosaic with chapparal and savanna, on open serpentine barrens, and high mountain meadows. Historically, grasslands in this ecoregion were maintained by frequent burning and included scattered deciduous and conifer trees. Oak savannas are grasslands with scattered trees. Oak trees in savannas are usually large with well-developed limbs and canopies.

West Cascades: Montane grasslands include open dry meadows, grasslands, and balds. Montane grassland habitats occur in a matrix of mixed conifer forests and woodlands. Mid- and high-elevation dry meadows tend to have deeper and better-drained soils than the surround forests and are dominated by grasses and wildflowers, such as green, Roemer, alpine or western fescue; California brome; timber oatgrass; broadleaf lupine; and beargrass. Balds and bluffs generally occur on south- to west-facing slopes on shallow, well-drained soils and are dominated by bunchgrasses, forbs, and mosses.

Willamette Valley: Grasslands, also called upland prairies, are dominated by grasses, forbs, and wildflowers. Grasslands have well-drained soils and often occur on dry slopes. They are similar to wet prairies in structure and share some of the same prairie-associated plants and animals. Oak savannas are grasslands with scattered Oregon white oak trees, generally only one or two trees per acre. Oak trees in savannas are usually large with well-developed limbs and canopies.

Conservation Overview:

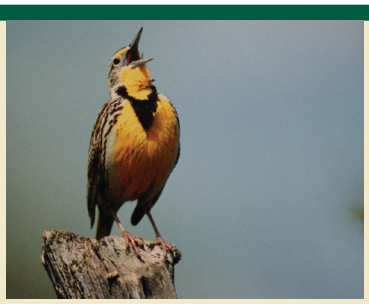
As a whole, native grasslands are one of the most imperiled habitats in the western United States and are disappearing rapidly around the globe. In Oregon, the greatest loss of grasslands has been in valley bottoms and foothills where they have been impacted by conversion to agriculture, development, and invasive plant species. In some areas, past grazing has impacted grasslands, affecting plant composition and structure. Also, non-native species were historically seeded for livestock forage in some grasslands, decreasing the abundance and diversity of native plants. However, grazing practices become more sustainable over time, and carefully managed grazing can help maintain grassland structure where prescribed fire is not practical or desired. Disruption of historical fire regimes has allowed for shrubs or trees to encroach, replacing grasslands with forest. In addition, some foothill grasslands have been converted to forests through tree planting.

In the Blue Mountains ecoregion, less grassland habitat overall has been lost as compared to the other Strategy Habitats, but grasslands are included because they have statewide and national significance, some have been impacted by past grazing practices and need restoration, and because they face threats from invasive species. There are several important grassland sites currently being managed for wildlife and habitat conservation and high-quality grasslands remain at higher elevations and the extensive canyons in the ecoregion. Native grasslands remain a particular concern at low elevations in this ecoregion.

In the Columbia Plateau, Palouse grasslands once dominated most uplands above 1,000 feet elevation in this ecoregion. Due to the moderate climate and the deep soils, these grassland habitats are valuable for agriculture. Approximately 77 percent of the historic Palouse grasslands have been converted to dryland farming, especially wheat and other grains. Many remaining grasslands have been degraded by invasive plants and poorly controlled livestock grazing.

In the Coast Range, open, grassy habitats once occurred on the marine terrace, headlands, bluffs, higher elevation ridges, and mountain peaks. In forested ecoregions such as the Coast Range and West Cascades, grasslands are particularly important for rare plants and invertebrates. In the Coast Range, mountaintops such as Saddle Mountain, Onion Peak, Sugarloaf Mountain, and Blue Lake Lookout host a number of endemic plant species, including Saddle Mountain bittercress, Chambers' paintbrush, frigid shootingstar, queen-of-the-forest, and Saddle Mountain saxifrage.

Sowing for Songbirds



Since much of the Willamette Valley is privately owned, the efforts of private landowners are key to the survival of grassland birds. The Sowing for Songbirds Project is an example of biologists and landowners working together to provide habitat on a voluntary basis. ODFW built partnerships with agricultural producers through groups such as the State Board of Agriculture, Ryegrass Growers Association, Eugene Farmer's Co-op, 4-H Leaders, and Master Gardeners. ODFW created a "how-to" booklet for landowners, which presented the biology and natural history of the five sensitive grassland bird species, habitat management strategies for different land uses, habitat restoration techniques, resources for implementation, and financial incentive programs. The booklet was widely distributed to interested landowners, agricultural and conservation groups, partners, and county, city, state, and federal agencies. "Hands-on" workshops for both agricultural and non-agricultural landowners in the Willamette Valley were the cornerstone of this program. The workshops gave landowners the opportunity to learn about grassland habitat and to ask questions about their own properties. The highlight of the workshops was a tour of successful grassland bird habitat within a working landscape. Through cooperative efforts with the Natural Resource Conservation Service and county Farm Service Agencies (FSA), biologists also made site-visits to provide site-specific recommendations for improving grassland bird nesting habitat while ensuring quality agricultural production. By working closely with the landowners, biologists developed management plans specific to each property and land manager's goals. In agricultural landscapes, long-term bird conservation efforts will require forming partnerships with landowners to forge "win-win" solutions. During the first nine months of the program, 13 habitat management plans were written, resulting in the management and restoration of more than 300 acres of grassland bird nesting habitat. The seed of conservation was planted, and, with the help of Oregon's farmers, grassland bird populations will hopefully grow.

Compared to historic grassland distributions, grassland loss has been extremely high in the Coast Range (99 percent estimated loss), West Cascades (99 percent estimated loss for montane grasslands and 93 percent for balds and bluffs), and Willamette Valley (99 percent estimated loss). Grasslands have been lost due to conversion to other uses, particularly development, vegetation changes following fire suppression, and invasive species. In these ecoregions, grasslands are particularly fragmented and isolated. In cooperation with landowners, remnant patches in these ecoregions should be maintained and, where feasible, restored.

Strategy Species associated with grasslands vary by ecoregion, but include burrowing owl, common nighthawk, grasshopper sparrow, long-billed curlew, ferruginous hawk, Oregon vesper sparrow, streaked horned lark, western bluebird, western meadowlark, common kingsnake, Fender's blue butterfly, hoary elfin (butterfly), Kincaid's lupine, Oregon silverspot butterfly, Siskiyou short-horned grasshopper, Taylor's checkerspot butterfly, bristly-stemmed sidalcea, Coast Range fawn-lily, Cascade Head catchfly, Nelson's sidalcea, Lawrence's milk-vetch, Spalding's campion and Tygh Valley milk vetch. A recovery plan is currently being developed by the U.S. Fish and Wildlife Service for grassland-dependent species that occur in western Oregon and southwestern Washington. It will provide conservation strategies for several Strategy Species in the Willamette Valley.

Limiting factors to grassland habitats

Factor: Altered fire regimes: At sites with deep soils, maintenance of grasslands is dependent in part on periodic fire. Fire suppression has lead to encroachment by shrubs and conifer trees in some areas. In the Columbia Plateau, the introduction of cheatgrass can increase the frequency, intensity, and spread of fires. In the Coast Range, prescribed fire is difficult due to high precipitation and wet conditions. When conditions are dry enough to use prescribed fire, there are usually concerns with risk to surrounding forests. In the Klamath Mountains and Willamette Valley, prescribed fire poses challenges such as conflicts with surrounding land use, smoke management and air quality, and safety.

Approach: Maintain open grassland structure by using multiple site-appropriate tools such as prescribed burns, mowing, controlled grazing, hand-removal of encroaching shrubs and trees, or thinning. Re-introduce fire at locations and at times where conflicts such as smoke and safety concerns can be minimized. For all tools, minimize ground disturbance and impacts to native species.

Minimize the spread of cheatgrass. Carefully manage livestock grazing to maintain native plants and soil crust (cryptogrammic crust) in low cheatgrass areas. Control fires in cheatgrass-dominated areas.

Thorn Prairie Restoration

Named for mountain whitethorn, a shrub with evergreen leaves and sharp thorns, Thorn Prairie is a mosiac of montane grassland and shrubland habitats. It is located east of Roseburg in the Cascade Mountains, near Diamond Lake. Historic photographs taken from fire lookouts show that Thorn Prairie was once 5,000 to 8,000 acres and was a major feature on the landscape. Due to fire suppression and other reasons, Thorn Prairie is now only 10% of its former size. In addition, whitethorn has expanded into grassy areas and declined in health and productivity in other areas. St. John's wort, an invasive plant, has invaded the eastern edge of the prairie. Although greatly reduced in size and quality from historic conditions, Thorn Prairie is still critical habitat for elk and black-tailed deer. The mosiac of grass and whitethorn provides spring forage, hiding cover for calves and fawns, and winter range. The prairie also provides nesting habitat for songbirds that prefer open brush or grassy habitats. In fact, the diverse shrub community attracts calliope hummingbirds and green-tailed towhees, which are uncommon in the West Cascades ecoregion. In partnership with Rocky Mountain Elk Foundation, Oregon Hunters Association, Umpqua Valley Audubon Society, and ODFW, the Forest Service plans on restoring and expanding the prairie to 1000-2000 acres in size. Since the late 1990's, the Forest Service has treated about 250 acres by implementing prescribed burns; conducting mechanical treatment of shrubs (mowing); planting shrubs, forbs and grasses; and closing a low-use road. Future efforts will include a timber sale to remove encroaching small conifers, invasive plant control, more shrub mowing, and a volunteer-based effort to remove conifers by hand. These restoration efforts will benefit a variety of species, as well as the hunters and birders who enjoy wildlife and open spaces.

Factor: Invasive species: Invasive plants are degrading grassland habitats and displacing native plants and animals. Depending on the area, such invasives include cheatgrass, medusahead, ventenata, rush skeleton weed, spikeweed, Hungarian brome, yellow star-thistle, knapweeds (diffuse, spotted and purple), leafy spurge, Canada thistle, St. John's wort, tansy ragwort, Armenian (Himalayan) blackberry, evergreen blackberry, Scotch broom, false brome, Harding grass, and tall oatgrass. Most low elevation grasslands are almost entirely dominated by invasive grasses, forbs, and/or shrubs. At higher elevations, such as montane grasslands in the West Cascades, invasive plants are less common. However, these habitats need to be monitored to detect new invasives, as livestock (cows, pack horses, riding horses) can introduce invasive plants.

Approach: Identify the best remaining native grasslands and work with landowners to maintain quality and limit the spread on invasives. Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Prioritize control efforts and use site-appropriate methods to control newly-established invasive plant species for which management can be most effective. Re-seed with site appropriate native grasses and forbs after control efforts. Conduct research to determine methods to manage established species such as cheatgrass, medusahead rye, and false brome. Where appropriate, manage livestock grazing and recreational use to minimize new introductions in montane grasslands. Support current prevention programs such as weed-free hay certification.

Factor: Land use conversion: Remnant low-elevation grasslands in valleys, foothills and coastal headlands are subject to conversion to agricultural, residential or urban uses.

Approach: Because many of these areas are privately-owned, voluntary cooperative approaches are the key to long-term conservation using tools such as financial incentives, technical assistance, regulatory assurance agreements, and conservation easements. Use and extend existing incentive programs such as the Conservation Reserve Program and Grassland Reserve Program to conserve, manage and restore grasslands and to encourage no-till and other compatible farming practices. Support and implement existing land use regulations to preserve forest land, open spaces, recreation areas, and natural habitats.

Factor: Land management conflicts: Resource conflicts can arise because high quality grasslands are often high quality grazing resources. Although grazing can be compatible with conservation goals, it needs to be managed carefully because Oregon's bunchgrass habitats are more sensitive to grazing than the sod-forming

Zumwalt Prairie: A Grassland System with Great Promise for Conservation

Nestled between the Wallowa Mountains and the canyon lands of the Imnaha, Snake and Grande Ronde rivers, Zumwalt Prairie is the largest and healthiest fescue-dominated grassland in the western United States. Fescue-dominated, deep-soiled prairies such as Zumwalt once stretched across the intermountain region of the northwestern United States and southwestern Canada, the northern foothills of the Rockies, and the northern edge of the Great Plains. Globally, nationally and at the state level, this grassland habitat currently occupies a very small fraction of its historical range. In 2000, The Nature Conservancy (TNC) purchased a 28,000-acre property which makes up the Camp Creek drainage, part of the 161,000-acre Zumwalt Prairie. Zumwalt's native prairie supports a stunning diversity of plant and animal species, including one of the most significant concentrations of breeding birds of prey in North America. Large mammals such as mule deer, elk, black bear, bighorn sheep, cougar, and bobcat share the preserve's grasslands and wooded canyons with smaller creatures including Belding's ground squirrel, badger, coyote, porcupine and fox. Thriving populations of Spalding's catchfly, a federally-listed threatened plant species that occurs in small isolated populations in remnant grasslands of the Northwest, can also be found on the prairie. Zumwalt has benefited from the careful management of past landowners, and grazing on the prairie has had limited lasting effect on the bunchgrass ecosystem. In addition to collecting data on a variety of plant and wildlife subjects, TNC is currently collaborating with members of the local community to better understand the compatibility between ecological and restoration goals and various forms of land use, including grazing. TNC's approach is one example of community-based conservation, and their research will provide new insights into best management practices on grassland habitats.

grasses of the mid-western prairies. Overgrazing can lead to soil erosion, changes in plant species composition and structure, and degradation by invasive plants.

Approach: Use incentive programs and other voluntary approaches to manage and restore grasslands on private lands. Manage public land grazing to maintain grasslands in good condition. Conduct research and develop incentives to determine grazing regimes that are compatible with a variety of conservation goals. Restore native grassland habitat when possible, using active work that creates local jobs where passive restoration is impractical due to grassland condition, invasive species, or other issues. Promote use of native plants and seed sources in conservation and restoration programs.

Factor: Loss of habitat connectivity: In the Columbia Plateau and Willamette Valley, grassland habitats often occur in small patches such as roadsides and field edges. These patches are valuable habitat for some species, especially some plants. However, small size and poor connectivity of remnant patches limits dispersal for some species, and makes patches more vulnerable to potential impacts from adjacent lands (e.g., herbicide and pesticide drift).

Approach: Maintain high priority patches and improve connectivity when possible. When possible and practical, use a landscape approach in incentive programs to create buffers around key grassland patches.

Factor: Loss of habitat complexity in oak savannas: In the Klamath Mountains and Willamette Valley ecoregions, large-diameter oak trees with lateral limb structure and cavities continue to be lost.

Approach: Maintain large oaks, remove competing conifers or densely-stocked small oaks, create snags from competing conifers to provide cavity habitat. Also see discussion on oak woodlands.

Factor: Recreational impacts: In some grasslands in the Coast Range, Klamath Mountains, and West Cascades ecoregions, recreational use impacts grassland vegetation.

Approach: Work with land managers to direct recreational use away from highly sensitive areas. Provide recreational users with information on grassland issues and low-impact uses.

Photo © Bruce Newhouse

Strategy Habitat: Late Successional Conifer Forests (low and mid-elevations)

Ecoregions:

Late successional conifer forests are a Strategy Habitat in the Coast Range, Klamath Mountains, and West Cascades. Although late successional conifer forests occur at all elevations, the Conservation Strategy focuses on ones at low and medium elevations (primarily below 4,500 in elevation).

General Characteristics:

Late successional forests are defined by the plant species composition, overstory tree age and size, and the forest structure. They include characteristics such as a multi-layered tree canopy, shade-tolerant tree species growing in the understory, large-diameter trees, and a high volume of dead wood such as snags and logs. Historically, fire was the major natural disturbance in all but the wettest climatic areas. Depending on local conditions, fires in western Oregon conifer forests were moderate- to high-severity with fire return intervals averaging 100 to more than 400 years. The historic fire regime created a complex mosaic of stand structures across the landscape.

Ecoregional Characteristics:

West Cascades: Coniferous forests dominate the landscape of the West Cascades ecoregion. Late successional Douglas-fir forests are older forests (hundreds of years old), generally occurring below 3,500 feet, but sometime occurring up to 4,000 feet. Douglas-fir trees occur up to 5,000 feet, but do not dominate the forests at higher elevations. Western hemlock is almost always co-dominant and usually dominates the understory. Other common trees include grand fir and western redcedar in the northern portion of the ecoregions, or incense cedar, sugar pine, white fir and western redcedar in the southern portion of the ecoregion. The understory has shrub and forb species such as vine maple, salal, sword fern, Oregon grape, western rhododendron, huckleberries, twinflower, deerfoot vanillaleaf and oxalis. In the absence of disturbance, Douglas-fir forests eventually will convert to western hemlock.

Coast Range: Although there are several forest types in the Coast Range ecoregion, two types predominate: Sitka spruce and Douglas-fir. Sitka spruce forests occur within a narrow fog- and salt-influenced strip along the coast and extending up some valleys. Soils tend to be deep, acid and well-drained. Sitka spruce dominates the overstory, but western hemlock, western redcedar, Douglas-fir, big leaf maple, and red alder may be present. The lush understory has salmonberry, vine maple, salal, evergreen huckleberry, sword fern, deer fern, and a high diversity of mosses and lichens. Due to high precipitation, fires are rare and the primary disturbances include small-scale windthrow and storm surges. Inland, Douglas-fir forests dominate. These characteristic species are similar to those in the West Cascades Douglas-fir forests, described previously.

Klamath Mountains: Mixed conifer forests are characterized by conifers but have high tree diversity. Douglas-fir is usually dominant. Depending on site characteristics, other canopy trees include white fir, sugar pine, ponderosa pine, and incense cedar. Port-Orford cedar occurs on moist sites such as riparian areas. Jeffrey pine and knobcone pine occur on serpentine soils. Broadleaf trees such as tanoak, canyon live oak, golden chinquapin and Pacific madrone may occur in the subcanopy. Understories are mostly dominated by shrubs, but can be dominated by forbs, graminoids, or may be relatively open.

Conservation Overview:

Oregon's forests have long contributed to local economies through timber harvest. However, both timber harvests and a number of large fires have replaced much of late-successional forests with younger forests in western Oregon. Based on a comparison between historic (1850) and current vegetation maps, an estimated 25 percent of late-successional Douglas-fir mixed conifer forests remain in the Klamath Mountains, 23 percent remains in the West Cascades, and 8 percent remains in the Coast Range. In the West Cascades, less than 10 percent of historic

low-elevation and mid-elevation (more than 4,500 feet) late-successional forests remain. (Source: Oregon Natural Heritage Information Center spatial data sets).

Federal lands contain substantial acreages of mature and late successional forests, but many of these forests occur in a patchwork with much younger forests that are managed with shorter rotations to generate timber products. The younger forests still maintain their capacity to become older forests, and they often support many of the same wildlife species. However, late successional forests support a wide array of species. Many of these species require large patches of these older or mature forests to survive and may be sensitive to changes in the forest seral stage.

The Northwest Forest Plan and National Fire Plan are both large, comprehensive natural resource planning efforts that include some federal forests in western Oregon. The Northwest Forest Plan identifies conservation priorities for species affected by loss and fragmentation of large patches of late successional forests, assessing over 1,000 species (See the Northwest Forest Plan description in Appendix II). The federal plan is expected to provide at least 50 percent probability that populations of most species would stabilize with either good or only moderately limited distributions on public lands. For the majority of species, the probability of stable, well-distributed populations is estimated at 75 percent (USDA/USDI 1994). The adaptive management component of the Northwest Forest Plan has not been fully implemented. Adaptive management approaches could be used to experimentally deal with risk of uncharacteristically severe wildfires, restore wildlife habitat features, and accelerate the development of characteristics such as multi-layered canopies.

Late Successional Reserves established under the Northwest Forest Plan were intended to ensure enough high quality habitat to sustain identified species. However, many of the federal lands that are designated as late-successional reserves do not include forests at the late-successional stage, while others are relatively small "checkerboards" of forests embedded in a matrix of private industrial timber lands, particularly in the Coast Range and Klamath Mountains. There is a potential for the amount of late successional forests to increase over time, under current state and federal policies.

Many of the Late Successional Reserves are in Fire Regime Condition Class II or Condition Class III, where the risk of loss of key ecosystem components is moderate or high. This risk is particularly acute in the Klamath Mountains, where recent large-scale severe wildfires have impacted wildlife habitat. In addition, all planning efforts are limited by understanding of landscape management and by ecological data availability. The outcome of these decisions, and the ultimate long-term impacts of these plans, is unknown.

Dead Wood isn't Dead

Dead wood is a vital habitat component. Woodpeckers excavate nesting cavities and forage for insect larvae in standing dead trees. The cavities they create provide shelter and nest sites for a wide variety of mammals and birds. Black bears crawl inside the base of decaying trees or hollow logs in search of warmer winter shelter. Amphibians, reptiles and small mammals travel through networks of downed logs, making vital connections between habitat and potential mates. Both standing dead wood, or snags, and downed dead wood thrown to the forest floor from storms or timber harvest are vital to many forest species, and provide nutrients and structure for a habitat brimming with wildlife. Salamanders, frogs, snakes, woodpeckers, swifts and other small birds, bats, squirrels, moles, voles, mosses, lichen, liverworts and bryophytes use snags and/or logs, while hundreds of species of insects, mollusks, slugs, mites, microbes and bacteria are abundantly attracted to it. These bugs busily recycle the dead matter into usable organic material, and make nutrients available for plants in soils. Large logs attract masses of carpenter ants, which in turn attract birds and mammals.

Dead wood links terrestrial and aquatic systems, too: when it falls into streams, dead wood provides necessary cover and breeding grounds for invertebrates, amphibians and fish. Nutrients infuse the water, and the large complex structures help to create pools of still water where young fish and aquatic invertebrate larvae can develop or hide from predators. One of the best ways to maintain the benefits of dead wood in the forest is to simply maintain existing snags and logs, where possible. Where dead wood is deficient, snags can be created through girdling, topping or fungal inoculation. Depending on the tree species and site characteristics, snags last from a few years to a few decades before falling to the forest floor and continuing their value as logs. In fact, large trees may provide habitat for more wildlife species, and provide habitat for a longer time, after they have died than they did while they were alive. For more information, see:

http://www.ccffa-oswa.org/index.html

http://www.fs.fed.us/pnw/pubs/brochures/dec-aid.pdf

The National Fire Plan is attempting to address the historic fire suppression and the impacts of recent catastrophic and uncharacteristic wildfires, recommending a variety of active management techniques for forests to increase fire safety and evaluation of their effects on fire behavior and the effectiveness of suppression [see the Statewide Perspectives and Approaches chapter for more information on altered fire regimes]. Results of implementing the National Fire Plan and its effects on both public safety and forest habitats are continually being evaluated.

In the Coast Range, three-quarters of the ecoregion is in state and private ownership. Oregon Department of Forestry manages 550,000 acres in the Coast Range ecoregion, primarily in the Clatsop, Tillamook, and Elliot State Forests. The Northwest and Southwest State Forest Management Plans provides management direction for all Board of Forestry Land and Common School Forest Lands. The plans include management strategies for 16 resources, including fish and wildlife, timber, recreation and water resources. The plans describe long-term desired future conditions, which include 10-30 percent in older forest structure. Most private forest lands are currently managed intensively for timber values using relatively short rotations, which will limit future development of late successional habitats in many areas.

Late successional conifer forests are particularly important for wildlife, mosses, and lichens. Depending on ecoregion, Strategy Species associated with late sccessional conifer forests include ringtail, fisher, marbled murrelet, northern spotted owl, red tree vole, American marten, Oregon slender salamander, Johnson's hairstreak (butterfly), and Roth's ground beetle.

Limiting Factors in Late Successional Conifer Forests:

Factor: Loss of some structural habitat elements: Where historic stands were perpetuated for 200 to more than 1,000 years, commercial forest lands are now harvested every 80 years or less, which discourages the establishment of large-diameter trees. In addition, the amount of large-diameter snags and large-diameter logs has been reduced over time through wildfire and timber harvest in many areas.

Approach: Develop programs, incentives, and market-based approaches to encourage longer rotations and strategically located large-diameter tree tracts. Where feasible, maintain structural elements such as large-diameter cull trees, snags and logs. Create snags from green trees or high-cut stumps where maintaining snags is not feasible or where snag management goals are not being met.

Factor: Loss of late-successional stand size and connectivity: Late successional forest stands have been greatly reduced in size and connectivity, particularly at lower elevations. This can impact species that are highly adapted to late successional conditions and /or species that have limited ability to move over long

H.J. Andrews Experimental Forest

Located in the heart of the central Cascade Mountains, the H.J. Andrews Experimental Forest is an innovative and unique resource for the long-term, integrated, and collaborative study of forest ecosystems. The Andrews Experimental Forest is the Pacific Northwest's only Long Term Ecological Reserve (LTER), one of only 26 sites established by the National Science Foundation to promote synthesis and comparative research across sites and ecosystems and among other related national and international research programs. The USDA Forest Service and Oregon State University work together to manage the forest, bringing dozens of scientists to the facility each year to conduct projects on many aspects of forests. The forest was established over 50 years ago, and became part of a national network of long-term ecological research sites in 1980. Researchers have the ability to manipulate large tracts of land, to study the results of different management practices in the most real-world scenario possible. Recent studies at the Forest are highly integrative, including the study of how forest practices affect streams and watershed dynamics. There is a continued emphasis on understanding how to predict the effects of land use, disturbance and climate change on the structure, function and composition of forested ecosystems. For more information, see:

http://www.fsl.orst.edu/lter/

http://www.fs.fed.us/pnw/exforests/hjandrews.shtml

distances to find new suitable areas. It also allows edge species to compete with ones adapted to extensive interior forest habitat.

Approach: Maintain existing plans to protect and develop habitat that has been identified as important to species of conservation concern. Use active management to accelerate development of late successional structural characteristics in key areas to expand existing late successional patches into larger areas to provide greater blocks of habitat for species with large area requirements or those that require interior forest habitat and are vulnerable to "edge effects." Continue to carefully plan forest practices to maintain connectivity, particularly when species vulnerable to fragmentation are present. Seek opportunities to coordinate management of public and private lands, whenever possible, to address conservation needs. Use voluntary conservation tools such as financial incentives and forest certification to achieve conservation goals on private lands. Carefully-implemented land exchanges in the Bureau of Land Management checkerboard areas offer potential to improve connectivity and habitat values.

Factor: Altered fire regimes: Particularly in the Klamath Mountains ecoregion, fire suppression has altered forest composition and structure, increasing the risk of large-scale, uncharacteristically severe wildfires. In the last few years, large wildfires like the Biscuit Fire have impacted late successional forest stands in the Klamath Mountains and West Cascades. Dense, brushy understories and land ownership patterns make it challenging to reintroduce fire in many areas. Efforts to reduce fire danger can help to restore habitat, but require careful planning to provide sufficient habitat features that are important to wildlife (e.g., snags, down logs, hiding cover).

Approach: Use an integrated approach to fuels management and forest restoration that considers historic conditions, wildlife conservation, natural fire intervals, and silvicultural techniques. Reintroduce fire where feasible; prioritize sites and applications. Maintain important wildlife habitat features such as snags and logs at a level to sustain wood-dependent species. Support implementation of the adaptive management component of the Northwest Forest Plan to experimentally address wildfire risks. Monitor results and use adaptive management techniques to ensure efforts are meeting habitat restoration and wildfire prevention objectives with minimal impacts on wildlife.

Photo © Bruce Newhouse

Photo © Bruce Newhouse

Photo © Stephen Anderson, The Nature Conservancy

Strategy Habitat: Oak Woodlands

Ecoregions:

Oak woodlands are a Strategy Habitat in the Coast Range, East Cascades, Klamath Mountains, West Cascades, and Willamette Valley ecoregions. Oak habitats also occur to a lesser extent in the West Cascades and western portion of the Columbia Plateau ecoregion.

Characteristics:

Oak woodlands are characterized by an open canopy dominated by Oregon white oak. Depending on the ecoregion and site characteristics, oak woodlands may also have ponderosa pine, California black oak, and/or Douglas-fir, or, on steep slopes, canyon live oak. In general, the understory is relatively open with shrubs, grasses and wildflowers. The tree canopy of an oak woodlands obscures between 30 percent - 70 percent of the sky as you look up at it. Oak habitats are maintained through fire, which removes small conifers and maintains a low to moderate shrub cover.

In the Coast Range and West Cascades, oak habitats are found in drier landscapes, such as south-facing slopes and foothills bordering the Willamette Valley. In the Klamath Mountains, oak woodlands are found in low elevations, on dry sites or in areas with frequent low-intensity fires. Here, woodlands may occur in a mosiac with chaparral and dry conifer woodlands. In the Willamette Valley, oaks were originally found in a mosaic of prairies, oak savanna, and riparian habitats throughout the valley floor and low elevation slopes. Oaks were most common on flat to moderately rolling terrain, usually in drier landscapes, and often are found between prairie remnants and conifer forests. Today, oak woodlands often are found in small isolated pockets surrounded by other land-uses, such as development or agriculture.

In the East Cascades, oak woodlands occur primarily on the north end of the ecoregion and in the Klamath River Canyon. They are located at the transition between ponderosa pine or mixed conifer forests in the mountains, and the shrublands or grasslands to the east. Oak habitats in the East Cascades are different in structure and composition than those in western Oregon, but are just as important to a variety of wildlife as well as rare plants.

Oak woodlands grade into oak savannas. Oak savannas are characterized by primarily upland prairie with widely-spaced large Oregon white oak and conifers. Oak savannas are discussed in the grasslands section. Oak woodlands also grade into pine-oak habitats in the Klamath Mountains, which are discussed in the ponderosa pine section.

Conservation Overview:

Oak woodlands once covered almost one million acres in the Coast Range and 400,000 acres in the Willamette Valley. However, the Coast Range now has less than four percent of its estimated historic oak woodlands and the Willamette Valley less than seven percent. Habitat loss has been less severe in the East Cascades, where fire suppression may have led to expansion of oaks into former shrub-steppe and grassland habitats, and in the Klamath Mountains.

Oak woodlands have been impacted by conversion to other land uses, invasive species, and vegetation changes due to fire suppression. As a result of conifer plantings and changes in fire frequency and intensity after European settlement, Douglas-fir now dominates in many of areas of the Coast Range and Willamette Valley foothills. Oak habitats are being converted to agriculture, residential and other uses in Willamette Valley, the Coast Range foothills and the coastal hills in southern Oregon. Although loss of oak woodland in the Klamath Mountains is not currently as severe as in the Willamette Valley, increasing development threatens these habitats. The same rolling hills and scenic landscapes that indicate healthy pine-oak habitat also attract new residents and developers. Because much of the remaining oak woodlands are in private ownership and maintenance of these habitats require active management, cooperative incentive-based approaches are crucial to conservation.

Loss of oaks, particularly large diameter open-structured trees valuable to wildlife, are of particular concern because oak trees have a slow growth rate and require a long time to regenerate, slowing restoration. In addition, reproduction and recruitment of younger trees is poor in many areas.

Depending on the area, Strategy Species associated with oak woodlands include Columbian white-tailed deer, chipping sparrow, slender-billed (white-breasted) nuthatch, Lewis' woodpecker, white rock larkspur, and wayside aster.

Limiting Factors in Oak Woodlands

Factor: Fire suppression and fir encroachment: With fire suppression, Douglas-fir encroaches into oak habitats and eventually shades out oak trees and seedlings, as well as other plants that require open growing conditions. Many oak woodlands are now dominated by Douglas-fir. Without active management, they will eventually become conifer forests. In some areas of the East Cascades, fire suppression combined with grazing has influenced fine fuel production and led to encroachment by conifers and establishment of dense patches of small, shrubby oaks.

Approach: Use multiple tools, including prescribed fire, mowing, grazing and selective harvest to maintain open canopy oak-dominated woodlands. Ensure that tools are site-appropriate and implemented to minimize impacts to native species. Re-establish site-appropriate native grasses, herbaceous plants, and shrubs.

Factor: Land use conversion and continued habitat loss: Particularly in the Willamette Valley and Klamath Mountains, oak woodlands continue to be converted to agricultural (especially vineyards), rural residential, and urban uses.

Approach: Much of the remaining oak woodland habitat occurs on private land, so cooperative incentive programs are the best approach. Work with private landowners to maintain and restore oak habitats. Develop oak products compatible with conservation to promote maintenance of oak as an economic use. Work with local communities to plan development in a manner that conserves critical habitats.

Factor: Loss of habitat structure: Large-diameter oak trees with lateral limb structure and cavities have been lost. In many areas, there are not sufficient numbers of replacement trees to maintain these habitat elements over time. In the absence of fire, densely-stocked regenerating oaks often do not develop open-grown

Oregon White Oak and Wildlife

With its sweeping branches, graceful form, and sometimes impressive size, the Oregon white oak adds drama to open landscapes. Oregon white oak ranges from southern British Columbia to southern California. It is the most widely distributed oak species in Oregon and the dominant oak of the Willamette Valley. Its acorns once fed the Calapooia people, and its wood is now used for special products such as fine furniture and oak barrels. It provides food and shelter for a great variety of wildlife. Acorn woodpeckers and western gray squirrels feed on the acorns. Birds forage for insects among the variety of lichens and mosses that grow on the large limbs. Mistletoe parasitizes its branches, providing fruit as important winter food for western bluebirds and is a host plant for Nelson's hairstreak (butterfly). Probably the most valuable habitat features of white oak are its dead branches and cavities, which provide safe places for wildlife to rest and raise young. Oregon white oaks are slow-growing and shade intolerant. Open-canopy, large-diameter trees are continuing to be lost due to overshading by conifers, removal and natural causes, but are not being replaced. Landowners can maintain the oak's legacy by conserving older trees and managing younger trees

Oregon Oak Communities Working Group

Since 1999, people interested in Oregon's oak communities have been meeting informally to better understand the ecology and management of savanna and woodland oak communities found throughout the state. Participants include private landowners, foresters, wildlife biologists, nursery owners, botanists, parks managers, planners, restoration specialists, and researchers from over 40 organizations, universities, and agencies. Under the umbrella of the Oregon Oak Communities Working Group, this diverse group of people is drawn together by a common interest in oak habitats and the wildlife and plants associated with oaks. The group meets 2-4 times a year to share information on restoration and management techniques, restoration projects, research findings, and grant and financial incentive opportunities. The meetings always involve a field trip to a project site for better discussion of issues and techniques. By providing a forum for information sharing, the group assists landowners with a variety of management goals and approaches and increases our overall understanding of oak communities.

structures due to shading. In the East Cascades, grazing or very hot fires can lead to development of brushy-structured trees. The shaded or grazed oaks do not develop the lateral limbs, cavities and higher acorn crops of open-grown trees, thus are less valuable to wildlife. Woodcutting often removes snags.

Approach: Maintain a diversity of tree size and age across the stand, in particular large oak and ponderosa pine trees. Remove conifers or small oaks that are competing with larger oaks. Maintain snags and create snags from competing conifers to provide cavity habitat. Encourage oak reproduction through planting or protective exclosures. It may be appropriate to use nest boxes as a temporary cavity habitat in oak restoration project areas. Improve methods to promote oak reproduction and creation of open-grown structures.

Factor: Invasive species: Depending on the ecoregion and site, invasive plants such as Armenian (Himalayan) blackberry, evergreen blackberry, Scotch broom, English hawthorn, false brome, yellowstar thistle, diffuse knapweed, and puncturevine invade and degrade oak woodlands. In many oak woodland stands, the overstory is intact but the understory is highly degraded.

Approach: Identify the best remaining native oak woodlands and work with landowners to maintain quality and limit the spread on invasives. Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Prioritize control efforts and use site-appropriate methods to control newly-established invasive plant species for which management can be most effective. Re-seed with site-appropriate native grasses and forbs after control efforts. Prescribed burning may be useful for management of some invasive species, particularly shrubs.

Photo © Bruce Newhouse

Acorns and *Quercus garryana* (Oregon White Oak) Acorn Production Study

The number of Oregon oak species range from 5 in southwest Oregon to just one, the Oregon white oak, in the northern Willamette Valley and East Cascades ecoregions. Oaks are probably most famous for their acorns. Oregon's Native Americans boiled Oregon white oak acorns to remove the tannins, then ground the acorns into meal. Acorns are eaten by a variety of wildlife and are particularly important in the winter, when other foods are scarce. During the fall, jays, woodpeckers, and rodents busily cache acorns for later meals. Wildlife that either regularly or occasionally eat acorns include wood duck, band-tailed pigeon, California quail, varied thrush, western scrub jay, Steller's jay, Lewis' woodpeckers, acorn woodpeckers, black bear, western gray squirrel, Douglas tree squirrel, mice, raccoons, black-tailed deer, and mule deer. Oregon's oak habitats have declined due to habitat conversion and fire suppression. Research and restoration projects are being implemented to help understand and reverse the decline.

In the *Quercus garryana* Acorn Production Study, citizens are helping scientists learn more about oaks and acorns. The USFS Olympia Forest Sciences Laboratory has been conducting a volunteer-based survey of Oregon white oak acorn production since 1999. As of March 2004, over 1400 trees have been measured across the tree's range in Oregon, Washington and British Columbia. The survey is intended to find out patterns in acorn production, especially related to environmental characteristics. Volunteers record tree and site characteristics and then estimate acorn production each year using standard categories. Although new study trees are added each year, some trees have been followed for 6 years. These measurements over time give an idea of average acorn crop size and how often good and bad acorn crops occur over time. By using volunteers, the survey can measure more trees in more places than foresters on their own. In addition, school classes can adopt an oak tree to study as a science project. The survey will provide insight into factors that help oak reproduction, as well as food sources for wildlife. For more information, visit www.fs.fed.us/pnw/olympia/silv/oak-studies. In addition to the acorn survey, the Olympia Forest Sciences Laboratory maintains an oak literature database that allows landowners, land managers, biologists and other interested people to search for information about Oregon white oak. It is at www.fs.fed.us/pnw/olympia/silv/oak-studies/oak-bibliography.shtml.

Strategy Habitat: Ponderosa Pine Woodlands

Ecoregions:

Ponderosa Pine Woodlands are a Strategy Habitat in the Blue Mountains, East Cascades, and Klamath Mountains ecoregions.

Characteristics:

The structure and composition of ponderosa pine woodlands varies across the state, depending on local climate, soil type and moisture, elevation, aspect and fire history. In Blue Mountains, East Cascades and Klamath Mountains ecoregions, ponderosa pine woodlands have open canopies, generally covering 10-40 percent of the sky. Their understories are variable combinations of shrubs, herbaceous plants, and grasses. Ponderosa woodlands are dominated by ponderosa pine, but may also have lodgepole, western juniper, aspen, western larch, grand fir, Douglas-fir, incense cedar, sugar pine, or white fir, depending on ecoregion and site conditions. In the Blue Mountains, ponderosa pine habitats also include savannas, which have widely-spaced trees (canopies of <10 percent) that are generally more than150 years old. The structure of a savanna is open and park-like with an understory dominated by fire-adapted grasses and forbs. In the Blue Mountains and East Cascades ecoregions, ponderosa pine habitats generally occur at mid-elevation and are replaced by other coniferous forests at higher elevations. In the Klamath Mountains ecoregion, pine or pine-oak woodlands occur on dry, warm sites in the foothills and mountains of southern Oregon. Here, pine woodlands are usually dominated by ponderosa pine, but may be dominated by Jeffrey pine, depending on soil mineral content, fertility, and temperatures. The understory often has shrubs including green-leaf manzanita, buckbrush, and snowberry. Pine-oak woodlands are found primarily in valley margins and foothills on rolling plains or dry slopes. The structure is park-like with an open grassy understory, but may also have a shrubby understory. Throughout Oregon, the open structure of ponderosa pine habitats were historically maintained by frequent, low-intensity surface fires.

Conservation Overview:

Ponderosa pine habitats historically covered a large portion of the Blue Mountains ecoregion, as well as parts of the East Cascades and Klamath Mountains. Ponderosa pine is still widely distributed in eastern and southern Oregon. However, the structure and species composition of woodlands have changed dramatically. Historically, ponderosa pine habitats had frequent low-intensity ground fires that maintained an open understory. Due to past selective logging and fire suppression, dense patches of smaller conifers have grown in the understory of ponderosa pine forests. Depending on the area, these conifers may include shade-tolerant Douglas-fir, grand fir and white fir, or young ponderosa pine and lodgepole pine. These dense stands are vulnerable to drought stress, insect outbreaks, and disease. The tree layers act as ladder fuels, increasing the chances that a ground fire will become a forest-destroying crown fire. Many of these mixed conifer forests are located in Fire Regime Condition Class II or Condition Class III areas where the risk of loss of key ecosystem components is moderate or high.

Of particular concern is the loss of large-structured pine habitats. Based on a comparison between historic (1850) and current vegetation maps, less than 1 percent of the historic large-structured ponderosa pine is estimated to remain in the Blue Mountains and East Cascades ecoregions and approximately 7 percent remains in the Klamath Mountains (Source: Oregon Natural Heritage Information Center spatial data sets). Most of these large-structured ponderosa pine stands are greatly reduced in size and connectivity, occurring in a patchwork with much younger forests that are managed with shorter rotations to generate timber products. The younger forests still maintain their capacity to become older forests, and they often support many of the same wildlife species. However, large-structured ponderosa pine forests support some species, such as the white-headed woodpecker, that require large-diameter trees and an open understory and are sensitive to changes in the forest seral stage.

On federal land, ponderosa pine habitats are increasingly being restored or managed consistent with wildlife conservation goals through fuel reduction treatments and retention of large-diameter trees and high snags densities.

Ponderosa pine habitats are important for wildlife that prefer open, dry forests. In addition to the white-headed woodpeckers, other Strategy Species associated with ponderosa pine habitats include flammulated owl, Lewis' woodpecker, and several bats.

Limiting factors to Ponderosa Pine woodlands:

Factor: Altered fire regimes and addressing risk of uncharacteristically severe wildfire: Past forest practices and fire suppression have resulted in either dense growth of young pine trees with greater shrub cover or dense, young mixed-conifers stands, depending on local site conditions and natural climax species. These dense stands are at increased risk of uncharacteristically severe wildfires, disease, and damage by insects. Over time, some stands will convert to Douglas-fir and grand fir forests, which do not provide adequate wildlife habitat for species dependent on open ponderosa pine habitats. Particularly in the Blue Mountains and East Cascades, dense understories and insect-killed trees make it difficult to reintroduce natural fire regimes.

Efforts to reduce wildfire danger and improve forest health may help restore wildlife habitat but require careful planning to provide sufficient habitat features that are important to wildlife (e.g., snags, down logs, hiding cover for big game.) Hiding and thermal cover for deer and elk can be lost as a result of thinning ponderosa pine habitats. Loss of hiding cover can increase vulnerability to illegal hunting and other disturbances. It can also contribute to redistribution of elk to private property, potentially creating an unwanted situation for landowners.

In parts of the East Cascades and Klamath Mountains, increasing home and resort development in forested habitats makes prescribed fire difficult in some areas and increases risk of high-cost wildfires. Although many urban-interface "fire proofing" measures can be implemented with minimal effects to wildlife habitat, some poorly-planned efforts have unintentionally and unnecessarily harmed habitat.

Wildfire reforestation efforts should be carefully planned to create stands with tree diversity, understory vegetation and natural forest openings.

Approach: Use an integrated approach to forest health issues that considers historic conditions, wildlife conservation, natural fire intervals, and silvicultural techniques. Evaluate individual stands to determine site appropriate actions, such as monitoring in healthy stands or thinning, mowing, and prescribed fire in at-risk stands. Implement fuel reduction projects to reduce the risk of forest-destroying wildfires. Reintroduce fire where feasible. Thin stands where appropriate, and develop markets for small-diameter trees. Maintain historic native understory conditions.

Implement fuel reduction projects and (where appropriate) prescribed fire to reduce the risk of forest-destroying wildfires, considering site-specific conditions and goals. Fuel reduction strategies need to consider the habitat structures that are needed by wildlife (snags, down logs, and hiding cover). Design frequency and scale of prescribed fire to improve regeneration and establishment of native shrubs. However, lower log and shrub densities may be desirable in priority white-headed woodpecker areas, so sites need to be evaluated for appropriate understory vegetation management. Maintain areas of multi-species, dense woody plant hiding cover in patches. Maintain vegetation to provide screening along open roads, prioritize roads for closure based on transportation needs and wildlife goals, and/or manage road use during critical periods.

Monitor forest health initiatives efforts and use adaptive management techniques to ensure efforts are meeting habitat restoration and forest-destroying fire prevention objectives with minimal impacts on wildlife.

Work with homeowners and resort operators to reduce vulnerability of properties to wildfires while maintaining habitat quality. Highlight successful, environmentally sensitive fuel management programs.

In the case of wildfires, maintain high snag densities and replant with native tree, shrub, grass, and forb species. Manage reforestation after wildfire to create species and structural diversity, based on local management goals.

Factor: Loss of size and connectivity of large-structure ponderosa pine habitats: Particularly in the Blue Mountains and East Cascades ecoregions, large-structure ponderosa pine habitats have been greatly reduced in size and connectivity by timber harvest, conversion to rural residential uses, and other activities. Few large blocks remain.

Approach: Maintain large blocks of large-structure ponderosa pine habitat. Plan reforestation to allow for corridors between habitat blocks. In areas of the East Cascades experiencing rapid development, work with local communities to minimize development in large blocks of intact habitat.

Photo © Wallowa Resources

Factor: Invasive species: In parts of the Blue Mountains and East Cascades, invasives such as diffuse and spotted knapweed, Dalmatian and common toadflax are invading and degrading some ponderosa pine woodlands. Also in the Blue Mountains, the annuals cheatgrass and medusahead rye can result in an invasive vegetative understory that is highly susceptible to burning and provides a "high-fuel" content that carries wildfire more easily than the native vegetation. Armenian (Himalayan) blackberry, Scotch broom and several grasses are an issue in the Klamath Mountains.

Approach: Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Prioritize efforts and control key invasives using site-appropriate methods. Control wildfires in cheatgrass-dominated areas of the Blue Mountains. Fortunately, many areas of the Blue Mountains and East Cascades still have few invasives currently threatening ponderosa pine habitats. In these areas, invasive plants should be monitored and controlled as they first arrive when control is more efficient, practical, and cost-effective. Reintroduce site-appropriate native grasses and forbs after invasive control. Prescribed burning may be useful for management of some invasive species in the Klamath Mountains.

Collaborative Conservation Project: Restoring ponderosa forests, reviving the wood products industry

In the western United States, historical fire exclusion, livestock grazing and timber management practices have led to unhealthy forest conditions characterized by dense, diseased stands left vulnerable to intense wildfires. The warm-dry and hot-dry ponderosa pine forests of Wallowa County in the Blue Mountains are no exception. Based in the town of Wallowa, Community Smallwood Solutions (CSS) is helping to restore

Gentner's Fritillary (*Fritillaria gentneri*) Habitat Restoration

Old cemeteries provide a taste of Oregon's history, both cultural and natural. In addition to honoring Oregon's early citizens, historic cemeteries often have healthy native plant communities. The Jacksonville Oregon Cemetery is the home for a rare lily and is the site of innovative conservation efforts. The recovery plan for the endangered Gentner's fritillary identifies the need for "rehabilitation of habitat, restoration of sites of historical occurrence, and augmentation of existing populations." The goal of population augmentation is to expand the geographic extent of existing populations, while simultaneously maintaining their natural densities and genetic integrity. The U.S. Fish and Wildlife Service, Oregon Department of Agriculture, the City of Jacksonville, the Jacksonville Woodlands Association, and the Herbert Stone Nursery are some of the partners working together to achieve this goal. In 2002, over 3,000 fritillary bulblets were collected Jacksonville Oregon Cemetery and two other populations. The bulblets were transported to Oregon State University for propagation trials. By 2004, the initial bulblets had grown to full-sized bulbs, and were producing their own bulblets. Many of these large bulbs and bulblets have now been planted back out at the original collection sites, and appear to be establishing successfully. At the Jacksonville Oregon Cemetery, additional efforts to improve the fritillary habitat include planting other native plant species and controlling invasive plants. These efforts promise new life for Gentner's fritillary populations.

Photo © Oregon Department of Agriculture

ponderosa pine and mixed conifer forests in northeastern Oregon by buying underutilized species and small diameter trees that contribute to overstocked, fire-prone stands.

For many years it was standard practice to remove the larger, more valuable timber from the forest. This form of timber management reduced the amount of large-structure habitat for wildlife. Combined with active fire suppression, this has led to an abundance of smaller trees, which increased fuel loads and the likelihood of a severe fire event. Ponderosa trees are covered by bark that is well-adapted to low-grade fires, a type of disturbance that is a normal and necessary component of ponderosa pine ecosystems. However, wildfires made intense by the build up of fuel loads like underbrush and an excess of small trees can damage soil, destroy habitat utilized by wildlife and put people and property at risk. CSS encourages the practice of thinning by creating a financial incentive to remove trees of comparatively lower value. Thinning overcrowded forests enhances the gradual diversification in species composition and wildlife habitats and fosters a fire regime that is more in balance with historical conditions and ecosystem requirements.

Photo © Wallowa Resources

Community Smallwood Solutions, a business venture of Community Solutions, Inc., the wholly owned for-profit of Wallowa Resources, exemplifies a commitment to forest restoration and economic development by utilizing small diameter trees from fuel-laden stands, resurrecting jobs in the battered wood products industry and increasing the overall value of forest property in northeastern Oregon.

Cooperative Conservation Project: Sustainable Logging Advances Forest Health on Tribal Lands

Forestry officials from around the world visit the Confederated Tribes of the Warm Springs Reservation to study one of the state's best examples of sustainable forest management. The tribes have adopted an integrated, holistic approach to managing their forests because they recognize that maintaining the ecological, cultural, spiritual and economic values of this resource is central to present and future tribal prosperity. With 15 to 20 percent of the tribes' operating budget and programs funded

Ponderosa Pine and Wildlife

Butterscotch or vanilla? On a warm summer day, the bark of ponderosa pine smells of butterscotch to some people and vanilla to others. Valuable to people and wildlife alike, ponderosa pine is an icon of the American West. Ponderosa pine, also called "yellow pine," is one of the most widespread and abundant tree species in the western United States. It grows on warm, dry sites with a short growing season and low summer precipitation. The distinctive bark is dark on young trees, but over time becomes cinnamon-tinged with deep furrows and scales resembling a jigsaw puzzle. Oregon's ponderosa pines have 5-10" long needles in bundles of three, although subspecies in other areas have two or five needles. The oval cones are three to six inches long and two to four inches wide and take two years to develop. Depending on site conditions, ponderosa pine trees generally grow 100-160 feet tall and two to five feet in diameter. Yet, they can grow even larger. The current state champion ponderosa pine, nicknamed "Big Red," is 162 feet tall, almost 29 feet in circumference, and nine feet two inches in diameter. "Big Red" may be over 500 years old and can be seen at LaPine State Park.

Ponderosa pine trees greater than 80 years old are well adapted to withstand fire, especially frequent, low intensity fires. Thick, scaly bark protects the tender inner bark, the self-pruning growth habit reduces ladder fuels, and an open-crown structure reduces intensity of crown fires. The ponderosa pine is truly a tree of many uses, for people and wildlife. Native Americans ate the seeds and sweet inner bark and used the resin as a salve for rheumatism and backaches. Ponderosa pine has long been valued for lumber because it has clear, knot-free wood that is low-resin and resistant to splitting. It is used for a variety of purposes, but is currently especially prized for cabinetry and furniture.

Ponderosa pine trees provide food and shelter for many wildlife species. Mule deer browse on young buds. The seeds provide food for gray jays, white-headed woodpeckers, Clark's nutcrackers, Cassin's finch, red crossbills, evening grosbeaks, mice, chipmunks, and tree squirrels. Chipmunks and nutcrackers cache the seeds for later meals, which helps seed dispersal. An even wider variety of species use pine bark, leaves, and cavities for foraging, nesting and hiding. Currently many ponderosa pine stands are considered "unhealthy" due to fire suppression and past management practices, which has affected pine-dependent wildlife populations. However, current efforts to restore ponderosa pine forests include innovative approaches that could potentially benefit both wildlife and people.

by timber sales and 10 percent of their workforce employed by the forestry industry, the tribes have a significant stake in the future of their forests. Grounded in sustainability, the tribes' strategy for maintaining their forests prescribes best management practices that reduce the threat of disease and devastating wildfires while generating income for the tribe and protecting wildlife diversity.

The tribes have divided their forested lands into two types, unreserved and reserved. Within these, different land use designations and levels of protection apply. For instance, unreserved lands are split into timber, wildlife and riparian zones. In the timber zone, commercial tree harvest is permissible but priority is given to high value, diseased or overstocked stands. Sensitive species and habitat for game and non-game are also protected in the timber zone. The wildlife zone is managed for deer and elk habitat and a higher percentage of tree canopy is left intact. The riparian zone buffering streams is off limits to any timber harvest, although limited harvest may occur outside of these zones. Reserved lands are strictly managed for recreational, cultural and ecological values and human meddling in natural processes is discouraged.

Striving for forest health by carefully managing the resource base for a range of values has turned into an opportunity for the tribe. In 2003, the tribes had their forests certified by Smartwood, an organization accredited by the Forest Stewardship Council (FSC), which is the gold standard in sustainable forest management. Smartwood determined that the tribes' responsible management of timber, wildlife and recreational resources and their solid standing with local stakeholders qualified for FSC certification. To become 'certified' under FSC means that a forestry operation must meet FSC's high environmental, social and economic standards and be vetted by an approved third party like Smartwood.

While the tribes have been committed to forest stewardship for some time, certification is a market-based incentive that guides like-minded consumers towards products and brands they wish to support. With its logo, FSC gives tribes brand recognition that in turn helps consumers identify wood products made from well-managed forests.

"By choosing to have our forests certified by FSC we are reinforcing the priorities of our integrated resource management plan," says Robert Brunoe, Director of the Natural Resources Branch for the Confederated Tribes of the Warm Springs Indian Reservation. "We are also maximizing the visibility and value of our wood products in a marketplace that rewards sustainable practices."

Snags: Wildlife Condos

Photo © Bruce Newhouse

Also known as snags, dead trees provide food and shelter for a remarkable variety of wildlife. Carpenter ants and termites colonize dead trees and are food for woodpeckers and bears. Bats use crevices behind bark for roosting, and brown creepers use them for nesting. Using especially adapted skulls and bills, woodpeckers drill holes and carve cavities in wood. The cavities provide shelter and a place to raise young for the woodpeckers, and later provide homes for owls, songbirds, squirrels, bats, and martens. Landowners and land managers can provide snag habitat by retaining snags during management activities and creating snags by topping, girdling or inoculating trees with certain fungi. The diameter of snags should vary across the landscape, but large-diameter snags are particularly important to some wildlife species. Because snags frequently last only 10-30 years, depending on species and climate, snag management should plan for future as well as

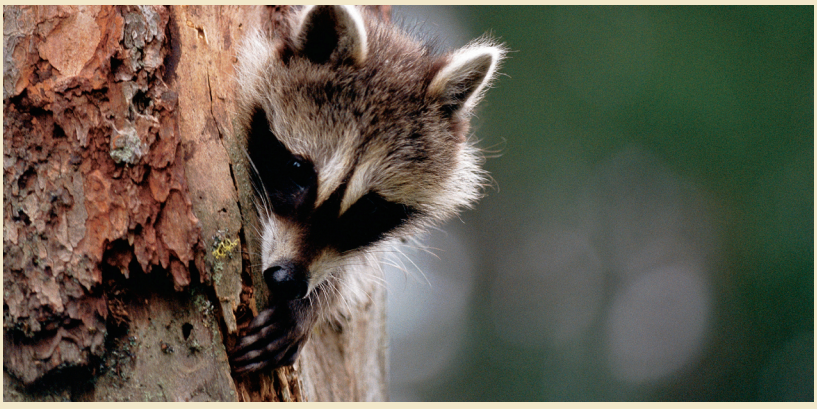


Photo © Bruce Newhouse

Strategy Habitat: Riparian Habitats

Characteristics:

Riparian habitats are those adjacent to rivers and streams or occurring on nearby floodplains and terraces. Riparian habitats are shaped and maintained through seasonal flooding, scour, and soil deposition. Floods replenish nutrients, recharge groundwater, and reset successional processes. Riparian habitats occur along rivers and streams at all elevations, from valley bottom floodplains to alpine torrents. Riparian habitats also include springs, seeps, and intermittent streams, and many low elevation alluvial floodplains confined by valleys and inlet.

Riparian habitats vary from sparsely vegetated areas to cottonwood gallery forests due to flood dynamics. Plant composition is influenced by elevation, stream gradient, floodplain width, and flooding events. Throughout most of the state, riparian vegetation is mostly dominated by deciduous trees and shrubs, such as bigleaf maple, alders, aspen, cottonwood, dogwood, willows and Oregon white ash. Conifers, such as pines and spruce, dominate some riparian woodlands at higher elevations. Riparian habitats in the Blue Mountains ecoregion are the most variable in Oregon, influenced by elevation and precipitation. In some ecoregions, riparian habitats include some riparian shrublands. In the East Cascades, riparian shrublands are dominated by deciduous shrubs, such as willows, creek dogwood, western birch or hawthorn. Shrub thickets in the Northern Basin are dominated by deciduous shrubs, such as several species of willow, birch, alder, and chokecherry. Riparian meadows are also found in the Northern Basin and Range and are dominated by grasses, sedges and rushes.

Conservation Overview:

Riparian habitats often have high species diversity and are critical for wildlife. These habitats are important to species that prefer moist shrubby or forested habitats. Riparian areas provide essential wintering habitat and travel corridors for songbirds, mountain quail, white-tailed deer, and other wildlife. In arid areas such as the Blue Mountains and Columbia Plateau, riparian habitats can provide abundant insects, plants, and moisture throughout the year. Riparian meadows include natural spring-seep habitats that are extremely important for a wide variety of species, including greater sage-grouse chicks and butterflies.

In addition to providing habitat for birds and other wildlife, riparian habitats have important ecological functions. Healthy riparian vegetation protects banks from erosion, influences in-channel aquatic habitats, maintains favorable water temperature for fish through shading, filters runoff, and provides nutrients. Riparian vegetation creates meanders and increases habitat complexity in valley bottoms. In the Northern Basin and Range ecoregion, riparian vegetation can protect against scour from summer storms. Riparian habitats link upland and aquatic habitats. Upland habitats have a critical role in watershed function and affect riparian and aquatic habitats, particularly in drier, low-elevation sites.

Riparian habitats have declined from historic levels and are now greatly reduced in area and connectivity, especially those in low-elevation areas and valley bottoms. Development, logging, road building, agriculture and pasture use have degraded some riparian habitat directly through decreased riparian vegetation, increased sedimentation, and reduced large wood in streams. Runoff containing fertilizers and other contaminants can further impact habitat.

However, steps have been taken through Oregon's planning and regulatory framework to address some of these issues. Cooperative restoration projects have benefited riparian-dependent species on forest and agricultural lands. In many cases, these efforts have focused on improving habitat quality in smaller, fish bearing streams. Streamside buffers implemented through the Northwest Forest Plan on public land and the Oregon Forest Practices Act on private land have improved riparian health on both public and private lands. On agricultural lands, Agricultural Water Quality Management Area Plans and Rules have been adopted across the state to address riparian conditions and other water

quality issues. While each riparian rule is slightly different depending on the local area, the riparian rules generally require agricultural activities to allow establishment, development, and maintenance of riparian vegetation consistent with site capability to provide moderation of solar heating, filtration of overland flow, and streambank stability. The State expects to see improvements in riparian conditions on agricultural lands in the future and has initiated a riparian land condition monitoring program to track changes in riparian conditions over time. Riparian areas across the state will likely be conserved by a variety of measures including a combination of existing state and federal programs, both regulatory and nonregulatory. This will control degradation and improve water quality. Oregon Department of Environmental Quality's completion of Total Maximum Daily Loads will also bring more specificity to recovery processes. For urban and rural residential development, some guidelines are provided through local land use ordinances adopted to address Statewide Planning Goal 5 requirements for riparian vegetation.

Riparian habitats can be difficult to map and study over time, presenting challenges for understanding their conservation. Of all the ecoregions, Klamath Mountains has the least sampled and least understood riparian habitats and more information is needed on their composition, ecology, and management.

In addition to these general conservation issues, there are several ecoregion-specific issues that affect riparian habitats:

- **Willamette Valley:** riparian forests have significantly declined with increasing development. Many streams now have only a thin strip of riparian vegetation, and some have none. Despite increasing emphasis on protection of riparian habitats and the formal establishment of the Willamette River Greenway, riparian habitats continue to decline.
- **Coast Range, Klamath Mountains, and West Cascades:** Historically, development, logging, road-building, and agricultural practices have all impacted riparian areas in these ecoregions and continue to have some impacts, particularly at lower elevations. Development threatens riparian habitats in these ecoregions because high quality riparian habitat is also often perceived as desirable sites for residential development. Creation of dams and reservoirs has impacted riparian habitats in the West Cascades. Streamside buffers implemented through the Northwest Forest Plan on public land and the Oregon Forest Practices Act on private land have improved forestland riparian health in the last 15 years.
- **Northern Basin and Range:** Riparian habitats have been heavily impacted by habitat conversion, unmanaged grazing, invasive species and alterations in hydrology such as water withdrawals and channelization. Historically, beavers played a key role in creating wetlands and riparian areas, but beaver populations have declined. Construction of flood control dams, channelization of stream courses, and increased stream withdrawals for irrigation and other uses caused further riparian loss and degradation. Juniper is encroaching in some riparian habitats, affecting hydrology.

Limiting factors to Riparian habitats:

Factor: Loss of riparian habitat, floodplain function, and habitat complexity: A high percentage of low-elevation and valley bottom riparian habitats have been lost. Riparian vegetation often is lost as habitat is converted to other uses. In several areas around the state, large cottonwood trees and gallery forest have been lost due to clearing and altered hydrological regimes. Development can restrict the natural ability of streams and riparian habitats to meander over time, limiting these habitats. Floodplains have been converted to other uses. Excessive removal of riparian vegetation can cause sedimentation that damages aquatic areas, loss of habitat complexity, and increased water temperatures that adversely affect aquatic habitat. Loss of streamside vegetation leads to bank erosion. Grazing and dam construction can degrade riparian habitats. Urban development has led to stream channelization and vegetation loss in some areas.

Approach: Restore riparian zones that will provide the full array of associated ecological functions. Use voluntary cooperative efforts (i.e., Conservation Reserve Enhancement Program) and incentive programs to conserve, maintain and restore riparian habitats on private lands. Identify and apply lessons learned from successful riparian restoration efforts on private lands to future projects. Develop tools and financial incentives to assist with streambank stabilization and decrease downstream soil movement. Improvements in riparian habitats and hydrology can also improve the quality of remaining wetland habitats. Maintain and restore riparian buffers and minimize impacts from road building on public lands. Where appropriate, permit beaver habitat usage to continue maintaining habitat complexity, particularly in the Coast Range and parts of eastern Oregon. Maintain channel integrity and natural hydrology. Where feasible, work to restore historic hydrological conditions. Ensure that adequate riparian vegetation remains following management activities, so riparian vegetation can continue to prevent erosion, preserve water quality, and promote water temperatures favorable for fish. Restore lost vegetation through planting of native trees, shrubs and ground cover. Manage for future sources of

large woody debris. Maintain and/or expand existing tracts of cottonwood forest and all cottonwood trees greater than 20 inches diameter regardless of landscape context.

Factor: Habitat degradation: In the Blue Mountains, Northern Basin and Range, East Cascades, and Columbia Plateau ecoregions, historic overgrazing has led to soil erosion, poor regeneration of hardwood trees and shrubs, changes in plant species composition and structure, and degradation by invasive plants. Although some areas are slowly recovering, many miles of stream are still lacking riparian vegetation. On-going grazing impacts remain in some areas, especially at low and mid-elevations. Western juniper is encroaching in some riparian areas of eastern Oregon.

Approach: In cooperation with landowners, land managers, and grazing leasees, encourage approaches that keep livestock out of riparian areas such as off-site watering. Develop and implement grazing regimes that are compatible with riparian conservation objectives. Selectively fence restoration sites or other high priority areas to exclude ungulates at least until riparian vegetation recovers. Evaluate impacts by encroaching western juniper, and remove juniper from upper reaches of higher elevation watersheds, if site-appropriate. Plant riparian vegetation at priority sites, using native plants. Consider managing seasonal timing of grazing. For example, projects in the Trout Creek Mountains and Pueblo Mountain areas in the Northern Basin and Range ecoregion have increased willow, aspen, and grass coverage. Continue to develop and implement grazing regimes in partnership with landowners and grazing permitees that support riparian conservation objectives.

Factor: Loss of habitat connectivity: Riparian habitats are important movement corridors for wildlife, but habitat loss has resulted in reduced area and connectivity of riparian habitats.

Approach: Enhance or re-establish the extent and connectivity of existing riparian habitats.

Factor: Water availability: Riparian bottomland habitats compete for water with other uses, particularly in the Blue Mountains, Columbia Plateau, East Cascades, and Northern Basin and Range ecoregions. In eastern Oregon, agriculture consumes much of the available water. Diversions occur at all major streams, and most valley bottoms have multiple canals that divert the water. As a result, riparian habitats no longer support the many channels and sinuosity that are characteristic of healthy stream systems.

Approach: Cooperative voluntary approaches which allow for purchase of instream water rights, prioritize use for agricultural purposes providing the greatest economic benefit, and maintain streamflow and water storage are important to riparian conservation.

Factor: Invasive plants: Invasive plants (such as knapweeds, knotweeds, reed canary grass, and thistles) degrade riparian habitats by competing with native plants. In the Columbia Plateau and Northern Basin ecoregions, pasture grasses and cheatgrass dominate the understory in some areas. In some riparian areas in the Northern Basin and Range, Columbia Plateau and East Cascades ecoregions, overgrazing has resulted in poor regeneration of hardwood trees and shrubs and change in plant species, including invasion by non-native grasses and forbs.

Approach: Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Control key invasive plants using site-appropriate tools, including mechanical, biological and chemical treatments. Use chemical treatment carefully and where compatible with water quality concerns, focusing on spot treatment during the dry season. In the Columbia Plateau and Northern Basin and Range, focus control at low elevation sites, unless near streams (seeds could flow downstream). Provide information to local governments and landowners about potential invasive plants. Where necessary (i.e., some areas in the Northern Basin and Range, East Cascades and Columbia Plateau ecoregions), develop and implement grazing management regimes that are compatible with riparian conservation objectives.

Cooperative Conservation Project: Landowner's vision, values at heart of Wallowa River restoration project

Doug McDaniel remembers when the Wallowa River meandered naturally through his family's property and the river was defined by its rugged character and healthy in-stream and riparian habitat for fish and wildlife. Since then, significant stretches of the Wallowa River, a tributary of the Grande Ronde, were straightened and pushed aside to accommodate rail, roads and pasture for livestock. Changing a river's course was standard practice well into the 20th century but the ecological effects of this engineering achievement were unknown or not considered until recently. The physical changes increased the riverbed's gradient and water velocity while overgrazing of streambanks and adjacent meadows led to less plant cover critical to maintaining the river's ecology and hydrology.

Today, with technical and financial assistance from private, government and tribal partners, McDaniel is restoring his reach, or approximately 2,550 feet, of the Wallowa River near Lostine in Wallowa County. Primary partners, led by Wallowa Resources of Enterprise, include ODFW,

USDA's Natural Resources Conservation Service, and the Grande Ronde Model Watershed Program. Construction of an oxbow will recreate the river's historically winding path and the addition of rootwads and rocks to the new channel will reduce water flow and improve instream habitat for anadromous and resident aquatic species such as steelhead and chinook. Restoring the river's surrounding wetland also is a priority. Improvements to riparian and meadow habitat will benefit a host of wildlife species that utilize this habitat for nesting, hiding cover, or winter forage.

Financial support for the restoration project has come from a variety of sources, including McDaniel, the landowner. The Bonneville Power Administration and the Oregon Watershed Enhancement Board have awarded grants to support excavation of the new channel and revegetation of the riverbank. Revenue from the sale of gravel removed from the newly excavated riverbed on McDaniel's property is also helping to pay for restoration activities.

No other restoration project of this magnitude has been undertaken in the region and the partners hope McDaniel's actions will inspire other landowners to carry out similar efforts.

Cooperative Conservation Project: 'CREP' funds enhance tribal, private efforts to restore creek

Since 1994, the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) have worked steadfastly with private landowners to improve water quality in Wildhorse Creek, which receives and transports tons of sediment from upland fields downstream into the Umatilla River. Consequently, sediment-laden water flowing into the Umatilla River from Wildhorse Creek poses a threat to salmon and steelhead known to spawn in the river.

Three quarters of the land in Wildhorse watershed is privately owned and under intensive cultivation so efforts to improve water quality and habitat for native fish hinge on the voluntary conservation practices of landowners. The CTUIR has relied on funding from the Bonneville Power Administration, the Bureau of Indian Affairs, and the U.S. Fish and Wildlife Service to carry out the lion's share of restoration work. Another source of federal funding, the Conservation Reserve Enhancement Program (CREP), promises to build on tribal efforts in the Wildhorse Creek watershed by encouraging agricultural producers to reduce soil erosion and restore natural vegetation along stream banks. CREP, funded by the U.S. Department of Agriculture and administered by the Farm Service Agency, makes annual rental payments to landowners who install or protect vegetative buffers along fish-bearing streams that cross their crop fields or pastures. Typically, landowners enrolled in CREP construct livestock exclusion fences to restrict grazing animals from streams or plant vegetation to rehabilitate riparian areas and protect aquatic species.

Containing some of the most productive farmland in the Umatilla Subbasin, Wildhorse Creek watershed is an important area for agricultural production. Today, 90 percent of the watershed is cultivated for dryland crops. Tilling the soil and removing upland and riparian vegetation to maximize the amount of land under production has contributed to soil erosion, elevated levels of in-stream sediment and altered the floodplain's hydrology to the detriment of salmonids. Excessive sedimentation smothers gravel beds used by spawning salmon, cutting off the supply of oxygen to developing salmon eggs. Moreover, inadequate streamside vegetation reduces shading, causing stream water temperatures to rise and placing greater stress on salmon.

So far, restoration activities include the planting of thousands of locally grown, native shrubs and trees, including choke cherry, elderberry, willow and cottonwood, along a mile of Wildhorse Creek. Smooth-wire fences have been erected to limit livestock access and impacts to help the vegetation recover. Sediment retention structures have also been installed in the stream channel to decrease in-stream erosion and capture top soil runoff from nearby fields. The creek passes through S & M Farms, owned by Bud Schmidtgall, who agreed to take some of his land out of production for 15 years in the hopes that bringing back natural vegetation is in the long-term interest of his business. As the creek's hydrology improves and the water table rises, portions of Schmitdgall's pasture that have been too dry for grazing will once again be fertile.

In the Wildhorse Creek watershed, several landowners have recently enrolled their streamside property in CREP. Statewide about 400 landowners and more than 700 stream miles are enrolled in CREP, with some 14 million in federal dollars dispersed under the program as of September 2003. Landowners who choose to sign up for CREP must enroll their land for at least 10 years but may extend their agreement up to 15 years. CREP requirements may soon be relaxed by expanding the definition of eligible streams to those that are not used by protected fish species. This change would increase the pool of potential landowners who qualify for the program.

The CTUIR identifies willing and qualified landowners to enroll in CREP. To date, the tribes have facilitated the transfer and maintenance of three stream miles of private land under the program in Wildhorse Creek watershed.

Cooperative Conservation Project: Local Land Trust-Utility Partnership Energizes Conservation Efforts

Residents of Eugene, Oregon drink some of the cleanest water in the country, according to national tests. The source of this drinking water is the McKenzie River, which originates in the Cascade Mountains and flows west, eventually emptying into the Willamette River.

The quality of the river's water is largely due to the health of the surrounding watershed, which harbors a variety of fish and wildlife, including the Willamette Valley's last sustainable run of wild chinook salmon. Much of the land in the watershed is federally protected as wilderness, restricting activities that might otherwise impact the key hydrologic functions of upland and riparian forests as natural filters and sponges. Private landowners and organizations also deserve credit for protecting the watershed and the ecological services it provides.

Endeavoring to conserve and enhance the watershed's habitat, fish and wildlife is the McKenzie River Trust (MRT), a private land trust that works toward this goal by partnering with private landowners, conservation organizations and, recently, a local utility. In 2000, the Eugene Water and Electric Board (EWEB) made a significant financial contribution to the McKenzie River Trust, enabling the organization to acquire and protect more than 1,000 acres of critical habitat.

The relicensing of the Leaburg/Walterville hydroelectric facilities in 1990 prompted calls within the community for EWEB to fund conservation work in the watershed. Ultimately, the utility donated $1 million in outright and matching grants to MRT after concluding that an investment in land conservation and habitat protection would benefit local residents by maintaining watershed function, water quality and fish and wildlife populations for years to come. Other stakeholders who stand to gain from long term protection of natural habitat are tribes, hunters, anglers, and wildlife viewers who utilize wildlife for cultural and recreational reasons.

Some of EWEB's donation was used by MRT to acquire the 47-acre White Branch Creek property off of the historic McKenzie River Highway 242, which has an abundance of wetlands, seeps, springs important to bull trout and wintering elk. Further downstream MRT acquired with EWEB funds the Big Island property whose side channels and slack water is essential habitat for the recently rediscovered Oregon chub, an endemic fish thought to have gone extinct in the McKenzie. MRT carried out a number of EWEB-funded conservation projects in the McKenzie River Watershed and established 25 partnerships with a diversity of stakeholders that continue to this day.

Cooperative Conservation Project: Untangling a knotty problem along the Sandy River

The Sandy River Watershed symbolizes the ecological fragility and importance of watersheds located in the shadow of large cities. Despite its proximity to Portland's suburbs, the Sandy River Watershed supports a remarkable diversity of animals ranging black bear and elk to neo-tropical migratory birds to amphibians. Anadromous fish such as federally protected chinook salmon and steelhead trout spawn and take shelter in the Sandy and its tributaries. In addition to its wealth of fish and wildlife, the watershed provides Portland area residents with drinking water, which ranks among the cleanest in the country.

While the river and its upland habitat bear many of the biological hallmarks of a healthy system, they also show signs of distress resulting from past and present human activity, including the seemingly innocuous human pastime of gardening. Unbeknownst to early residents, their decision to plant knotweed set the stage for a botanical invasion of the

Black Cottonwood and Wildlife

To many people, the spicy-sweet smell of cottonwood buds herald the warming days of spring. Birds value cottonwoods in the spring as well. Early migrant songbirds headed north to their breeding grounds are dependent on the insect food resources that occur first in these lowland riparian habitats while the forests and montane habitats are still under a blanket of winter. Large cottonwood trees and the gallery forests that form where stands of mature cottonwood trees occur, often are referred to as a "keystone" species or habitat. That is, they have a large impact on the ecosystem relative to their abundance on the landscape. Breeding and migratory bird densities in these cottonwood habitats are generally the highest of all habitat types in North America.

Mature stands of cottonwood trees also are essential nesting habitat for larger birds that need big trees for their nests such as bald eagles, great-horned owls, and a number of colonial nesters including great-blue herons. Mammals, amphibians and reptiles often are abundant in streamside habitats throughout Oregon. Through cooperative efforts such as The Oregon Plan for Salmon and the Willamette Restoration Initiative, riparian habitats are being restored. Initial efforts of wood placement, invasive non-native plant control, and riparian vegetation planting have begun to show early positive benefits. Maintenance of cottonwood gallery forests also will require new tools for restoring vital floodplain functions.

Sandy River Watershed that threatens to undermine the river's ecology. A native of Asia, knotweed probably escaped from private gardens and traveled downstream in the form of root fragments to establish new patches in freshly disturbed soil in the floodplains and cobble bars of the Sandy River. The catastrophic flood of 1996 is believed to have been a significant event and vector in helping knotweed expand beyond the sites where it was previously confined.

Knotweed is the botanical equivalent of the Hydra, the creature in Greek mythology that sprouted two new serpent heads for every head severed. Reproducing asexually from splintered rhizomes or even broken stems, knotweed can easily establish new patches from mother plants. Cutting knotweed stems down to the ground only encourages regrowth and mechanical removal can split roots or stems into pieces that disperse and form new patches down river.

Growing 13 feet or more each spring, knotweed effectively shades and displaces native riparian vegetation such as graminoids, shrubs, alders and willows. Native riparian plants provide critical breeding habitat or shelter for up to 90 percent of the wildlife species in any given watershed so the decline or displacement of native flora by knotweed can be detrimental to wildlife. Native shrubs and trees are important sources of in-stream woody debris, which help create favorable conditions for salmonid spawning and rearing. Moreover, knotweed's roots do not hold sediment as effectively as native plants, increasing the likelihood that sediment will accumulate on the riverbed floor and smother fragile salmonid eggs buried in the gravel.

Chemical treatment, either by spraying foliage or directly injecting the hollow stems, appears to be the only reliable way of destroying the persistent weed and this is exactly what The Nature Conservancy (TNC) has been doing, plant by plant, in the Sandy River Watershed. In 1998, TNC first detected knotweed patches on its Cornwell preserve in the Sandy River Gorge. Realizing the plant was a prolific weed and a potential ecological menace, TNC spearheaded a comprehensive, multi-year effort to survey knotweed's presence in the Sandy River Watershed and treat patches to bring the plant under control.

A major logistical challenge has been securing access to properties owned or managed by thousands of landowners ranging from individuals to government agencies. Building and maintaining relationships with hundreds of landowners was and remains a top priority of TNC. Jonathan Soll, TNC's Portland Area Preserve Manager, says "the cooperation exhibited by numerous, diverse landowners and TNC on knotweed control underscores what can be achieved when a conservation organization works in good faith with stakeholders."

Tony Lasher of the Resort on the Mountain in Welches echoes this sentiment, saying "Led by The Nature Conservancy and involving multiple partners, controlling knotweed on resort property has been a successful team effort. Treatment of invasive plants is part of a broader commitment by the resort to restore riparian and in-stream habitat, which we believe has helped bring back naturally spawning, wild coho. This work demonstrates that stewardship is compatible with use of the land as a golf course."

The Nature Conservancy also has partnered with several agencies and organizations whose funding, in-kind assistance or other services played a critical role in helping the organization wage a successful campaign against knotweed.

As of October 2004, The Nature Conservancy had surveyed and treated knotweed patches along more than 60 miles of the Sandy River or its tributaries. TNC has made significant progress in controlling knotweed, especially in the lower Sandy River where the number and density of stems has decreased 80 percent. TNC's efforts continue in earnest, with increasing energy and focus on the middle and upper Sandy River and its major tributaries of the Salmon River, Cedar Creek, Hackett Creek and Still Creek.

TNC's goal is to contain knotweed to the point where a local organization can take over much of the work and sustain the necessary level of landowner outreach, monitoring and treatment to minimize the plant's invasion and impacts in the Sandy River Watershed.

Cooperative Conservation Project: Ranchers and BLM restore at-risk aspen, rangeland potential

Private landowners, a local watershed council and the Bureau of Land Management have been working together to improve the health of Kiger Creek watershed in what has become a landscape dominated by western juniper. Low densities of western juniper, especially older stands, can be ecologically beneficial and provide valuable habitat to wildlife. However, the conversion of native plant communities like sagebrush, bunchgrasses and aspen to western juniper has implications for species that depend on these habitats for food or shelter. While the causes of juniper expansion are complex, most researchers agree that decades of fire suppression have allowed juniper to flourish.

Since the 1970s private landowners and public land management agencies in the Steens Mountains have been concerned about the impacts of juniper encroachment on local watersheds and wildlife. In areas of high juniper density, less precipitation feeds surface springs and streams because juniper plants intercept and transpire water back into the

atmosphere. As the carpet of native grasses converts to juniper, the soil hardens and runoff potential increases. One of the most significant changes to watershed function in the Kiger drainage has been the replacement of streamside stands of quaking aspen and other deciduous trees by juniper. Quaking aspen is a unique yet increasingly rare plant community because stands rely almost exclusively on the formation of new shoots from parent trees to replace themselves. Without the benefit of cross-pollination and seed production, aspen stands are genetically isolated and vulnerable to displacement by conifers like western juniper.

One of the participating private landowners, rancher Fred Otley, attributes the success of the watershed-wide restoration effort to the collaboration of multiple parties and to involving landowners along every step of the way. A grant from the Oregon Watershed Enhancement Board provided a third of the funding to the Harney County Watershed Council, which orchestrated the large-scale watershed and wildlife enhancement project. This funding enabled Fred's family ranch, along with neighboring rancher, Hoyt Wilson of Mann Lake Ranch, to cover costs associated with their portion of restoration work in Kiger Creek watershed.

The watershed restoration partnership used a combination of management approaches to remove juniper and facilitate the recovery of sagebrush, grasses and quaking aspen. Controlled burns on several thousand acres overgrown with juniper had the most promising results, with the number of young aspen trees increasing five-fold. What were stands of dying aspen before the prescribed burn are now healthy again, doubling in acreage in many areas. Oregon State University and USDA's Agricultural Research Service have established monitoring plots on Otley's property and BLM lands to document changes in habitat and watershed condition.

Fire-induced restoration helps wildlife by bringing back a diversity of plants, reduces erosion run-off by promoting regrowth of ground vegetation and gives ranchers like Otley greater flexibility in managing their livestock. Otley says that "following a rangeland burn grasses return in vigor and in greater diversity, giving me the level of comfort I need to change the rotation, timing and duration of grazing." If forage is plentiful a rancher can distribute cattle over a wider area for a more even graze, reducing the potential for overgrazing.

The voluntary efforts of private landowners like Fred Otley and Hoyt Wilson combined with the support of government and local organizations testify to the importance and effectiveness of private-public partnerships in carrying out watershed-wide restoration projects.

The Splash Zone

When two very different habitats come together, the transition zone often is home to diverse variety of species, including some rare or highly unusual species. Along the banks of swift-flowing streams and under the continuous tumbling of waterfalls, the splash zone is such a habitat. The splash zone hosts a diverse array of plants, amphibians and invertebrates that benefit from occasional or continuous water spray, but are otherwise adapted for life on the land. Even some birds take advantage of this unique habitat. Because water spray provides moisture in all but the driest months and moderates air temperatures, the splash zone provides a relatively stable microclimate. Ferns, sedges, saxifrages, goatsbeard, elkclover, mosses, and liverworts form a lush border around streams and waterfalls. In the Cascade Mountains, torrent salamanders, Dunn's salamanders, Cope's giant salamanders, and adult tailed frogs are frequently found in these splash zones, although they are also well adapted to other areas such as riparian habitat, wet talus and seeps near stream headwaters. American dippers forage in these areas, often nesting in holes in basalt streambank cliffs that are kept moist by continuous splashing. Black swifts frequently nest behind waterfalls. Some unusual and delicately beautiful wildflowers also occur near waterfalls, including mistmaiden, bronze bells and the endemic Oregon sullivantia.

Photo © Bruce Taylor

Strategy Habitat: Sagebrush Steppe and Shrublands

Ecoregions:

Sagebrush steppe and shrublands are a Strategy Habitat in the Blue Mountains, Columbia Plateau, and Northern Basin and Range ecoregions. Sagebrush habitats also occur in the East Cascades ecoregion. Due to the diversity of sagebrush community types and localized patterns of historic habitat loss, this Conservation Strategy focuses on different sage communities for each ecoregion.

General Characteristics:

Sagebrush-dominated communities differ greatly in structure and species composition depending on ecoregion, elevation, soils, moisture regimes, and fire history. In general, sagebrush habitats occur on dry flats and plains, rolling hills, rocky hill slopes, saddles and ridges where precipitation is low. Sagebrush steppe is dominated by grasses and forbs (more than 25 percent of the area) with an open shrub layer. In sagebrush steppe, natural fire regimes historically maintained a patchy distribution of shrubs and predominance of grasses. In shrub-steppe habitats of the Columbia Plateau and Blue Mountains, a soil crust (called a microbiotic or cryptogrammic crust) composed of lichens, mosses, fungi, and bacteria reduces soil erosion and moisture loss. Sagebrush shrublands are dominated by shrubs, with less area covered by grasses and forbs than in steppe habitats. In many, but not all, sagebrush shrublands, natural fire regimes created a mosaic of stand ages and structures.

Ecoregional Characteristics:

Columbia Plateau: Shrub-steppe habitats are open grass-dominated communities and are usually found on loamy, wind-deposited (loess) soils. In this ecoregion, shrub-steppe communities can be broadly divided into two elevational types. Within ten miles of the Columbia River, sandy shrub-steppe communities occur on unstable, well-drained soils. These include grasslands dominated by needle-and-thread; shrub-steppe habitats dominated by bitterbrush and needle-and-thread grass or Indian rice grass; and sand dune communities characterized by sagebrush, bitterbrush, and western juniper. There is usually a component of bare ground or open sand present. Further from the Columbia River, big sagebrush steppe communities include basin big sagebrush/needle-and-thread grass; basin wildrye and bluebunch wheatgrass steppe; and Wyoming sagebrush/bluebunch wheatgrass, which formerly occupied the low-elevation, loess uplands in the Columbia Plateau.

Blue Mountains: Big sagebrush steppe communities are similar to those of the Columbia Plateau. Sagebrush shrubland species vary by elevation and soils but include low sagebrush, silver sagebrush, rigid sagebrush, basin big sagebrush, Wyoming big sagebrush, mountain big sagebrush, threetip sagebrush, bitterbrush, and rabbitbrush. Soils vary in depth and texture but are non-saline.

Northern Basin and Range: Big sagebrush habitats include mountain, basin and Wyoming big sagebrush shrublands and shrub steppe. Structurally, these habitats are composed of medium-tall to tall (1.5 – six feet) shrubs that are widely-spaced with an understory of perennial bunchgrasses. Basin big sagebrush communities occur on deep silty or sandy soils along stream channels, in valley bottoms and flats, or on deeper soil inclusions in low sage or Wyoming big sage stands. Wyoming big sagebrush communities occur on shallower, drier soils. Mountain big sagebrush communities occur at montane and subalpine elevations on deep soiled to stony flats, ridges, nearly flat ridge tops, and mountain slopes. The fire frequency in big sagebrush habitats ranges from 10-25 years for mountain big sagebrush and 50-100 years for Wyoming big sagebrush.

Although these particular sagebrush communities are considered the priorities for this Conservation Strategy, other sagebrush types also provide important habitat for wildlife and may need to be considered at the local and watershed scale or for the conservation of particular species. For example, low sagebrush is important for greater sage-grouse, a Strategy Species.

Low sagebrush habitats cover large areas of the Northern Basin and Range ecoregion. They are characterized by very shallow, poorly developed soils and dominated by low sagebrush, perennial forbs and Sandberg's bluegrass. Low sagebrush provides critical wildlife habitat for many sagebrush-obligate species. Because of the poor shallow soils low sagebrush communities are slow (150-300 years) to recover from significant soil disturbance or fire. Soil disturbance in these sites often result in establishment of invasive annual grasses.

Conservation Overview:

Sagebrush habitats in eastern Oregon are both extensive and diverse, ranging from low elevation valleys to high mountain areas and from grassland-like shrub-steppe to relatively dense shrublands. In addition, there are many species and subspecies of sagebrush, which are associated with different grasses and herbaceous plants, depending on site conditions. General ecology and conservation issues vary by sagebrush community type, so conservation actions must be tailored to local conditions and conservation goals. Detailed descriptions of the different sagebrush plant communities are available from sources included in the references. Also, additional information on sagebrush habitats is in Oregon Department of Fish and Wildlife's *Greater Sage-Grouse Conservation Assessment and Strategy for Oregon: A Plan to Maintain and Enhance Populations and Habitat.*

Although sagebrush habitats are still common and widespread in eastern Oregon, some sagebrush habitat types have high levels of habitat loss and are of conservation concern. These types vary by ecoregion. In the Blue Mountains, valley-bottom sagebrush types, including threetip or basin big sagebrush, that occur on deep soils are particularly at risk. Also important are the valley margin steppe types with Wyoming sagebrush, squawapple and bitterbrush. In the lower elevations of the Columbia Plateau, shrub-steppe communities have been almost entirely replaced by irrigated agriculture. Remnant habitats occur on public lands such as the Boardman Bombing Range and in scattered patches along roadsides and fields.

In the Northern Basin and Range, several types of big sagebrush are combined into a single priority habitat for this Conservation Strategy, including mountain, basin and Wyoming big sagebrush shrublands and shrub steppe. This part of Oregon has some of the largest blocks of high-quality sagebrush habitat left in the United States, but some types have been impacted by several factors. Basin big sagebrush communities have had the greatest loss as compared to historic distribution. These communities historically occurred on deep soils, and they have been converted to agricultural development in some areas. The deep soils of basin big sagebrush are important for pygmy rabbits to create burrows.

Although Wyoming big sagebrush habitats are still common and widespread in this ecoregion, they have been altered to some degree by unmanaged grazing, invasive species, and altered fire regimes. With overgrazing and fire suppression, shrub (mostly sagebrush) density increases, bunchgrass and forb density decreases and invasive annual grasses increase. In many areas, these habitats have shifted from mosaics of native perennial grasses, forbs, and shrubs to landscapes heavily dominated by shrubs and invasive annual forbs and grasses. Juniper encroachment is an important issue in mountain big sagebrush communities between 4,500 and 7,000 feet.

Big sagebrush habitats have high structural diversity, thus more places to forage, hide, and build nests. As a result, the number of bird species generally increases with sagebrush height. Habitat values are also dependent on a diverse understory of bunchgrasses and flowering plants.

Throughout eastern Oregon, loss of grassland-shrub mosaics across landscapes and the degradation of understories have contributed to the decline of species dependent on high-quality sagebrush habitats. Strategy Species associated with sagebrush include greater sage-grouse, ferruginous hawk, loggerhead shrike, sage sparrow, Brewer's sparrow, sagebrush lizard, Washington ground squirrel, and pygmy rabbits (which often burrow along the interface where low sagebrush mixes with mountain big sagebrush). Other wildlife closely associated with sagebrush include black-throated sparrow, sage thrasher, sagebrush vole, and pronghorn.

Limiting factors to Sagebrush Steppe and Shrubland habitats:

Factor: Altered fire regimes and localized issues with prescribed fire: Fire suppression has resulted in undesirable changes in vegetation and contributes to increases in the intensity of wildfires. Western junipers encroach into and degrade sagebrush habitats with fire suppression in some areas. Dense juniper stands are not suitable for species that require open sagebrush habitats.

While a useful tool when tailored to local conditions, prescribed fire is not necessarily suitable for all sagebrush habitat types. Some sagebrush habitats, such as low sagebrush, are extremely slow to recover from disturbance such as prescribed fire. Inappropriately managed fire, both prescribed fire and wildfire, can increase dominance by invasive plants.

Approach: Carefully evaluate sites to determine if prescribed fire is appropriate, and be particularly cautious in low productivity needlegrass sites where recovery times are prolonged or in sites with invasive annual grasses. If determined to be ecologically beneficial, reintroduce natural fire regimes using site-appropriate prescrip-

tions. Use prescribed fire to create a mosaic of successional stages and avoid large prescribed fires. In areas where prescribed fire is undesirable or difficult to implement, use mechanical treatment methods (e.g., chipping, cutting for firewood) to control encroaching junipers. Develop markets for small juniper trees as a special forest product to reduce restoration costs.

Maintain juniper trees with old-age characteristics, which are important nesting habitat for songbirds and raptors. Use mechanical treatments such as mowing to maintain shrub cover at desired levels. Consider landscape context and landscape diversity when planning conservation actions.

Factor: Invasive species: Depending on the area, invasive plants such as yellow-star thistle, knapweeds (diffuse, spotted and purple), rush skeleton weed, spikeweed, leafy spurge and perennial pepperweed invade and degrade sagebrush habitats. The introduction and spread of the invasive annuals cheatgrass and medusahead, can increase the frequency, intensity, and extent of fires. Sagebrush and native bunchgrasses are adapted to infrequent, patchy fires, so are eliminated by hot fires. The dominance of invasives thus increases, further increasing wildfire risk.

Approach: Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Prioritize control efforts and use site-appropriate methods to control newly-established species for which management can be most effective (e.g., leafy spurge and perennial pepperweed). Cooperate with partners through habitat programs and County Weed Boards to address invasive species problems. Reintroduce shrubs, grasses and forbs at control sites through seeding and/or planting. In some cases, it may be desirable to use "assisted succession" strategies, using low seed rates of non-invasive non-native plants in conjunction with native plant seeds as an intermediate step in rehabilitating disturbances to sagebrush habitat.

Medusahead Challenge

In 2004, a group of concerned people from five western states convened to develop a strategic plan for managing medusahead. The mission of the Medusahead Challenge is to enhance and coordinate education, research, and management of medusahead infested rangeland throughout Oregon, Washington, Idaho, California, and Nevada. The USDA-Agricultural Research Service-Burns has been providing over all leadership to the program, and there are an additional 144 partners involved. The Medusahead Challenge is an outcome-based program organized around three interrelated focus areas; management, research, and education. In eastern Oregon, four working teams have developed community level management plans for medusahead. Each plan has identified a prevention and containment border, control strategies, and a restoration program where necessary. These plans are currently being implemented to the extent current resources allow. In addition, the Circle-Bar Ranch located near Mitchell, Oregon is being used a demonstration and case study for effective and state-of the art medusahead management. Substantial research is also underway. The goals are to 1) improve the ability to prevent invasion of rangeland by medusahead, 2) determine the most ecologically sound and cost effective methods for managing medusahead using herbicides, 3) develop landscape scale restoration strategies for medusahead-infested rangeland using successional management. For more information about the Medusahead Challenge contact: Dr. Roger Sheley at 541.573.8938; email: roger.sheley@oregonstate.edu.

Photo © Bruce Newhouse

Prevent and control wildfires in areas where cheatgrass dominates in the understory. Conduct research to determine methods to manage established species such as cheatgrass and medusahead. Minimize soil disturbance in high priority areas to prevent establishment of invasive species.

Factor: Damage to microbiotic soil crusts: In the Columbia Plateau and Blue Mountains, unmanaged grazing can damages soil crusts, which leads to soil erosion, changes in plant species composition and structure, and degradation by invasive plants.

Approach: Because most of the Columbia Plateau ecoregion is privately-owned, voluntary cooperative approaches are the key to long-term conservation in this ecoregion. Use tools such as financial incentives, technical assistance, regulatory assurance agreements, and conservation easements to achieve conservation goals. Continue to work with public land managers to ensure grazing is carefully managed. Conduct research and develop incentives to determine grazing regimes that are compatible with a variety of conservation goals.

Factor: Conversion to other land uses: In the Columbia Plateau, remnant shrub-steppe habitats are subject to conversion to agriculture. In the Blue Mountains and East Cascades ecoregions, rapidly growing human populations near Bend, Redmond and Madras, and slowly but steadily growing populations near Baker City and La Grande are resulting in land use conversion, habitat loss, and habitat fragmentation.

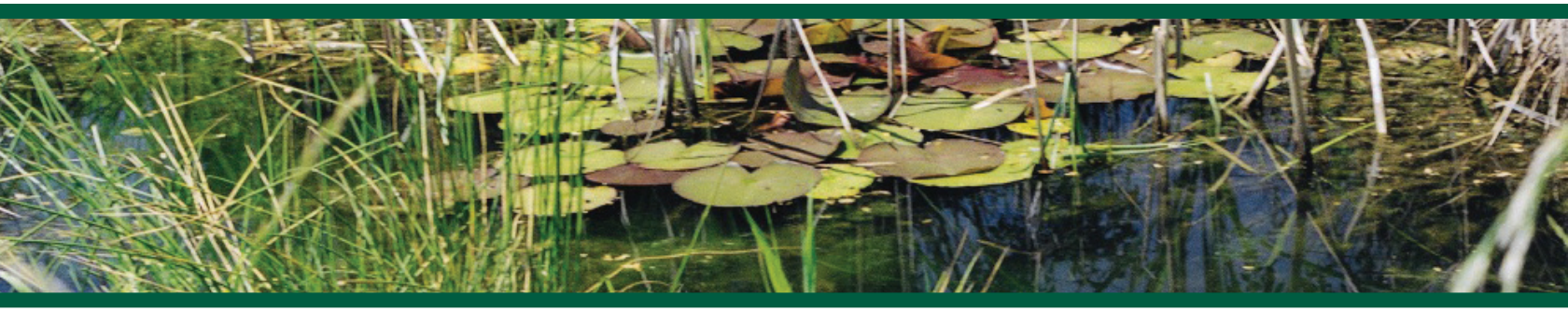
Approach: Use tools such as financial incentives and conservation easements to conserve priority sagebrush habitats. For example, re-establishing shrub component of lands enrolled in the Conservation Reserve Program has helped restore habitat structure. Work with community leaders and agency partners to ensure that development is planned and consistent with local conservation priorities. Support and implement existing land use regulations to preserve farm and range land, open spaces, recreation areas, and natural habitats from incompatible development.

Factor: Loss of habitat connectivity: In the Columbia Plateau, shrub-steppe habitats often occur in small patches such as roadsides and field edges. These patches are valuable habitat for some species, especially some plants. However, small size and poor connectivity of remnant patches limits dispersal for some species.

Approach: Maintain high priority patches and improve connectivity when possible.

Photo © Jim Yuskavitch

Photo © Michael Wilhelm



Strategy Habitat: Wetlands

Ecoregions:

Wetlands are a Strategy Habitat throughout Oregon (all eight ecoregions).

Characteristics:

Wetlands are covered with water during all or part of the year. Permanently wet habitats include backwater sloughs, oxbow lakes, and marshes, while seasonally wet habitats include seasonal ponds, vernal pools, and wet prairies. Wetland habitats are highly diverse and include the following different types:

- **Alkaline wetlands** occur in depressions in more arid areas and are intermittently flooded. An impermeable soil layer prevents water from percolating through the soil and concentrates salts in some areas. Soil salinity varies greatly by soil moisture and type and determines plant species. Plant species are tolerant of saline conditions due to the concentration of salts by water evaporation. Vegetation includes salt-tolerant grasses, rushes, sedges and shrubs such as black greasewood. Examples are found in the Klamath and Goose Lakes of the East Cascades ecoregion, and in the Northern Basin and Range ecoregion.
- **Deciduous swamps and shrublands** are located in depressions, around lakes or ponds or on river terraces. They generally flood seasonally with nutrient-rich waters and are dominated by woody vegetation including willows, hardhack, alder, red-osier dogwood, Pacific crab apple, and ash.
- **Marshes (including emergent marshes)** occur in depressions (ponds), fringes around lakes and along slow-flowing streams especially in valley bottoms. Marshes are seasonally or continually flooded and have water-adapted plants such as sedges, bulrush, spikesedges, rushes, cattails, and floating vegetation. Marshes can have mucky soils resulting in water with high mineral content and dominated by herbaceous species, often including wildflowers.
- **Off-channel habitat** (oxbow lakes, stable backwater sloughs, and flooded marshes) are created as rivers change course. In these areas, water moves slowly, providing quiet aquatic habitats.
- **Playas**, found in the Northern Basin and Range ecoregion, are sparsely vegetated (generally <10 percent plant cover) with grasses and are surrounded by a ring of shrubs. They are seasonally flooded and have highly saline soil. Plant species composition depends on soil salinity and moisture. Characteristic species include iodine bush, black greasewood, spiny hopsage, saltbush, alkali grass, wildrye and saltgrass.
- **Seasonal ponds and vernal pools** hold water during the winter and spring but typically dry up during the dry summer months. Vernal pools occur in complexes of networked depressions that are seasonally-filled with rainwater. They host a variety of species with unique adaptations.
- **Wet meadows (including montane wet meadows)** occur on gentle slopes near stream headwaters, in mountain valleys, bordering lakes and streams, near seeps, in large river valley bottoms, and in open wet depressions among montane forests. They are dominated by tufted hairgrass, sedges, reedgrass, spikesedge, rushes, and wildflowers. Montane wet meadows may have shallow surface water for part of the year, are associated with snowmelt, and are not typically subjected to disturbance events such as flooding
- **Wet prairies** occur in lowlands, especially in floodplains whereas wet meadows occur in depressions surrounded by forests and are associated with snowmelt. Wet prairies are dominated by grasses, sedges and wildflowers.

Conservation Overview:

Wetlands provide important habitat for migrating and breeding waterfowl, shorebirds, waterbirds, songbirds, mammals, amphibians and reptiles. In addition to being critical for birds and many kinds of wildlife, floodplain wetlands and backwater sloughs and swamps are impor-

tant rearing habitats for juvenile salmon. Wetlands have direct value for people because they improve water quality by trapping sediments and toxins, recharge aquifers, store water, and reduce the severity of floods. Restoration and careful management of wet meadow systems and other wetlands can increase sustainable production of forage for livestock and increase late-season stream flows.

In general, most wetland habitat loss has occurred at lower elevations and valley bottoms. Many of these wetlands have been drained and converted to agriculture. Some ecoregion-specific conservation issues include:

- **Blue Mountains:** In the Grand Ronde and Baker valleys, many of the lower elevation wetlands have been drained and converted to agriculture. Wetlands have been lost in other low elevation areas as well. Most remaining wetlands in this ecoregion are found at higher elevations, although some important valley bottom wetlands occur on private land.
- **Columbia Plateau:** Historic wetlands along the Columbia River have been inundated by reservoirs, while floodplain wetlands along the Umatilla and Walla Walla rivers and other tributary streams have mostly been developed for agriculture. The ecoregion once had extensive springs and vernal pools, many of which have been lost as water tables lowered. Currently, many wetlands in this ecoregion are man-made, such as marshes established along the edges of reservoirs and wetlands created as a result of crop irrigation practices. The Wanaket Wildlife Area, managed by the Confederated Tribes of the Umatilla, is a network of wetlands created through irrigation of pastureland and provides important habitat for many wetland – dependent species (see *www.ohjv.org/projects/columbia.html#wanaket*). Similarly, ponds on the Umatilla National Wildlife Refuge use runoff from the fish hatchery to seasonally water shallow pools for migrating shorebirds and to provide breeding habitat for Woodhouse's toads. Irrigation wetlands can be critical habitat, but can also be impacted by runoff containing fertilizers or other chemicals.
- **Coast Range** wetlands are vulnerable to development as more people relocate to be near the coast. Although wetland drainage is now discouraged, continuing development is a threat to some remaining wetlands. In addition, the ecological processes that create coastal wetlands - such as landslides, beavers, or logjams blocking streams – often are not compatible with current land uses, especially in more developed areas.
- **East Cascades:** The upper Klamath Basin once had an extensive shallow lake and marsh system, but much has been lost due to drainage and conversion to agriculture and urban uses, contributing to the complex issues surrounding water use and species conservation in the basin. The remaining wetlands in the Klamath Basin support one of the largest concentrations of waterfowl in North America, with over three million ducks and a half-million geese passing through annually. The area is a critical migratory staging area for 80 percent of all Pacific Flyway waterfowl. In the winter, the Klamath Basin hosts the largest wintering population of bald eagles in the continental United States. Klamath Basin provides Oregon's only permanent nesting areas for red-necked grebes and yellow rails.
- **Klamath Mountains:** Most low-elevation seasonal wetlands have been lost to habitat conversion to agricultural, urban,

Conservation Agreement for the Oregon Spotted Frog, Mink Lake Basin Population

In healthcare, there is a saying, "an ounce of prevention is worth a pound of cure." The same is true for nature conservation. Focusing efforts to benefit declining species before they become threatened is more successful and cost-effective than when populations become critically low. Conservation Agreements, which are voluntary partnerships between agencies or between agencies and private landowners, can provide a dose of conservation prevention. In 2000, the USFWS, USFS and ODFW created a Conservation Agreement for the Mink Lake Basin population of the Oregon spotted frog. Surveys conducted in the 1990's indicated that the Oregon spotted frog had disappeared from up to 90% of its former range in Oregon, Washington and British Columbia. As of 1999, only 31 populations were known to remain, making each population important. The Mink Lake Basin, part of the Three Sisters Wilderness Area of the Willamette National Forest, contained 2 known spotted frog populations. With over 100 ponds, lakes and wetlands and fewer impacts from habitat loss and degradation, the Mink Lake Basin offered a valuable conservation opportunity for this species. The agency partners identified limiting factors and evaluated risk to the two frog populations, then created a Conservation Agreement to address those factors. The Agreement addressed needs and responsibilities for site protection planning, population surveying and monitoring, data management, and developing education materials for wilderness recreationalists. The Conservation Agreement is a first step to ensure the long-term survival of these populations. By working together, people can find new ways to prevent species from becoming Threatened and Endangered.

and rural residential uses. Upland activities or altered hydrology impact many remaining wetland habitats. Rare vernal pool wetlands in Agate Desert near Medford support several rare plant and animal species.

- **Northern Basin and Range** has several large, deep freshwater marshes. Significant large wetlands are assocated with the large lake basins: Abert, Summer, Malheur and Harney lakes, and Warner Basin. However, many of the ecoregion's smaller historic wetlands have been lost due to habitat conversion or have been degraded through stream channelization, water diversions, and historic overgrazing. Creation of watering holes for livestock and wildlife has altered the hydrology at many major playas, making them one of the most altered habitat types in the ecoregion. In some areas, flood-irrigation of private pasture and hay meadows provides important seasonal habitat for migrating and breeding birds. In areas where flood irrigation is being applied to row crops, converting flood irrigation to piped sprinkler systems can improve water quality, reduce sedimentation, and reduce water loss due to evaporation. However, loss of flood irrigation without restoring wetlands in the landscape will negatively affect wetland species now dependent on flooded habitats. Cooperative projects such as settling ponds designed for cleaning flood irrigation "tail water" may offer a way to address water quality and wetland habitat issues.
- **West Cascades** wetlands are generally in excellent condition, although some areas, such as those located around Mt. Hood, can be impacted by uncontrolled livestock grazing, camping, or off highway vehicles use.
- **Willamette Valley:** Almost all remaining wetlands in this ecoregion have been degraded to some degree by altered water regimes, pollution, and invasive plants and animals.

Limiting factors to Wetland habitats:

Factor: Habitat loss: A high percentage of low-elevation and valley bottom wetlands have been lost or degraded through diking and draining, particularly in the Willamette Valley, Klamath Mountains and Coast Range ecoregions. In other areas, such as the Blue Mountains ecoregion, overgrazing can lead to soil compaction, changes in plant species composition, and spread of invasive plants. In some cases, due to short growing seasons and other factors, degraded meadows can be slow to recover if overgrazed. In the East Cascades, significant bird nesting habitat has been lost: early season haying in wetland habitats on private and public land can result in poor reproduction of ground-nesting birds due to increased predation on exposed nests and, in particular, direct mortality of young.

Approach: Identify wetlands that have been altered or lost and identify the potential for restoration. Some wetlands remain on private lands, so cooperative voluntary approaches are important to wetland conservation. There are also valuable wetlands on federal, state, and private reserves that are currently being restored. Build upon current cooperative efforts to maintain and restore wetlands

Big Marsh Wetland Restoration

Located just east of the Cascade crest and southeast of Crescent Lake, Big Marsh is part of the Oregon Cascades Recreation Area and offers excellent bird watching, hunting, hiking, and cross-country skiing opportunities. Big Marsh is a lush complex of wetland, aquatic, and meadow habitats. It is home to many wildlife species, including greater sandhill crane, blue-winged teal, Wilson's snipe, bitterns, mink, river otters, and elk. The marsh supports Oregon's largest remaining population of spotted frogs and provides breeding habitat for the rare yellow rail. Big Marsh's habitat diversity also hosts many uncommon and interesting plants including sundew, a carnivorous plant.

The valuable habitat present at Big Marsh today is the result of 15 years of cooperative restoration efforts. In the 1940's, ditches were installed to drain the marsh for grazing. The drainage resulted in a lowered water table, drier soils, and loss of aquatic and wetland habitats. Dry conditions and fire suppression allowed conifers to encroach into the marsh, further degrading open meadow and marsh habitats. The USFS purchased the marsh in 1982 and began restoration in 1989 in partnership with Ducks Unlimited. The main drainage ditch was blocked, which allowed water to spread naturally across the marsh and return to historic channels. Since 1997, side drainage ditches have been dammed or closed to further improve water flow, floodplain function, and habitat diversity. Recently, prescribed fire has been used on 650 acres to remove encroaching conifers and to restore historic open emergent wetland habitat. Also, lodgepole has been hand-removed from 300 acres with the assistance of RMEF, OHA, and SOLV volunteers. Future planned efforts include additional prescribed fire and lodgepole cutting, willow plantings, installation of a logjam to slow water discharge, continued monitoring of spotted frogs and yellow rails, and plantings of two rare plant species. Over the years, the USFS has partnered with RMEF, OHA, SOLV, Klamath County, Oregon Trout, Trout Unlimited, Federation of Flyfishers, ODFW, and USGS to restore habitat and monitor wildlife and fish at Big Marsh.

in partnership with private and public landowners. Continue to provide incentives to protect, maintain or restore wetlands such as the Wetlands Reserve Program offered through Natural Resource Conservation Service and private mitigation banking. Develop and implement grazing regimes that are compatible with wet meadow conservation objectives. Use cooperative efforts and incentive programs to establish semi-permanent livestock exclusion zones in priority areas. In partnership with landowners, implement later haying dates in critical bird nesting areas, particularly in the East Cascades.

Continue successful programs to educate individuals about the function and services provided by wetlands. Manage beaver populations to contribute to wetland creation and maintenance, when compatible with existing land uses. As part of mitigation programs, restore or create wet prairie, vernal pool and other seasonal wetland habitats as well as permanent wetlands. Promote awareness of the importance of temporary pond habitat. Explore opportunities to expand existing protected sites as a preference to restoring isolated small sites.

Factor: Water availability: Water is extremely limited in much of the Blue Mountains, East Cascades, and Northern Basin and Range ecoregion. As a result, there is competition for water resources, particularly in late summer. Lowered water tables affect wetland habitats. Competition for water harms both ecologic and economic goals. Water diversions for other uses change the seasonality of flooding, reduce the growing season, and can slow recovery and increase invasion of nonnative grasses. Drought years intensify water shortages.

Approach: Use cooperative efforts and incentive programs -- such as financial incentives for wetlands restoration, water rights acquisition, and wetland mitigation banking -- to manage water allocation and wetland habitats. Recognize importance of irrigated wetland habitats, and maintain benefits to species when considering various management and irrigation options.

Factor: Degraded water quality: Although wetlands have a role in purifying water, water quality is poor in some wetland systems. High temperatures affect water quality in some areas. Nonpoint source runoff from agricultural and residential areas contains pollutants that can affect water quality and nutrient levels, and these levels may increase as water evaporates throughout the season. High nutrient loads can contribute to toxic algal blooms. Under some conditions, repeated use of irrigation water can degrade water quality.

Approach: Provide economic incentives to decrease and manage the release of potential contaminants, such as fertilizers or pesticides, by controlling the timing of application. Use incentives to promote substitutes that are less toxic to wildlife and break down quickly in the environment. Work with agency, landowner and business partners to implement the federal Clean Water Act. Restore additional wetlands to increase filtering capacity.

Ladd Marsh Wildlife Management Area

With a whir of wings and kaleidoscope of color, thousands of ducks take flight from a hidden marsh on ODFW's Ladd Marsh Wildlife Area. Some have nested and raised their young during the summer, while others are merely passing through on their way to their winter homes. Located in the south-west corner of the Grande Ronde Valley, Ladd Marsh harbors some of the few remaining areas of undisturbed native valley floor vegetation and demonstrates the power of cooperative restoration efforts. A sprawling complex of shallow lake and wetlands known as Tule Lake once covered 10,000 acres in the valley. Ditching and diking, begun in the late 1800's, drained all but small remnants of the original wetlands. In 1949, 400 acres of remnant wetlands were set aside for Ladd Marsh. Since then, acquisitions and restoration efforts have restored approximately 1,300 acres of the original Tule Lake wetlands. Restoration has increased the numbers of waterfowl, shorebirds, and sandhill cranes using the area. Mountains, grasslands, and wetlands converge to provide habitat for nearly 300 different species of birds that occupy Ladd Marsh on a seasonal or year-round basis. Elk, mule and white-tailed deer, and pronghorn antelope find summer and winter forage on the hillsides and meadows. With abundant wildlife, Ladd Marsh is popular with hunters and wildlife watchers. An auto tour route, viewing platforms, and hiking trails help make the marsh a treasure for all Oregonians to enjoy. More than a dozen partners have contributed to these efforts, including Ducks Unlimited, The Nature Conservancy, NRCS, Bonneville Power Administration, USFWS, OWEB, Union County, Rocky Mountain Elk Foundation, ACOE, and the City of LaGrande.

In the Willamette Valley: Adopt critical actions recommended by the Willamette Restoration Initiative on Clean Water, such as reduce the levels of toxins and other pollutants in the Willamette Basin, provide economic incentives to decrease water pollution, and promote a developer education/certification program tied to incentives.

Factor: Invasive species: Invasives such as reed canarygrass, purple loosestrife, and Japanese knotweed invade and degrade wetlands, displacing native plants and reducing sources of food for wildlife and altering water flow and storage function. Perennial pepperweed and purple loosetrife in particular has affected important wetlands including Malheur Lake. Carp can impact wetlands by consuming important plants and by increasing turbidity.

Approach: Emphasize prevention, risk assessment, early detection and quick control to prevent new invasives from becoming fully established. Control key invasive plants using site-appropriate tools such as flooding (reed canary grass), biological control (purple loosestrife), and mechanical treatment such as mowing (all species). Use chemical treatment carefully and where compatible with water quality concerns (all species), focusing on spot treatment during the dry season. Adjusting water levels can also help to control invasive carp. Use revegetation and other means to establish and maintain healthy plant communities that are relatively resistant to invasion and that also meet other land use objectives.

Sycan Marsh Preserve: A Wetland Revitalized

Vast, remote and sometimes inaccessible, The Nature Conservancy's Sycan Marsh Preserve is a 30,500 acre montane-meadow wetland perched at 5000' elevation and surrounded by ponderosa and lodgepole pine forests, about 80 miles northeast of Klamath Falls. The name Sycan is derived from the Klamath Indian term "saiga keni" meaning "level grassy place," an apt description as the marsh is dominated by grasses, sedges and rushes thriving in a nearly level basin. The marsh is bounded to the east by the gently sloping flank of Winter Rim and by the Yamsay Mountain shield volcano to the west.

The wetland complex supports an exceptional diversity of wildlife, fish, and freshwater features. Over 130 species of birds are known to nest here, with an additional 60 species occurring during migration. The marsh supports one of the highest concentrations of nesting greater sandhill cranes in Oregon, and also has high densities of nesting willets, Wilson's phalaropes and black terns, long-bill curlews, white-faced ibis and common snipe. The marsh is one of a half-dozen locations in Oregon with breeding populations of yellow rail, and has nesting records for upland sandpiper, horned grebe and trumpeter swan, all rare breeders in Oregon. During spring migration, northward bound waterbirds stage on the marsh, with upwards of 10,000 tundra swans, 1,000 or more lesser sandhill cranes and flocks of white-fronted geese and northern pintails noted in some years.

Photos © (top) Alan D. St.John; (bottom-right) Larry N. Olson

The surrounding forested lands host over eight species of woodpeckers, including black-backed, northern three-toed and white-headed woodpeckers. Ongoing research by The Nature Conservancy and the U.S. Forest Service is evaluating the effects of prescribed fire and thinning on cavity nesting bird species on these adjacent forested lands. Sycan Marsh and its key tributaries, the Sycan River and Long Creek, support populations of threatened bull trout, rare native freshwater lampreys, several species of unique freshwater mussels and other aquatic invertebrates, and native redband trout. The marsh also supports unique plant communities, including a large fen, which is a groundwater system characterized by sundews, buckbean and other unique species.

Within the past decade, Sycan Marsh has been the subject of extensive restoration efforts lauded by wetland and wildlife managers. Major drainage canals have been filled, dikes cut, and water control structures repaired and managed with the goal of replicating the historic flow of water across the marsh. Efforts to recover bull trout have involved removal of non-native brook trout and the restoration of critical riparian habitat and stream channels on Long Creek. Surrounding upland forests have been thinned to improve watershed functions and benefit wildlife, including cavity-nesting birds.

Partners in the restoration and management of Sycan Marsh include the U.S. Forest Service, USFWS, NRCS, OWEB, the North American Wetland Council, ODFW and Klamath Tribes. In partnership with the ZX Ranch, The Nature Conservancy is testing different grazing regimes to evaluate practices and their compatibility with wetland and upland management strategies. The Sycan Marsh preserve is the focus of numerous research and monitoring projects concerning fish, wildlife, invertebrates, plants, freshwater and forest systems and restoration techniques. These efforts will provide guidance to future restoration and management actions both at Sycan Marsh and throughout the region.

Vernal Pools in Western Oregon

Vernal pools are a unique wetland type that fill and dry out each year with changing seasons. They are found in depressions among grasslands and open woodlands throughout the Willamette Valley and Klamath Mountains ecoregions. They range from a few square yards to several acres in size. Due to a layer of clay or other impervious materials, they retain water throughout some of the spring, but they typically dry completely by the early summer months. Vernal pools tend to be acidic wetlands with characteristic plant species including downingia, quillwort, pillwort, spikerush, popcorn flower, veronica, and tufted hairgrass. Due to drying patterns, vernal pools typically form concentric rings of similar vegetation. They are home to many unusual and rare plant species because of their relative isolation in upland-dominated landscapes and their wet-dry cycles.

In addition to rare plants, many wildlife species have adapted to life in these temporary pools. For example, amphibians have a short time period for growth and reproduction, and tadpoles in the pond must quickly obtain enough energy to metamorphose into frogs. Fairy shrimp produce their embryos in hardened cysts that remain dormant over the dry period of the pond. When they are vernal pools dry later in the spring, they provide feeding and nesting habitat for grassland birds. In many areas, vernal pools have been converted to other uses, particularly urban and rural residential development and agriculture. Recognizing the unique and sensitive nature of vernal pools, a recovery plan was recently drafted by the U.S. Fish and Wildlife Service (November 2004). It covers 33 species associated with vernal pools in California and Southern Oregon, including several Strategy species in the Klamath Mountains ecoregion (many plants; vernal pool fairy shrimp). Many of these species are local endemics occurring in this ecoregion because of its unique geology and climate. Upland habitat condition influences vernal pools in some areas because alterations in hydrology affect the amount and timing of pond fill. Restoration efforts focused on this sensitive habitat will benefit a wide variety of species with unique adaptations.

Photo © Bruce Newhouse

Howell's Spectacular Thelypody (*Thelypodium howellii* ssp. *spectabilis*) Conservation

The Baldock Slough Wetland Reserve Program project is truly an example of an innovative and effective plant conservation partnership. The Oregon Department of Agriculture (ODA), the U.S. Fish and Wildlife Service (USFWS), the Natural Resources Conservation Service (NRCS), Baker County, private landowners and private nurseries have combined resources and expertise to establish a new population of the endangered Howell's spectacular thelypody while working to conserve important wetland resources in Baker County. In 2001, thelypody seeds and nursery-grown plugs were planted at two sites and monitored for three years. Additional restoration efforts included invasive plant control, hydrologic restoration, and preliminary seed grow-out trials. The showy purple flowers of the thelypody were visible in many of the plots the year after transplanting. As of June 2004, both seed and plug plots have demonstrated recruitment, with many plots having over one hundred seedlings. Future monitoring is needed to document the ongoing success of the new populations, but the initial prognosis for these new populations is good.

Hairy Popcorn Flower or Rough Allocarya (*Plagiobothrys hirtus*) Conservation

State, federal and local government agencies have combined forces with The Nature Conservancy (TNC) and other private landowners to work towards recovering the hairy popcorn flower. This endangered species, with its cheerful white and yellow flowers, occurs only at low elevations in Douglas County. It is found in seasonal wetlands, which are one of the most rapidly disappearing habitat types throughout the state. The partnership to conserve the hairy popcorn flower started back in 1996, when the U.S. Fish and Wildlife Service provided initial funding for Oregon Department of Agriculture staff to collect seeds from several existing popcorn flower sites, develop seed germination and propagation protocol, and plant the cultivated plants on Oregon Department of Transportation (ODOT) and TNC land. The project was then expanded to include additional sites on Bureau of Land Management (BLM) and adjacent privately-owned lands. Since then, these populations have been monitored regularly, and they appear to be self-sustaining.

Wet Meadow Potholes Provide Stronghold for Biological Complexity

Even a puddle can provide a home. In fact, several small but distinct and important types of wetlands are filled each year by rain or snowfall, with no input from streams. These habitats include vernal pools that are only seasonally wet with snowmelt; shallow potholes that are often created by elk wallowing during the rut; wet meadows with waterlogged soil after seasonal snow; and wet prairies, where standing water occurs for only a very short time. Bull elk create wallows during the breeding season, which become valuable puddle habitat in the spring. Habitats like these range in size from puddles to many acres in size. These habitats are typically poorly described and rarely inventoried, but they are truly critical for the life cycles and genetic diversity of many animals in the West Cascades, including amphibians and insects such as dragonflies, fairy shrimp and water striders. Because they dry out near the end of each summer, these habitats cannot support fish, which are common predators of amphibians and aquatic insects. For example, Cascade frogs, Pacific treefrogs and long-toed salamanders commonly rely upon wet meadow potholes to lay their eggs. The timing of pool drying each year is critical, as tadpoles must metamorphose before the pond dries up. Additionally, meadow potholes can be an essential water source for migratory birds, which also use these resources only seasonally. Recognition of the diversity and importance of these meadow habitats is the first step towards protecting them. The next time you are out in a wet meadow, pause along the trail to look in a puddle or two, and at the right time of the year you might be surprised at what you see.

Photo © Carla Wise

Habitat Data Gaps

Oregon's habitats provide many values for people, fish and wildlife. In the last few decades, great progress has been made in understanding how Oregon's habitats function. In addition, landowners, land managers, and restoration experts have learned "on-the-ground" lessons through experimentation and sharing information. However, there are still data gaps that need to be addressed in order to effectively restore and manage fish and wildlife habitats in Oregon. Here, some broad themes for data gaps identified for Strategy Habitats are presented. This list is not meant to be comprehensive, but represents some high priority information needs.

Habitat data gaps, research and monitoring needs have been previously identified for several Strategy Habitats:

- The Northwest Forest Plan and associated programs addressed needs for late successional conifer forests in the West Cascades, Coast Range, and Klamath Mountains ecoregions. The adaptive management component of the Northwest Forest Plan could address some research and monitoring needs in forested habitats of western Oregon, but it has not yet been fully implemented.
- The Oregon Plan for Salmon and Watersheds and associated programs addressed needs for salmonid habitats
- Bonneville Power Administration identified research needs for the Lower Columbia River and Estuary

For all habitat types:

- Determine disturbance factors (e.g., fire, flooding, winter storms) and regimes that historically maintained Strategy Habitats.
- Determine historic range of successional stages and landscape pattern at multiple scales. In other words, how has habitat varied over time? Compare current conditions to historic, or "baseline" conditions, to determine change from historic conditions.
- Increase understanding of how to manage habitats at multiple scales. For example, improve methods for managing wetland and riparian habitats across landscape and watershed scales.
- Continue to refine GIS-based habitat maps. Improve ability to map linear and small-scale habitats such as riparian areas, aspen clones, and vernal pools.
- Update historic vegetation maps as additional information is developed regarding temporal and spatial ecosystem dynamics.
- Determine priorities and restoration techniques for Strategy Habitats:
    - Which habitats and sites are most suitable for restoration?
    - Which plant species are most appropriate for planting based on site-evaluations?
    - Where should they be planted?
    - What type of maintenance is required to become established?
    - What other actions are needed?
- Develop innovative management techniques and markets with potential to support job creation and support local economies while restoring habitats (e.g., markets for small-diameter trees removed during forest restoration).
- Establish propagation methods for native plants for restoration. Collaborate with partners to develop sustainable markets for native plant producers in order to assist producers and provide a reliable supply of restoration materials (e.g., Native Seed Network's programs).
- Determine most effective methods to restore natural hydrological conditions to streams, rivers and wetlands, including seasonal wetlands (e.g., vernal pools, wet prairies, and playas)
- Determine and evaluate methods to:
    - Control priority invasive plant species, particularly those species that degrade habitats and alter ecological processes, and monitor effects of control on target and non-target species.

  - Restore native plants in habitats dominated by non-native plants (e.g. understory plants in oak woodlands).
  - Restore habitats dominated by invasives that alter ecological processes (e.g., cheatgrass, medusahead, European beachgrass).
  - Treat ballast water in a matter that is both safe and effective.
- Determine distribution and spread rates of priority invasive species.
- Develop measurable indicators of high quality habitat, including aquatic systems. Coordinate with the Oregon Watershed Enhancement Board's work on aquatic indicators and the Oregon Board of Forestry's efforts to identify indicators for forestlands. For example, develop framework for using species and habitat indicators to assess habitat status and trends. Another example: develop measurable indicators of forest health that reflect a variety of goals, including wildlife habitat values and natural fire regimes, in addition to insect and disease levels and fire risk.

Terrestrial habitats:

- For oak woodlands and savanna, develop and evaluate methods:
  - To enhance cavity development in oak trees (e.g., fungal inoculations, limbing).
  - Determine effectiveness of snag creation from competing conifers to provide cavity-nesting habitat for oak-associated birds such as western bluebird, acorn woodpecker, and slender-billed (white-breasted) nuthatch.
  - To encourage large, open-structure Oregon white oak tree growth.
- For oak woodlands and savanna, evaluate effects of management practices on natural oak regeneration.
- For aspen:
  - Determine the effects of altered subsoil water levels on aspen.
  - Genetic relatedness of aspen clones and genetic considerations for restoration.
- For ponderosa pine:
  - Determine desired patch size and connectivity across landscapes.
  - Determine gap dynamics (how forest openings are created, maintained, change over the landscape, and are used by or affect wildlife).
  - For high elevation ponderosa pine habitats that have converted to mixed-conifer habitats, determine if restoration is possible and desirable. If so, investigate restoration methods.
- Clarify the role of playas for wildlife.
- Determine and evaluate methods to:
  - Reintroduce natural fire regimes into forested habitats and reduce wildfire risk while maintaining late successional habitats
  - Reintroduce fire into fire-dependent landscapes such as native grasslands, shrub-steppe, oak savannas, and ponderosa pine habitats. Develop fire prescriptions to address the constraints of surrounding land uses, smoke management, safety and other considerations.
  - Control encroaching native vegetation (e.g., conifers in oak woodlands, western juniper in sagebrush) and effects on native plant composition and ecological function (e.g., transpiration impacts on surface water flows caused by western juniper).
  - Maintain fire-dependent habitats in the absence of natural fire regimes, especially where prescribed fire is not practical.
  - Utilize prescribed fire techniques that can be applied in aspen habitats to control junipers while stimulating aspen shoots.
  - Improve bitterbrush and mountain mahogany regeneration.

Aquatic habitats:

- For streams:
  - Determine specific requirements for large woody debris levels in streams
  - Identify factors that impact channel stability and channel conditions
  - Understand and assess effects of changes in channel geometry
- Assess historic temperature and water quality regimes on a watershed basis, particularly the Northern Basin and Range ecoregion where this is poorly understood.
- Determine impacts of roads on streams (e.g., do they impede channelization or increase sedimentation?) in Conservation Opportunity Areas and other priority areas
- Continue efforts to inventory and map eelgrass beds (e.g., Tillamook Bay National Estuary Project and South Slough National Estuarine Research Reserve research)
- To ensure effective management of non-point source pollutants, such as fertilizers and pesticides:
  - Understand the chemical breakdown of pollutants in wetlands and other temporary aquatic habitats
  - Investigate potential impacts of pesticides or herbicides on ecological communities, considering trophic dynamics.

- Compile management suggestions for reducing the impact of non-point source pollution .
- Develop non-toxic alternatives to pesticides and fertilizers, where feasible.

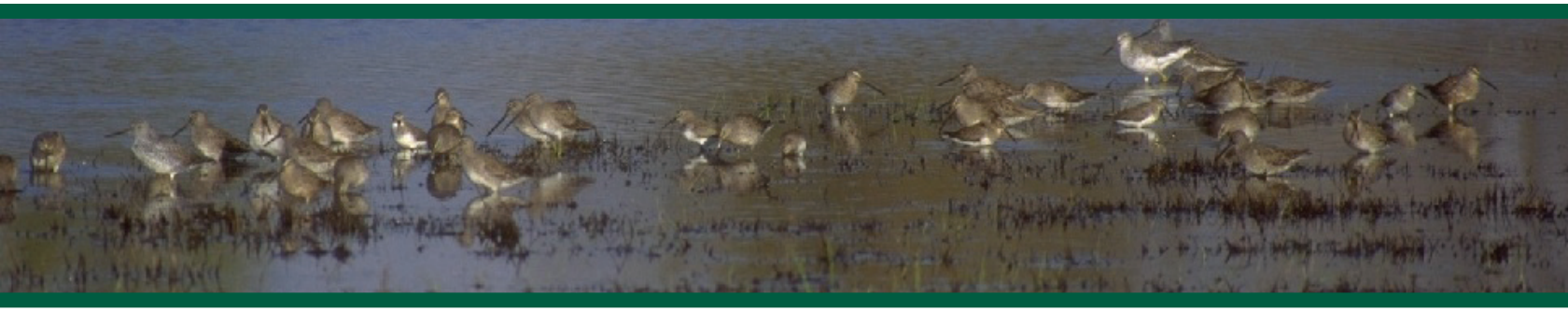
Multiple-objective resource lands:

- Use adaptive management to evaluate the effects of forest management practices that reduce the risk of uncharacteristic fire on wildlife and other ecological values.
- Develop decision-making tools to help land owners and land managers assess and compare the short-term risks to wildlife and habitat of forest management practices to reduce the risk of uncharacteristic fire against the long-term risks to wildlife and habitat posed by uncharacteristic fire.
- Determine the potential impacts of intensive vegetation management of recent harvest units (through herbicides and fertilizers) on native wildlife and ecological communities.
- Increase efforts to understand and evaluate the functioning of managed farm and rangeland (for example, soil and ecological processes; ability to adapt to change).
- Investigate grazing regimes that are compatible with a variety of grassland conservation goals, including grazing as a restoration tool.
- Investigate impacts of range management regimes on big sage habitats, understanding what habitat components are important to wildlife and how grazing or other activities affect these habitats.
- Evaluate management actions on range and other land to determine best practices.
- Evaluate efficiency with which runoff and irrigation water is used, and evaluate the degree to which farm and rangeland resist erosion and runoff.
- Determine relationships between groundwater withdrawals and surface water volume.
- Develop quantitative measures of environmental condition and performance for managed landscapes, including managed forests, agricultural lands, rangelands, and urban areas.
- Increase understanding about the ecological effects of urbanization, and ways to minimize negative consequences for species and habitats within and beyond the urbanized footprint.

Several large-scale, cooperative research and monitoring programs are currently working on various habitat research questions in Oregon. These include: Cooperative Forest Ecosystem Research Program, Watersheds Research Cooperative, Coastal Landscape and Modeling Study, H.J. Andrews Experimental Forest (Long Term Ecological Research site), Oregon Watershed Enhancement Board monitoring, Oregon Board of Forestry's work to implement the Forestry Program for Oregon, and other programs. In addition, the Urban Ecological Research Consortium is a unique, informal effort to promote the collection and use of information in the Portland/Vancouver metropolitan area for conservation purposes. Also, monitoring restoration efforts and other conservation actions taken through the Conservation Strategy will provide additional management guidance.

Photo © Michael Murphy

Photo © Claire Fiegener



Specialized and Local Habitats

Some natural communities and landscape features are not adequately represented through the "coarse filter" of Strategy Habitats. These communities and features often occur at the local scale and have a patchy distribution across the landscape. They may be difficult to map, particularly using satellite data, so are not represented well in spatial data sets. Some communities are highly specialized to the local environment and host a suite of rare or endemic species. To address the conservation needs of these communities and their associated species, "local and specialized habitats" were determined through review of geographic vegetation data, rare plant or animal occurrences, importance to Strategy Species, and occurrences of animal concentrations, such as migrating or wintering birds.

Key to ecoregion abbreviations:

BM = Blue Mountains
CP = Columbia Plateau
CR = Coast Range
EC = East Cascades
KM = Klamath Mountains
NBR = Northern Basin and Range
WC = West Cascades
WV = Willamette Valley

Feature	Ecoregions	Comments	Conservation Actions
Alkaline lakes and wetlands	BM, EC, NBR	Most common in Northern Basin and Range, but a few important areas occur in East Cascades and Blue Mountains ecoregions. Habitat for rare plants; feeding habitat for shorebirds	Maintain existing sites. Restore hydrology. Also see Strategy Habitat description for wetlands.
Alpine meadows and dwarf shrublands	BM, EC, KM, NBR, WC	Habitat for small mammals and unique plants; nesting areas for some birds; important foraging areas for wildlife during late summer and early fall, especially during migration. Uncommon in Klamath Mountains ecoregion.	Depending on local conditions, manage recreation and domestic sheep grazing to minimize impacts to plant communities. Monitor for and control invasive plants.
Aquatic vegetation beds	All Ecoregions	Habitat for invertebrates that are base of the aquatic food chain	Retain and restore natural water flow regimes. Control invasive plants such as reed-canary grass. See Strategy Habitat description for freshwater aquatic habitats.
Ash flows and ash beds	BM, EC, NBR	Habitat for endemic and other rare plants, and important fossil localities.	Manage grazing, mining, off-highway vehicle use to minimize conflicts with rare plants.
Aspen forests and woodlands	BM, EC	Particularly important as nesting habitat for songbirds. Habitat for deer and elk. Note: Aspen is a Strategy Habitat for Northern Basin and Range.	Maintain and restore aspen patches using site-appropriate tools such as thinning of encroaching conifers, prescribed fire, and/or exclosures. See Strategy Habitat description for aspen woodlands.
Balds and bluffs	BM, CR, EC, KM, WC, WV	Habitat for unique plant communities and invertebrates such as butterflies. In Coast Range, includes Coastal bluffs and headlands. In Klamath Mountains, includes serpentine barrens and outcrops.	Control encroaching conifers and shrubs at priority sites. Monitor for and control key invasive plants at priority sites. In serpentine barrens, minimize disturbance (e.g., trail or road construction) to rare plant communities.
Bays	CR	Winter habitat for waterfowl and other waterbirds. Rearing area for juvenile anadromous salmonids.	Provide areas of low disturbance during critical time periods. Also see Strategy Habitat for estuaries.

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Feature	Ecoregions	Comments	Conservation Actions
Bitterbrush communities	BM, EC, NBR	Bitterbrush is an important habitat component that provides forage, cover, and nesting habitat for a variety of wildlife, including deer and elk winter range. In Northern Basin and Range, bitterbrush is found in canyons, often in areas with more moisture, in a mosaic with sage and rabbitbrush.	Continue restoration efforts. Improve understanding of bitterbrush regeneration methods.
Bogs and fens	BM, CR, EC, KM, WC, WV	Habitat for unique and rare plants, including carnivorous plants in some areas. In Klamath Mountains, includes serpentine wetlands.	Maintain and restore natural flow regimes and hydrological conditions. Conserve and manage known occurrences of serpentine wetlands. Also see Strategy Habitat description for wetlands.
Canyon shrublands (also known as moist deciduous shrubland)	BM, CP, EC, NBR	Nesting habitat for songbirds, hiding cover for deer, once winter habitat for sharp-tailed grouse	Maintain healthy stands and restore degraded stands. Some degraded stands can benefit from prescribed fire, removal of encroaching invasive junipers, or management of grazing season timing.
Caves and old mines	BM, CR, EC, KM, NBR, WC	Habitat for rare invertebrates and cave-roosting bats, such as Townsend's big-eared bat and several myotis species. In East Cascades, includes lava tubes.	Use gates or seasonal closures to protect known roost sites from recreational caving and other disturbance. When mines are closed for human safety, provide for bat entry and exit.
Chaparral and Ceonothus shrubland	BM, CR, KM, WC, WV	Nesting and foraging habitat for songbirds. Important for kingsnakes, some butterflies and other invertebrates. May occur in early successional habitats or at high elevations where temperatures and other factors inhibit tree growth. In Klamath Mountains, often removed as fire hazard; increasing removal with development, particularly in particularly in lowland valleys. Where not removed, often they become senescent without the fires needed for regeneration. Unusual habitat in the Willamette habitat, which makes existing sites important for local diversity.	Maintain shrub diversity during forest management activities. Delay replanting with conifers where shrub habitat is limited. Control key invasive plants (i.e., Scotch broom and Armenian [Himalayan] blackberry) at priority sites.
Depressional wetland forests (swamps) and shrublands	CR, KM, WC, WV	Have seasonally fluctuating water levels; are nutrient-rich; provide habitat for a variety of wildlife	Maintain existing habitats, promoting the presence of beavers where they would create hydrological conditions beneficial to wetland creation and would not conflict with other uses of the land. Also see Strategy Habitat description for wetlands.
Eelgrass beds	CR	Basis for aquatic food chain; important rearing area for juvenile fish, including commercially important species; foraging habitat for black brant.	Maintain and restore eelgrass habitats. Also see Strategy Habitat description for estuaries.
Forest openings	CR, WC	Forest openings provide essential structural complexity and plant diversity. These structures provide foraging and nesting habitat for deer, elk, black bear, ruffed grouse, olive-sided flycatcher, willow flycatchers, orange-crowned warblers, MacGillivray's warblers, white-crowned sparrows, fox sparrows, and common nighthawk. Open areas with snags are important for purple martins, western bluebirds and mountain bluebirds. Clouded salamanders live in large logs and stumps in openings, and their populations increase following wildfires. Disturbances such as wildfire, disease and insect outbreaks reset succession and often result in large or small openings with high forb and shrub diversity and structure such as large snags and logs. With management emphasis on older successional stages on public land and more intensive management of private forest lands, openings with structural complexity and plant diversity are now rare. This has resulted in a declining food base for black-tailed deer and elk and loss of nesting and foraging habitat for some songbirds.	During salvage logging or other timber harvest, minimize ground disturbance, maintain and create snags and logs, and maintain patches of shrubs. Look for opportunities to create forest openings and maintain natural forb, grass and shrub species. Control key invasive plants in openings. After burns, reseed with native grasses and forbs and maintain open habitats after burns by delaying replanting with conifers. Carefully evaluate salvage logging in burned late-successional forests.
Grasslands	EC, NBR	Includes alkali grasslands, perennial bunchgrass, and montane grasslands. Important for raptors, grassland birds, and rare plants	Maintain and restore these features using site-appropriate tools. Monitor for invasive species. Manage grazing to minimize impacts to native species.
Greasewood flats and washes	BM, CP, EC	Typically found in flats, washes and terraces with saline soils and shallow water tables; flood intermittently, but remain dry for most growing seasons; habitat for rare plants. High estimated habitat loss in Blue Mountains ecoregion but still common in Baker and Grande Ronde valleys. Very high estimated loss in Columbia Plateau (more than 96 percent) and East Cascades (more than 99 percent) ecoregions.	Maintain and restore greasewood habitats. In Blue Mountains, include black greasewood habitats when managing for a mosaic of valley bottom habitats.

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Feature	Ecoregions	Comments	Conservation Actions
Inland dunes	NR	Includes unvegetated to moderately vegetated (10-30% plant cover) active and stabilized dunes. Habitat for reptiles, small animals, and unusual plants.	Includes unvegetated to moderately vegetated (10-30 percent plant cover) active and stabilized dunes. Habitat for reptiles, small animals, and unusual plants.
Intertidal mudflats	CR	Foraging habitat for shorebirds (critically important during migration); habitat for invertebrates such as clams; estuarine mineral springs are necessary resource for band-tailed pigeons.	Manage water flows to maintain mudflat habitats; maintain or restore water quality and natural sedimentation patterns to maintain habitat quality for invertebrates. Also see Strategy Habitat description for estuaries.
Large lakes and associated wetlands	EC, NBR	Year-round habitat for waterbirds and aquatic species; critical wintering habitat for waterfowl and bald eagles; lakeshore edges are feeding areas for migratory shorebirds.	See Strategy Habitat description for wetlands. Also see Strategy Habitat description for freshwater aquatic habitats.
Large pool habitats	All ecoregions	Required by several Strategy Species, particularly fish but also used by turtles; declining.	Maintain and restore water flow to maintain large pool habitat. Also see Strategy Habitat description for freshwater aquatic habitats.
Mountain mahogany woodland and shrubland	BM, EC, NBR	Mountain mahogany communities may spread with fire suppression, but depend on fire for long-term maintenance. Expanding in some areas, but lacking regeneration in others. Threatened by juniper encroachment in some areas, especially in Northern Basin and Range. Many stands have non-native understory vegetation. In East Cascades ecoregion, mountain mahogany is more diverse than other ecoregions. Here, it includes birchleaf mountain mahogany which covers moist shrublands in the southern portion of the ecoregion. Mountain mahogany is important nesting habitat for birds because it provides tree structure in open shrub-dominated landscapes. It is a valuable forage plant for deer and elk.	Develop methods to manage mahogany stands and encourage regeneration. Restore understory vegetation at priority sites.
Oak and oak-pine woodlands	BM, WC (Strategy Habitat in CR, EC, KM, WV)	Found on western-most portion of Columbia Plateau ecoregion, near border of East Cascades ecoregion. Once common in the West Cascades foothills, oak habitats have been replaced by conifer forests due to fire suppression and conifer planting. Here, oak woodlands remain only in dry sites with shallow soils. Important for western gray squirrel, reptiles, birds and native plants.	Maintain and restore oak habitats through selective thinning of encroaching conifers and prescribed fire; restore native plants in understory.
Off-channel habitat (beaver ponds, oxbow lakes, stable backwater sloughs, and flooded marshes)	All ecoregions	Provides critical habitat for juvenile salmonids and other fish, northwestern pond turtles, freshwater mussels, dragonflies and other invertebrates.	Raise awareness so that activities can be managed for minimal impact. Maintain current off-channel habitat and restore, where possible. Maintain or restore stream hydrology. Manage beaver populations to provide for beaver-created habitats, while minimizing conflicts with other land uses. Also see Strategy Habitat description for freshwater aquatic habitats.
Off- shore rocks (e.g., sea stacks)	CR	Critical nesting habitat for seabirds; haul-outs for marine mammals; roosting areas for bald eagles, peregrine falcons, and Aleutian Canada geese.	Implement existing restrictions and continue successful outreach efforts to minimize disturbance during sensitive nesting and pupping seasons.
Port Orford Cedar forests	KM	Endemic to Klamath Mountains; associated with serpentine soils and characterized by unusual plant and animal associations. Severely impacted by the invasive Port Orford root-rot, particularly near the coast.	Maintain existing habitat. Minimize vehicular traffic and/or new road construction where potential exists to spread the invasive root pathogen.
Rock habitats (cliffs, rimrock, rock outcrops, and talus)	BM, CP, CR, EC, KM, NBR, WC	Habitat for peregrine falcons, cliff swallows, and other cliff-nesting birds, cliff-roosting bats, rare plants, and wildlife that use rocks for shelter, and/or foraging areas (such as lizards, piñon mouse, bobcat and yellow-bellied marmots). Talus is habitat for Larch Mountain salamander, pika and unusual invertebrates. In the Willamette Valley, hibernacula for snakes, including western rattlesnakes. In dry ecoregions, rock habitats are particularly important for salamanders as a refuge from hot, dry weather.	These habitats have few limiting factors in most ecoregions. In the East Cascades, residential development at the edge of rims alters vegetation and disturbs nesting birds. Work with local planners to implement existing setback distance standards. Rock mining should be avoided in talus areas where known populations of Larch Mountain salamander and rare invertebrates occur. For all ecoregions, if important roosts or nest sites are known, minimize disturbance (such as rock climbing) during the breeding season.
Rocky shore and tidepools	CR	Rocky shores are habitat for marine invertebrates and shorebirds such as black oystercatcher, rock sandpiper, black turnstones and surfbirds. Tidepools are habitat for marine invertebrates and fish.	Minimize disturbance during shorebird nesting season. Work with local communities and land management agencies to minimize impacts from tidepool viewing, a popular activity.

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Feature	Ecoregions	Comments	Conservation Actions
Salt desert scrub	NR	This low-to-medium shrub habitat can be found on dry sites with saline soils, such as dry lake beds, flat desert pavements, low alkaline dunes, around playas, or on gentle slopes above playas. It provides habitat for kit fox and suits reptile and small mammal species that are primarily or exclusively associated with this habitat.	Cheatgrass invasion and increasing surface fuel accumulation are problems at some locations. Microbiotic soil crusts are particularly critical in these habitats, so it is important to minimize activities that cause soil disturbance.
Sand spits, sand bars, and sparsely vegetated islands (surrounded by saltwater or freshwater	CR, EC, NBR	Sparsely vegetated sandy habitats that are isolated from disturbance due to humans and mammalian predators are important roosting and nesting sites for colonial waterbirds such as American white pelican, brown pelicans, gulls, cormorants, and Caspian terns. In eastern Oregon, this habitat occurs in large lakes and wetlands.	Maintain open habitat characteristics and minimize disturbance at key sites.
Seasonal wetlands (vernal pools, playas, and freshwater mudflats)	BM, CP, EC, KM, NBR, WV	Habitat for amphibians, rare plants, fairy shrimp and other invertebrates, grassland birds, migrating and wintering shorebirds. Playas are also important for migrating waterfowl. Difficult to survey and map. Once common in floodplains and small depressions in the Columbia Plateau, Willamette Valley and Klamath Mountains ecoregions, much of this habitat has been lost in these ecoregions.	Maintain and restore natural water flows and water quality (to maintain habitat quality for invertebrates). Control key invasive plants. Evaluate methods to imitate function through old ditches and depressions in fields. Improve mapping capabilities. Also see Strategy Habitat description for Wetlands and U. S. Fish and Wildlife Service Draft Recovery Plan for Vernal Pool Ecosystems in California and Oregon.
Springs, seeps, and headwaters	All ecoregions	Habitat for amphibians, invertebrates, and rare plants. The isolated nature of springs is one of the factors resulting in high levels of invertebrate endemism in the East Cascades. In dry ecoregions, spring and seep habitats are important as a source of water for wildlife and as habitat for amphibians and invertebrates. These habitats have been impacted by livestock watering and agricultural uses.	Use incentives, and, where applicable, maintain existing protection standards to provide buffers around springs, seeps and stream headwaters during forest management and road building activities. Use open-bottomed culverts or bridges when building roads or upgrading culverts to allow fish and amphibian passage. In dry ecoregions, use cooperative incentive programs to fence spring heads, which provides benefits to wildlife but allows water to be available for other uses.
Western juniper savanna with mature trees; late successional western juniper woodlands	BM, CP, EC, NBR	Western juniper savanna consists of scattered, often large, juniper trees within shrub-steppe. Late successional juniper woodlands may have a higher density of trees, but are characterized by large-diameter trees. These juniper habitats are important for juniper titmouse, raptors and other birds. In Columbia Plateau ecoregion, the remaining ferruginous hawk nest sites are primarily juniper trees. Currently, about three to five percent of Oregon's juniper woodland is considered late-successional. A high percentage of old-growth juniper in Central Oregon near Bend, Redmond and Madras has been lost. Remaining stands are highly fragmented and are threatened by encroaching small junipers. In contrast, recruitment of juniper in sandy shrub steppe of the Columbia Plateau is naturally poor, so young juniper trees are not replacing older ones lost to cutting or natural death.	Remove small-diameter encroaching juniper trees while maintaining larger diameter junipers and connectivity of juniper patches. Reintroduce fire where practical. Need better spatial data on distribution of mature juniper savanna. In Columbia Plateau, maintain existing large juniper trees and examine factors affecting tree recruitment. Research is underway to determine the age, composition, structure, and wildlife usage of old growth juniper woodlands (for more information, see the Eastern Oregon Agricultural Research Center website http://oregonstate.edu/dept/EOARC/researchhome/research.html)
Western larch forest and woodland	BM, EC	Occurs on cool moist sites interspersed with ponderosa pine habitats; may have been much more common historically in the Blue Mountains ecoregion.	Maintain large-diameter larch trees and patches of larch forest to provide local diversity; control key invasive plants.