A GUIDE TO CONSERVING WILDLIFE ON WILLAMETTE VALLEY FARMS

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TABLE OF CONTENTS

Cover Page Photos: (Top) Yellow warbler © John J. Mosesso, (Center) aerial imagery provided by the Oregon Geospatial Enterprise Office, (Bottom) Cook Family Farm © David G. Vesely

INTRODUCTION

More than 95% of the Willamette Valley is under private ownership and almost half of these lands are used for agricultural purposes[1]. Clearly, growers and livestock producers have a key role in shaping the future landscape of the region. How these lands are managed will have a considerable effect on wildlife. As a general rule, farmers have always shown interest in game, conspicuous species, and wildlife that cause losses to crops and livestock. However, the human residents of rural areas are often unaware of most of the 300 or so vertebrate species that live in the Willamette Valley. Species that were common on farmlands 50 years ago such as the western meadowlark and western bluebird occur only in scattered populations now.

Fortunately, growers and food processors in the Willamette Valley are demonstrating an increasing commitment to the principles of sustainable agriculture (SA) and integrated pest management (IPM) practices that can reduce the impact of farm operations on wildlife and other natural resources. Many processed vegetable growers are already certified by the *Food Alliance* or a SA program administered by one of the regional vegetable processors.

The purpose of this guide is to provide Willamette Valley growers with an introduction to the wildlife diversity of the region, a primer on habitat management, and some suggested actions that can be taken by growers to benefit native wildlife living on agricultural landscapes. Given the extensive area of the Valley used for farming, even modest actions undertaken by individual growers can accumulate into a major contribution toward regional conservation goals.

Early Willamette Valley Observations

"Country undulating: soil rich, light with beautiful solitary oaks and pines interspersed through it, and must have a fine effect, but being burned and not a single blade of grass except on the margins of rivulets to be seen."

David Douglas, 1826

"The country had an uninviting look from the fact that it had lately been overrun by fire, which had destroyed all the vegetation except the oak trees, which appeared not to be injured."

Charles Wilkes, 1841

"before drainage ditches were opened the whole valley was like a swamp. The streams, many of them, had no definite channels but spread out over the valley, wandering here and there all over the land."

John Garth Bramwell, circa 1850

Excerpts from Environment and Experience: Settlement Culture in Nineteenth-Century Oregon by Peter G. Boag. 1992. University of California Press.

The Walhamette River from a Mountain. Paul Kane

[1] Oregon Dept. Fish & Wildlife. 2006. The Oregon Conservation Strategy. P. 235

CONSERVATION PLANNING EXAMPLE: COOK FAMILY FARM

Throughout this guide there are brief sidebar stories learned from an assessment of the Cook Family Farm and conversations with the family. It is hoped that these may serve as examples for other growers planning for fish and wildlife on their own lands.

Matt Cook is the fourth generation to live and work on the family farm located in the Dever-Conner neighbor of northwest Linn County. Since the 1950s, processed vegetables have been the major crop produced on the 900+ acre farm. However, grass seed, filberts, and mint are also important sources of farm income. In spite of the long hours and risk that are always inherent in agriculture, Matt loves the life and plans to be working on the farm for a long time to come. According to Matt, other neighbors in the Dever-Conner area have sons and daughters looking forward to continuing their family's farming operations.

Matt has watched interest in sustainable agriculture grow among family farmers over the last decade. The Cook farm is certified under the stewardship program established by a local vegetable processing cooperative. An important principle shared by all of the SA certification programs is that producers and processors must show a commitment to continuous improvements for meeting sustainability standards and criteria, including wildlife conservation. However, growers report that wildlife standards are generally the most difficult of all the criteria they are required to meet under the SA programs. Some of the criteria are subjective and difficult to assess. Others are written to be broadly applicable for different types of production and ecosystems across North America. But on-the-ground management actions need to be tailored to local wildlife communities and regional conservation priorities.

The Cook Family Farm is located in the Dever-Conner neighborhood of northwest Linn county. The landscape is dominated by small- to medium-size farms operated by families that have been in the area for generations. The availability of water for irrigation and the proximity to processors make beans, broccoli, cauliflower, sweet corn, and other vegetables among the important crops in the Dever-Conner area. But most farms have a diversified production that includes grass seed, grains, filberts, and peppermint. Sheep are transported onto the Cook farm seasonally to graze on vegetable stubble and grass seed crops.

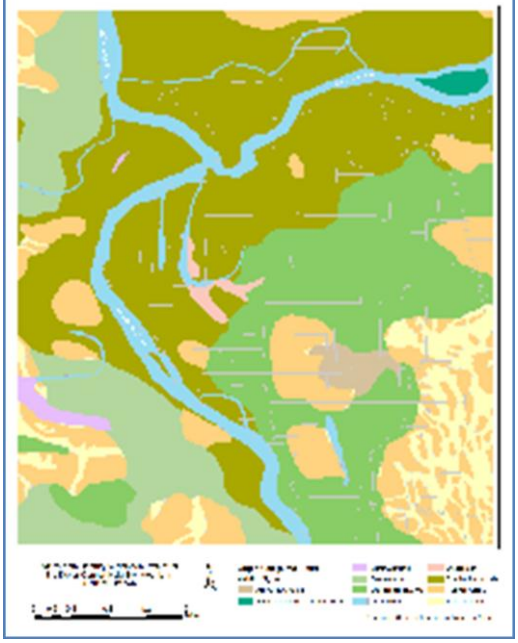
The Dever-Conner neighborhood lies just south of the confluence of the Willamette and Santiam River. Aquatic habitats here are important for spring and fall runs of Chinook salmon, as well as summer and winter steelhead. Riparian forests surrounding the confluence support hundreds of species of native wildlife. The Oregon Conservation Strategy program recognizes the vital function of the area for fish and wildlife so has included portions of the Dever-Conner neighborhood in Willamette Floodplain and Santiam River Conservation Opportunity Areas.

The Cook Family Farm is representative of many other small to medium-size operations either enrolled in an SA certification program or considering doing so. Matt has already undertaken one modest habitat management project and he knows there are other potential opportunities for wildlife management on the farm.

The Willamette Valley: The Environmental Setting

Eight thousand years ago, the Willamette Valley was warmer and much more arid than today. Summer droughts were prolonged and fires were frequent. Climatic conditions at that time led to the expansion of prairies and Oregon white oak savannas[2]. Higher elevation sites were transitioning from post-glacial western hemlock forest to open woodlands dominated by Douglas-fir, Ponderosa pine, and red alder. Approximately 6,000-7,000 years ago, the present climatic pattern began to form. Winters became wetter and temperatures cooled. Conditions became favorable for Douglas-fir in low elevations and higher sites transitioned back to western hemlock forest.

Although the modern climate has fostered the expansion of conifer forests, the Kalapuya and Chinook People regularly burned prairies and savannas to prevent conifer encroachment and to promote the growth of food plants such as camas, wappato, and tarweed [3]. Native Americans also were aware that black-tail deer are drawn to the edges between woodlands and openings, so deliberately used fire to create habitat edges[4]. So much of the Willamette Valley landscape was burned in the fall that the earliest explorers complained about the lack of grass for their horses.



The Oregon Natural Heritage Program has mapped nineteenth century vegetation patterns using notes of the early Government Land Office surveyors and other historical information. The map indicates that the riverine forest surrounding the Willamette-Santiam River confluence was more than a mile and a half wide in the mid-1800's. Oak/conifer savanna and upland prairies dominated by Roemer's fescue extended across much of the Dever-Conner landscape during the period of Euro-American settlement. Wetter sites were dominated by tufted hairgrass prairies.

Even though this historic landscape pattern will never exist again, such information is useful for understanding the conditions that native Willamette wildlife are adapted to and can help guide habitat restoration efforts.

Click on above map for larger version

[2] Barnosky, C. W. 1985. Late quaternary vegetation near Battle Ground Lake, southern Puget Trough, Washington. Geological Society of America Bulletin 96:263-271.

[3] Boyd, R. (ed.). 1999. Indians, fire, and the land of the Pacific Northwest. Oregon State University Press, Corvallis, OR.

[4] Boag, P. B. 1992. Environment and experience: settlement culture in Nineteenth Century Oregon. University of California Press. Berkeley, CA.

Prairie and savanna vegetation were dominated by perennial bunchgrasses and a wide variety of forbs. Common grass species on upland sites were Roemer's fescue, California oatgrass, and blue wildrye. On wet prairies, tufted hairgrass, western rush, and creeping spikesedge, were among the most common species. However most of the plant diversity on prairies and savannas was represented by annual and perennial forbs. Some representative species included western buttercup, spring gold, common camas, American vetch, and meadow checkermallow.

Prior to Euro-American settlement, the Willamette River would fill its side channels and spill across its floodplain every winter. The annual inundation created a network of ox bow ponds, swamps, and seasonal wetlands across the valley floor. Along the major rivers stood bottomland forests dominated by black cottonwood, Oregon ash, western redcedar, and willows.

During the last 160 years, most of the Willamette Valley pre-settlement habitat types have been lost or disrupted due to a combination of human land uses and ecological dynamics. Agriculture, industry, and residential development needed to support the increasing human population in the region have reduced and fragmented the once extensive areas of lowland forest, prairies, and Oregon white oak woodlands. Dams, levees, and stream diversions have isolated rivers from their historic floodplains.

Where semi-natural areas have persisted, cessation of annual burning has allowed trees to encroach upon grasslands and oak-dominated woodlands have transitioned into conifer forests. Non-native plants and animals began to arrive with the earliest Euro-American settlers in the Valley. Invasive weeds are now ubiquitous throughout the semi-natural areas across the Valley and non-native vertebrates such as house sparrow and bullfrog pose serious threats to native wildlife.

WILDLIFE OF THE WILLAMETTE VALLEY

Wildlife communities have so far proven remarkably resilient to the habitat loss and fragmentation that has been taking place western Oregon. There are 293 native vertebrate species that are reported to be resident, seasonal migrants, or irregular visitors to the Willamette Valley ecoregion[5]. Birds comprise the greatest number of species (186) followed by mammals (73), amphibians (18), and reptiles (16). There are at least 19 non-native, vertebrate species established in the Valley.

However, more than a dozen species have been extirpated from the Willamette Valley or no longer breed in the region. These include the sandhill crane, Lewis' woodpecker, and Oregon spotted frog. Many other species are experiencing serious declines in abundance and/or contractions of their geographic range. The wildlife communities most seriously disrupted are those associated with wetlands, prairies, and savannas—habitat types once widespread throughout the Willamette Valley but which have been greatly reduced in area due to development and agriculture.

Wildlife diversity on Valley farmlands can be remarkably high. Agricultural lands across Oregon and Washington support more species (342) than any other single habitat type in the Pacific Northwest,

[5] Oregon Natural Heritage Information Center. Accessed at http://oregonexplorer.info/wildlife.

largely because the wide extent of farmlands in the region, but also because of the different land cover types and management practices that characterize agricultural landscapes[6]. The varying conditions and frequency of disturbance tend to cause farms to be inhabited by habitat generalist species—wildlife that can find food, cover, and breeding sites across a wide range of environments. No wildlife species is wholly dependent on farmlands; most species also use adjacent habitats or migrate out of the region during part of the year.

This black cottonwood snag on the Cook Family Farm serves as a roost for turkey vultures and offers woodpeckers and other cavity-nesting birds a place to raise their young.

HABITAT MANAGEMENT 101

Wildlife habitat management is such broad topic that it's not feasible to give a detailed introduction here. However, it is important for any landowner developing a conservation plan or contemplating major wildlife projects to understand a few basic definitions and principles on which all successful wildlife habitat management projects are founded.

"HABITAT" DEFINED

The term "habitat" refers to the particular physical and biological components of an ecosystem used by a species to survive and reproduce. It includes the terrain preferred by the species, water and food sources, the vegetation it selects cover, as well as special resources used by some wildlife such as cliffs, tree cavities, or manmade structures. No two wildlife species require precisely the same habitat for survival and reproduction. However, many species may frequently coexist in the same "habitat type", which is a group of environments that share similar physical features, vegetation characteristics, and patterns of disturbance. Examples of habitat types in the Willamette Valley are Oregon white oak woodlands, riparian hardwood forest, and non-irrigated pastures.

[6] Edge, W. D. 2001. Wildlife of agriculture, pastures, and mixed environs. Pp. 342-360, In, D. H. Johnson and T. A. O'Neil (managing eds.) Wildlife-habitat relationships in Oregon and Washington. Oregon State University Press. Corvallis, OR.

Even professional biologists tend to use the terms “habitat” and “habitat type” interchangeably. But such erroneous usage can give the impression that wildlife which live near one another share the same habitat requirements—which is never the case. For example, savanna sparrows and western bluebirds are both found in the same habitat types-- Willamette Valley grasslands and savannas. The savanna sparrow nests on the ground, eats primarily seeds, and migrates south in winter. It is especially selective about the height and plant species of the grass/forb vegetation layer during the breeding season. However, the western bluebird is a year-round resident of the Valley. The species nests in tree cavities and it primarily feeds upon insects in the summer and berries in the winter. Savanna sparrows and western bluebirds may live side-by-side much of the year, but the two species exhibit very different sets of habitat requirements.

Habitat Elements & Structure

Habitat elements are the features of the environment that most influence the abundance and distribution of a wildlife species. Examples include trees, decaying logs, caves, stock ponds, and artificial nest boxes. Animals that coexist in the same habitat type may use different sets of habitat elements. In the examples described above, the grass/forb vegetation layer is an important element of nesting habitat for savanna sparrows, while tree cavities are a critical element in western bluebird habitats.

Habitat structure refers to the physical attributes and arrangement of habitat elements. For example, the habitat structure of livestock pastures tends to be relatively simple and might be characterized by the average grass height, the vertical stratification of grass and forb layers, and the spacing of any trees in the pasture. In contrast, the structure of a riparian hardwood forest is a complex arrangement of living trees, shrubs, snags, downed logs, and a variety of other features. Forest structure might be described by the maximum tree height, the degree (percentage) of canopy closure, frequency of large snags in a stand, the volume of woody debris, among many other possible descriptors. Generally speaking, habitat types that have more complex structure can support correspondingly more wildlife species because of the variety of food, breeding sites, and other resources available. Yet some wildlife are particularly adapted to habitat types with very simple structure. For example, streaked horned larks find most of their food and cover on mudflats or other areas of sparsely vegetated ground.

Need for Space

A western fence lizard may find everything needed for growth, survival, and reproduction over a lifetime in a 100 foot section of hedgerow, while a black-tailed deer will move through hundreds of acres to meet its requirements for food and cover. The term “home range” refers to the area covered during an animal’s daily movements as it forages or hunts for food and seeks places to rest. Table 1 presents the home range sizes for several common species in the Willamette Valley.

Table 1. Home range size for selected wildlife species common on farmlands of the Willamette Valley.[7]

Species	Home Range (ac)
Western fence lizard	0.1-1.7
Western gray squirrel	3-20
Vagrant shrew	0.25-0.8
Bobcat	Up to 1140
Hairy woodpecker	22-37
American kestrel	275-1100
White-crowned sparrow	1-20 ac

Home range sizes can be smaller in high quality habitats because animals don't have to travel so far to meet their needs for food, water, cover, and breeding sites. On agricultural landscapes, the conversion of diverse, native plant communities to large fields supporting just a few crops lowers the habitat suitability of farmlands for many species of wildlife. Furthermore, pesticides can lower the prey availability for insectivores. Therefore, wildlife home ranges tend to be larger in areas dominated by agricultural or developments than in more natural settings.

Some wildlife species that use large home ranges are not only affected by conditions on a farm, but also patterns of land use and vegetation across the surrounding landscape. Some species require different habitat types within relatively close proximity. One type may be used during the day for hiding cover and another type used at night for feeding. For example, the western pond turtle spends most of the spring and summer months in aquatic habitats such as ponds and sloughs. However, females seek out grassy or bare upland sites for nesting in early summer. Furthermore, many western pond turtles will burrow into deep leaf litter in woodland or shrubby sites for overwintering. Thus, the long-term survival of a western pond turtle population depends upon individual turtles being able to move throughout very different habitat types as seasons change through the year.

Farmlands and Ecological Traps

Farmlands present a particular challenge to wildlife because what looks like good habitat to them may include dangers that they cannot anticipate. For example, meadowlarks may choose to nest in hayfields that will be mowed before their breeding cycle is completed. Ecologists call this an ecological trap. The concern on farmlands is that some high priority wildlife species may find suitable breeding habitats among hayfields, vegetable crops, ditches, and other farm areas. However many animals die as a result

[7] Sources: a) Brown, E. R. 1985. Management of wildlife and fish habitats in forests of Oregon and Washington. USDA Forest Service Pub. R6-F&WL-192-1985. b) Zeiner, D.C., W.F.Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1988-1990. California's Wildlife. Vol. I-III. California Depart. of Fish and Game, Sacramento, CA.

of mechanized operations before the breeding season is over. Some wildlife species will attempt to breed and raise young year after year in the same field (the phenomenon is called breeding site fidelity) even if they continue to lose juveniles. Growers may have very little flexibility to adjust mechanized operations on croplands. However, if disturbance can be avoided in fallow areas and other non-crop lands during critical times of the year, growers may be able to change these areas on the farm from sink habitats where animals are killed to source habitats, where they successfully survive and reproduce.

Table 2. Critical nesting and fledging periods for selected ground-nesting birds in the Willamette Valley.

Species	Peak Nesting/Fledging Period
California quail	June 1 – July 15
Common nighthawk	June 20 – August 1
Western meadowlark	May 1 – July 1
Streaked horned lark	April 25 – June 15
Savanna sparrow	May 1 – June 15
Vesper sparrow	May 5 – June 30
Grasshopper sparrow	May 15 – July 15

Habitat Management Opportunities on Farms

Most wildlife inhabiting agricultural landscapes tend to use non-crop areas to a much greater extent than production fields. Recognizing wildlife resources and important habitat types already existing on the family farm is the first step to meeting SA program wildlife standards. Growers can make an important contribution to wildlife conservation in the Valley by preserving and actively managing these semi-natural habitat types and have their efforts recognized when audited for SA certification.

Oak Woodlands

It has been estimated that there were more than one million acres of Oregon white oak woodlands across the foothills of the Oregon Coast Range and 400,000 acres in the Willamette Valley during the mid-nineteenth-century. Today, oak woodlands cover less than 7% of their former area[8]. There are two major causes for the loss of this habitat type. The first is the conversion of woodlands for human land uses such as agriculture and residential development. The second cause is a successional change that occurs in the absence of wildfire. Oregon white oak was able to persist across the Valley when the Kalapuya regularly burned the savannas and woodlands. Oaks are adapted to fire-prone landscapes and can endure where other trees cannot. In the absence of frequent fire, conifers, big-leaf maples, and other fast-growing trees are able to gain a competitive advantage over oaks and eventually dominate

[8] ODFW. 2006. Strategy Habitat: Oak Woodlands. Pp. 279-281. In, The Oregon Conservation Strategy. Oregon Department of Fish and Wildlife. Salem, OR.

the woodland stand. Today, one can walk through almost any woodlot in the Willamette Valley and find large dead or dying oaks under a canopy of Douglas-fir.

The height and complexity of vegetation in oak woodlands or woodlots composed of mixed tree species create an environment with a greater variety of food resources and breeding sites than the surrounding farm fields or semi-natural grasslands. Woodlands also provide hiding cover and shelter during severe weather. Stands dominated by oaks are especially valuable because of the acorns they produce, their unique insect communities, and because oak snags can remain standing for decades, making tree cavities available for wildlife for longer durations than other tree species.

More than 150 wildlife species use woodland habitat types in the Willamette Valley[9]. Some wildlife demonstrate a particularly close association with Oregon white oaks, including western wood-pewee, Cassin's vireo, white-breasted nuthatch, acorn woodpecker, western gray squirrel, and Columbia white-tailed deer.

Management Approach—Oregon white oaks thrive in open woodland settings where individual trees are widely spaced. Oak stands occur most often on dry, upland sites. They are equally adaptable to moist sites, but often are excluded by faster-growing species. Initial management activities in an existing stand usually focus on reducing tree density, sometimes to only a few trees per acre. Select the trees with the fullest crowns for retention; spindly trees are not likely to respond quickly even when given extra space. Remove Douglas-fir, grand fir, and big-leaf maple to maximize oak growth. The objective is to concentrate site resources (water, nutrients, and sun) on well-spaced trees to maximize height and diameter growth. This will ensure the retained trees develop large crowns and produce good acorn crops. Invasive shrubs such as Himalayan blackberry and herbaceous weeds are always a challenging issue in woodland management. Aggressive treatment by spraying, under-burning, or grazing offers some control. Many of the worst weeds will be easier to manage once the stand canopy closes and the understory is shaded. Oregon State University Extension can provide assistance to farm owners in finding one of the Willamette Valley contractors specializing in small woodland harvests and thinning operations.

[9] Vesely, D. G. and D. K. Rosenberg. 2010. Wildlife conservation in the Willamette Valley's remnant prairies and oak habitats: a research synthesis. Oregon Wildlife Institute. Corvallis, OR.

Rivers, Streams, & Riparian Forest

These habitat types include the active channels, associated oxbows and side channels, seasonally connected ponds, and streamside forests. They form an aquatic and riparian network that connects the Willamette River to tributaries reaching high in the Oregon Coast Range and the Cascades. The Willamette basin contains 31 native fish species[10], most of which are unknown to all but a few human residents of the Willamette Valley. Besides the renowned Chinook and steelhead, the fish community includes the reticulated sculpin, longnose dace, sand roller and peamouth, and many others. Fish and hundreds of freshwater insects, mollusks, and crustaceans make the river network one of most biologically rich features of the Willamette Valley. As sources of water and food, aquatic habitats are also beneficial for many terrestrial wildlife species. Major river and wetland conservation issues in the region include:

- ***Loss of Habitat Area and Complexity***—The total area of Willamette River channels has decreased from 41,000 acres to less than 23,000 acres during the period of 1850 to 1995[11]. Most of the loss is due to decreased channel complexity. Long stretches of the river once braided with numerous side channels, oxbows, and alcoves have been blocked to control annual flooding or filled and developed. The slow-moving water in these off-channel features are crucial habitat elements for salmon, resident native fish, turtles, and waterfowl.

The Cook family farm contains almost 6 miles of permanent and seasonal stream channels. Stream reaches nearest to the Willamette River are likely used by Chinook, steelhead, native turtles, and dozens of other fish and aquatic wildlife. Vegetation along seasonal streams provides crucial ecological functions such as wood recruitment, intercepting sediment run-off, and providing wildlife habitat. The North Santiam Watershed Council is natural partner for landowners in the Dever-Conner neighborhood considering aquatic or riparian restoration projects.

[10] Gregory, S., R. Wildman, L. Ashkenas, K. Wildman, and P. Haggerty. 2002. Fish Assemblages. In, D. Hulse (ed.) Willamette River Basin Atlas: trajectories of environmental and ecological change (2nd ed.). Oregon State University Press.

[11] Gregory, S., L. Ashkenas, D. Oetter, P. Minear, and K. Wildman. 2002. Historical Willamette River Channel Change. In, D. Hulse (ed.) Willamette River Basin Atlas: trajectories of environmental and ecological change (2nd ed.). Oregon State University Press.

- ***Water Quantity***—In 1990, approximately 4% of the total discharge of the Willamette River was withdrawn for public and domestic use[12]. By far the single largest out-of-stream use is crop irrigation (49% of total water withdrawn in 1995[13]). While water scarcity is currently not a severe problem in the Willamette Valley, summer water shortages do occur in some tributaries now. One modeling study predicts that increases in withdrawals for irrigation could lead to serious shortfalls in the Pudding, Tualatin, and Mollala watersheds by 2050[9]; areas within the North Santiam watershed may also face future water shortages under the same modeling scenario.

- ***Water Quality***—Pollution in the Willamette River was so severe in the early 1900s that fish died within minutes of being placed in the water and humans risked serious disease by close contact with the River[14].

Management Approach— Given the extent of floodplain areas and streams on Willamette Valley farmlands, agricultural practices can have significant impacts on water quality and fish habitat—for better or worse. Restoration of stream and wetland habitats is a highly technical field and individual landowners should consult with a project manager at their local watershed council or soil and water conservation district before undertaking in-stream activities. However, growers can do much to protect aquatic habitats with good stewardship of riparian forests, using water efficiently, and preventing sediment run-off from fields and roads.

Maintain trees and tall shrubs along fish-bearing streams and when feasible, along seasonal channels to ensure adequate shade and wood recruitment. Riparian buffer strips should be wide enough to intercept water and sediment flowing off fields and roads before run-off reaches the channel. Tall riparian vegetation can also minimize pesticide sprays from drifting over streams. Non-forested wetlands should be protected with a filter strip of grass or other cover crop. Salmon-Safe, an organization that provides information about land use impacts on salmon, recommends a minimum 35 ft. width forested buffer along streams and 25 ft. minimum width filter strip around wetlands located within crop production areas; wider buffers may be required on some sites. Maintaining or restoring native plant species in riparian areas and filter strips will promote plant and wildlife diversity in addition to their functions in protecting fish habitat and water quality.

[12] Niemi, E., D. Dole, and E. Whitelaw. 2002. Water availability. In, D. Hulse (ed.) Willamette River Basin Atlas: trajectories of environmental and ecological change (2nd ed.). Oregon State University Press.

[13] Baker, J. J. Van Sickle, D. White. 2002. Water sources and availability. In, D. Hulse (ed.) Willamette River Basin Atlas: trajectories of environmental and ecological change (2nd ed.). Oregon State University Press.`

[14] Oregon Department of Environmental Quality. 2007. Fact sheet: protecting and restoring the Willamette River. Accessed online 5/17/11 http://www.deq.state.or.us/wq/pubs/factsheets/willamette/protectwillriver.pdf

Irrigation systems should be designed and well maintained to minimize the volume of water diverted from streams or ground water sources. Growers can minimize the risk that fish are trapped in water diversion devices by ensuring fish screens meet ODFW guidance .

Apply only the necessary amount of nutrients given the specific crop and site characteristics. Avoid applying nutrients when there is a possibility that surface run-off may contaminate streams. Maintain vegetation buffers along streams and around wetlands (see above section). Implement integrated pest management practices (IPM) and take advantage of natural enemies to minimize the need for chemical pesticides.

Turn Problem Areas into Wildlife Refuges

Every farm has odd corners, a wet patch, or field on the other side of the river that is difficult to reach. If growers could avoid mechanical operations on just a few acres during songbird breeding season, the cumulative effect of these individual efforts would create more wildlife habitat than all of the national wildlife refuges in the Willamette Valley.

The Cook Family Farm has a field that is regularly flooded by the Santiam River, creating a perennial problem area. The family is weighing all the factors that will influence future plans for the lower portion of this field. There is the loss of production to consider, but the struggle trying to work this wet patch could be avoided by dedicating it to wildlife habitat.

Legacy Trees

These are the old, large-diameter individuals and small clusters of trees standing in fields, farm yards, and woodlots that are relicts of Nineteenth-Century savannas. Most often they are Oregon white oak, but some are Douglas-fir or ponderosa pine. A recent study conducted in the Willamette Valley found that widely scattered oaks can greatly increase the avian diversity on farm lands—at least 47 bird species were found to use these trees[15]. There are several characteristics of legacy trees that enhance their ecological significance:

- ***Vertical structure***--Legacy trees are usually the tallest features standing on crop fields and pastures, making them natural hunting perches for American kestrels, red-tailed hawks, barn owls, and other raptors. Birds such as the chipping sparrow and red-tailed hawk construct their nests on tree branches. Many other wildlife species benefit from the shade of these trees in the heat of the summer
- ***Cavity nest/roosting sites***—Cavities in tree stems created by wood rot and termites or excavated by a woodpecker are crucial nesting resources for western bluebirds, swallows, black-

[15] DeMars, Craig A., Daniel K. Rosenberg, and Joseph B. Fontaine. 2010. Multi-scale factors affecting bird use of isolated remnant oak trees in agro-ecosystems. Biological Conservation 143:1485-1492.

capped chickadees, and other birds. Bats and other small-to-medium size mammals also use tree cavities for breeding sites and hiding places.

- ***Acorns***—acorns are an extremely valuable food resource for dozens of wildlife species—wild turkeys, band-tailed pigeons, western scrub jays, western gray squirrels, and black-tailed deer to name just a few.

- ***Unique invertebrate communities***—Oregon white oaks support rich assemblages of invertebrates, some of these species not occurring on any other plants. Thus, the presence of legacy trees increases the total biodiversity on farms lands and provides feeding sites for insectivorous birds.

Management Approach--The primary strategy is to preserve all existing legacy trees. Even large, dying trees provide multiple ecological functions. Unless a tree poses a risk to a farm structure, allowing it to stand will provide continuing benefits to wildlife. Soil-disturbing operations near mature trees can injure roots, which may promote tree some diseases. So management activities (such as weed control) within the drip line of the crown should be performed manually to protect important trees. No tree will stand forever, so planting and caring for replacement trees as individuals or in small clusters will ensure that these important habitat elements are maintained across farming landscapes.

Native Shrub Planting

When the Cooks changed an irrigation system on one of the vegetable fields in 2009, a two acre portion of the field was left dry and taken out of production. Matt Cook saw an opportunity to create a patch of wildlife habitat, but did not want to establish trees that would shade the nearby crops. So Matt planted native shrubs on the site that included willow, oceanspray, and Oregon grape.

The goal of the planting is to provide food and cover for wildlife, while occupying the site with native plants that hopefully will compete against weed species. Matt provided the labor for the project and the NRCS Environmental Quality Incentives Program (EQIP) offer financial and technical assistance.

Shrubs & Hedgerow

Shrubs are an essential habitat element for many wildlife species. Several of the neotropical migratory birds such as the yellow-breasted chat and Wilson's warbler require shrubs for nesting and dozens of other species feed upon their foliage, fruits, or shrub-dwelling insects. Shrubs also provide hiding cover and are especially important shelter for wildlife in winter. Hedgerows composed of trees and shrubs create vertical habitat structure that is uncommon on farm fields. Research from Great Britain indicates that shrubby hedgerows can increase the abundance

of airborne insects (important prey for swallows, swifts and bats) up to ten times the height of the hedgerow[16]. An understory layer of shrubs is a common feature of Willamette Valley riparian forests and farm woodlots. On moist soils, common native species are willows, red-osier dogwood, Indian-plum, thimbleberry, Douglas' spiraea, red elderberry, and Pacific ninebark. Common species on upland sites include: common snowberry, tall Oregon grape, oceanspray, red-flowering currant, California hazelnut, and western serviceberry.

Besides their function as wildlife habitat, shrubs and hedgerows provide other ecological services and advantages to growers.

- Shrubs can attract and help establish populations of native pollinators and predatory insects near crops.
- Hedgerows can reduce soil erosion and protect water quality by intercepting sediment runoff from fields and roads.
- Tall hedgerows can provide windbreaks and reduce pesticide drift.

Management approach—The choice of plant species to use in planting a new hedgerow will depend on the purpose(s) of the project and location of the site. Most new plants will need some irrigation for at least two years to ensure good plant survival. Willamette Valley native species are best adapted to local conditions and provide the most suitable habitat for native wildlife. Use at least two or three species to provide different resources for native insects and vertebrates. Consider establishing a strip of perennial grasses and forbs along the hedgerow or in a parallel ditch. The hedgerow site can be disked to prepare soil for transplant shrubs and seeds. Trees and large

Cook Family Farm: Pesticide Use

Pesticide use practices on the Cook Family Farm are conducted according to the principles and criteria established by the stewardship certification program of the processed vegetable coop of which the Cooks are members. Some important points of pest management program on the Cook Family Farm are:

- Monitoring surveys for plant diseases and insect pests are regularly conducted through the growing season by a contractor.
- Pesticide applications are adapted to the species and severity of the pest.
- Pesticides are applied only during appropriate weather conditions to minimize unintentional environmental impacts.
- Pest-resistant varieties of crops are used whenever feasible.
- Matt and Gary Cook regularly attend grower's meetings and research presentations to keep informed about best pesticide use practices.

[16] Lewis, T. 1969. The diversity of the insect fauna in a hedgerow and neighboring fields. Journal of Applied Ecology 6(3)453-458

shrub species should be planted at 15-30 ft spacing, infilling the gaps with smaller stature shrubs. Plant in fall. Weed control is the most challenging aspect of managing newly planted hedgerows. Pre-emergence herbicides can help control some weeds. Mulches and weed barrier mats are another approach. Established hedgerows can generally compete well against weeds but will need occasional spot spraying.

Population Conservation Measures

Some of the most effective means for improving wildlife diversity and safeguarding populations of species in decline don't involve significant changes in habitat. These are actions that can directly increase reproduction success, reduce wildlife mortality, or decrease competition from non-native species.

Protecting Native Insect Diversity

Sometimes modifying farm operations can significantly improve the breeding success or food availability for wildlife. For example, altering the pattern of pesticide use to avoid direct impacts on beneficial insects such as native pollinators. The Xerces Society, an invertebrate conservation organization, recommends several farm practices to promote native insect diversity:

- Leave at least a 20 foot no-spray buffer along field margins to minimize pesticide drift and allow pollinators to become established in field borders.
- If cropping system permits, allow plants to flower to provide forage for pollinators.
- Planting early and late varieties of a particular crop will extend the time that pollinators can use the crop for feeding.

Maintaining insect diversity also benefits vertebrate wildlife by ensuring an adequate prey base for insectivores, such as the western meadowlark, vesper sparrow, as well as dozens of species of bats and shrews. Insects are valuable source of protein and are especially important in the diets of birds during their breeding season.

Artificial Structures for Breeding, Roosting, and Perching

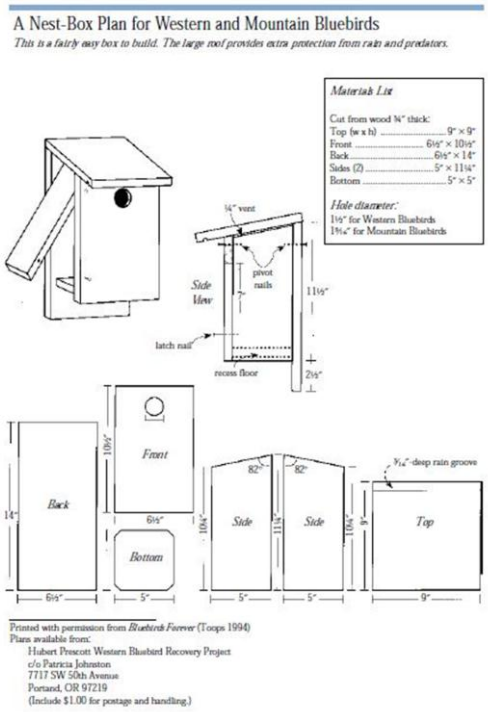
More than a dozen species of Willamette Valley birds nest and/or roost in tree cavities. Some of these species (such as American kestrels and barn owls) are predators of voles and other small mammals that cause crop damage. Today, non-native house sparrows and European starlings compete for tree cavities against native bluebirds, wrens, and swallows, often excluding these native birds from breeding sites. Landowners can improve reproductive success of native, cavity-using birds by placing nest boxes designed for the desired species. Constructing nest boxes with an entrance hole of the correct size and placing the box in suitable habitat for the desired species will give native cavity-users the best chance to occupy a box and defend it from house sparrows and starlings.

Bats are the most important nocturnal predators of insects, including many of the pests infesting vegetable crops. Growers can maintain bat populations by not disturbing colonies using barns and other farm structures. Landowners can also support bat populations by installing bat boxes on the exterior walls of existing buildings.

Raptors (falcons, hawks, and owls) are very effective predators of voles, mice, rats, and squirrels. Therefore, raptors can be a grower's valuable ally for controlling crop damage caused by small mammals. Artificial perches placed in and around fields can increase the hunting success of raptors where natural perches don't exist. Perches should be at least 12 ft tall and spaced 200-400 ft apart. A project conducted in Polk County during 2006-2008 reported that raptor perches resulted in a reduction of voles in grass seed fields, hay fields, and pastures[17].

Nest Boxes

The Cook Farm offers excellent habitat for western bluebirds, house wrens, and other cavity-nesting birds. Unfortunately, European starlings and house sparrows compete against native species for tree cavities and usually win. Providing nestboxes designed especially for native birds and placed in locations far away from buildings and grain storage areas decrease the chance of use by starlings and sparrows.



Nest box diagram courtesy of Cornell Lab of Ornithology

[17] Hastings, J. 2008. 2008 final report: predator control of rodent pests. Polk County Soil and Water Conservation District. Dallas, OR.

Reducing Non-Native Competitors and Predators

Humans have deliberately released hundreds of non-native plant and animal species into Oregon and many more organisms have been unintentionally introduced by hitching a ride on vehicles or hidden in materials transported into the state. Some invasive plant and animal species can experience much faster population growth than their native counterparts because factors limiting their abundance (for example: predators, parasites, physical setting) in their original geographic range are absent in newly colonized areas.

Invasive species impact native wildlife communities in several ways:

- Non-native vertebrates compete against native Oregon species for habitat resources and can have particularly serious impacts for native wildlife with special life requisites such as tree cavities for nests.
- Some non-native animals such as feral cats are highly effective predators, lowering the reproduction or survival rates of native wildlife.
- Non-native animals can introduce new diseases and parasites into native wildlife populations.

There are numerous non-native animals threatening streams and wetlands in the Willamette Valley. Some of the most serious aquatic invaders are the rusty crayfish, oriental weatherfish, and common snapping turtle. ODFW maintains a toll-free phone hotline (1-866-INVADER) for landowners to report sightings of invasive species.

European starlings have been called one of the"100 World's Worst Invaders". Crop damage by starlings in the US has been estimated to be $800 million annually with another $800 million annually in treatment costs for humans and livestock due to pathogen and parasites spread by starlings. Furthermore, starlings have been implicated in the decline of native cavity-nesting birds in the Willamette Valley. The close proximity of food (such as grass seed, grain, fruit) to buildings that offer roosting and nesting sites make farms optimal habitat for starlings. Growers can decrease starling populations by protecting crop storage areas and livestock feed from starlings. Closing entrances used by starlings into buildings and other structures will decrease the availability of nesting sites. Some research has indicated that large flocks of starlings prefer to roost in woodlots having tightly-spaced trees. Thinning woodlots used by starlings will discourage roosting and allow the retained trees to grow faster.

Although cats do serve a useful purpose by controlling rats and mice around farm buildings, they are among the serious causes of mortality among songbirds. Some of the ground-nesting bird species such as the streaked horned lark and western meadowlark are especially at risk of predation by cats. The American Bird Conservancy's *Cats Indoors* program attempts to address this important wildlife issue.

THREATENED AND ENDANGERED SPECIES

Sustainable agriculture certification programs are encouraging growers to learn more about threatened and endangered (T & E) species issues and take voluntary steps to protect species-at-risk on their farms. But many growers are concerned about the costs and restrictions they may face if T & E species are discovered on their land. The risks posed by federally-protected species on private property are real, but it's important to understand the basics of state and federal wildlife regulations before over-estimating the effects of T & E species on private property in the Willamette Valley.

The federal Endangered Species Act of 1973 (ESA) defined an endangered species as one that is in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered in the foreseeable future. The Federal ESA prohibits "taking" of an endangered or threatened animal. This means that you cannot "harm harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. Taking may also be caused by the removal or alteration of habitat that would be to the detriment of the listed species. ESA-listed plants are only protected on federal lands or on other lands that are enrolled in federal conservation programs[18]. Besides T & E species, there are several other species lists administered by the U.S. Fish and Wildlife Service (FWS) to promote wildlife conservation:

- ***Proposed***—These are species for which the FWS has found sufficient basis to warrant listing, but are awaiting public comment and final review before a decision is made to list as threatened or endangered.

- ***Candidate***—These are species for which the FWS has enough information to warrant proposing them for listing but is precluded from doing so by higher listing priorities.

- ***Species of Concern***—Species whose conservation status is of concern to the FWS, but for which more information is needed. Such species receive no legal protection and use of the term does not necessarily imply that a species will eventually be proposed for listing.

[18] U.S. Fish and Wildlife Service. 2011. ESA basics: More than 30 years of conserving endangered species. U.S. Fish and Wildlife Service, Endangered Species Program. Accessed at: http://www.fws.gov/endangered/esa-library/pdf/ESA_basics.pdf

More than 300 vertebrates and thousands of invertebrate species inhabit western Oregon. Of these, only five federal T & E animal species (1 mammal, 3 fish, 1 insect) currently occur on agricultural landscapes of the Willamette Valley (Table 3). By far, the majority of species having special federal conservation status are FWS Species of Concern, which receive no greater regulatory protection than is offered to all native wildlife under state law.

The Columbia white-tailed deer was federally listed as endangered in 1968[19]. The species is limited to portions of Washington, Clatsop, Columbia, and Douglas Counties in Oregon. Columbia white-tailed deer numbers have increased since its listing due to recovery actions that have benefited the species. The Douglas County population was de-listed in 2003.

Of the three ESA listed fish, two species are largely confined within navigable streams and rivers not under private ownership. Only the Oregon chub, a minnow-sized fish that lives in oxbows and flooded marshes along the Willamette River, has much likelihood of occurring on private lands. Currently there are less than 40 sites where Oregon chub are known to occur[20].

Fender's blue butterfly is the only terrestrial, federal T & E animal species that is comparatively widespread in the Willamette Valley. However even this species is known to occur only at 32 native prairie remnants, an exceedingly rare habitat type on Willamette Valley farms.

The State of Oregon maintains a list of T & E species separate from the federal government and criteria for state T & E listing are different than for federal listing. The Oregon chub and bald eagle are the only state listed T & E species breeding in the Willamette Valley.

Identifying High Priority Wildlife on the Cook Family Farm

We used a two-step process to identify the high priority species most in need of conservation effort in the Dever-Conner neighborhood surrounding the Cook Family Farm. First we checked for state threatened and sensitive species on the website of the Oregon Department of Fish & Wildlife and we also downloaded the special status species list for Linn County at the Oregon State Office of the U.S. Fish & Wildlife Service website. But some of these species are forest-dwellers and probably don't occur in the Dever-Conner area. So the next step was to use the Oregon Wildlife Explorer to find out more about each species and create a "short-list" of high priority wildlife that use grassland, wetland, and human-modified habitats that are common around the Cook Family Farm. The resulting list includes:

Riparian/Wetland Habitats
Northern red-legged frog
Western pond turtle
Bald eagle

Upland Forest/Woodlot
Olive-sided flycatcher
Western bluebird
Western gray squirrel

Shrubs/Hedgerows
Yellow-breasted chat
Willow flycatcher

Grassland/Croplands
Common nighthawk
Streaked horned lark
Oregon vesper sparrow
Western meadowlark

The state of Oregon also maintains two other lists of wildlife species with special conservation status. The state sensitive species list is a classification that calls attention to wildlife facing threats to their

[19] U.S. Fish and Wildlife Service. 1983. Columbian White-tailed Deer Recovery Plan. Portland, OR.

[20] U.S. Fish and Wildlife Service. 1998. Recovery Plan for the Oregon Chub. Portland, OR.

populations and/or habitats. The purpose of the sensitive species list to focus research and state management efforts on wildlife most in need of conservation action. Private landowners have no obligation to protect these species or their habitats[21]. The 2006 Oregon Conservation Strategy also identified a list of plant and animal species that have been recommended for elevated priority when planning state sponsored and voluntary private conservation efforts. Like the sensitive species list, there is no regulatory requirement to protect Conservation Strategy species to a greater degree than what is afforded to other native wildlife.

Landowners are not required to protect federal ESA-listed plant species on private farms (except those lands enrolled in federal conservation programs), but growers could make an important contribution to maintaining biodiversity in the Willamette Valley by voluntarily protecting listed plants when discovered on their farms. State-listed T & E plants are under the jurisdiction of the Oregon Department of Agriculture (ODA). The ODA Native Plant Conservation Program oversees management and conservation of Oregon's listed plants. The Oregon Flora Project website is one of the best places to find out about rare or T & E plants in your county.

Although growers are unlikely to encounter any regulatory issues with T & E species given their rarity on private lands in the Willamette Valley, the FWS does have a number of different approaches to addressing ESA-listed species should one be discovered on your farm. For example, the Oregon Chub Safe Harbor agreement was designed to promote conservation of the Oregon chub on private lands by offering landowners "no surprise" assurances, incidental take permits (under certain circumstances), plus tax incentives and cost-sharing plans to landowners engaged in protecting Oregon chub and its habitat.

On balance, the potential benefits of discovering and managing for species with special conservation status on your farm will outweigh the liabilities and costs in almost all cases. Only a few, rare, ESA-listed species entailing special protection on private lands inhabit the Willamette Valley. However, finding Species of Concern or Conservation Strategy species on your farm may increase your competitiveness for financial support and landowner assistance programs. These programs can cover some of the costs for managing wildlife habitats on your farm and make it easier to qualify for sustainable agriculture certification.

[21] ODFW. 2008. Oregon Department of Fish and Wildlife sensitive species: frequently asked questions and sensitive species list. Oregon Department of Fish and Wildlife. Salem, OR. Accessed at http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_taxon.pdf

Table 3. Animal species with special conservation status occurring in Willamette Valley lowlands and rivers.

Common Name	*Scientific Name*	Federal Listing[22]	State Listing[23]
Small-footed myotis bat	*Myotis ciliolabrum*	SOC	
Long-eared myotis bat	*Myotis evotis*	SOC	
Fringed myotis bat	*Myotis thysanodes*	SOC	
Long-legged myotis bat	*Myotis volans*	SOC	SV
Yuma myotis bat	*Myotis yumanensis*	SOC	
Camas pocket gopher	*Thomomys bulbivorus*	SOC	
Columbia white-tailed deer	*Odocoileus virginianus leucurus*	T	SV
Western burrowing owl	*Athene cunicularia hypugaea*	SOC	SC
Bald eagle	*Haliaeetus leucocephalus*	N/A	T
Streaked horned lark	*Eremophila alpestris strigata*	C	SC
Olive-sided flycatcher	*Contopus cooperi*	SOC	SV
Little willow flycatcher	*Empidonax traillii brewsteri*	SOC	SU
Yellow-breasted chat	*Icteria virens*	SOC	SC
Acorn woodpecker	*Melanerpes formicivorus*	SOC	
Band-tailed pigeon	*Patagioenas fasciata*	SOC	
Oregon vesper sparrow	*Pooecetes gramineus affinis*	SOC	SC
Western bluebird	*Sialia mexicana*		SV
Purple martin	*Progne subis*	SOC	SC
Oregon spotted frog	*Rana pretiosa*	C	SC
Western pond turtle	*Actinemys marmorata*	SOC	
Western painted turtle	*Chrysemys picta belli*	N/A	
Western rattlesnake	*Crotalus oregonus*	N/A	
Foothill yellow-legged frog	*Rana boylii*	SOC	SV
Northern red-legged frog	*Rana aurora aurora*	SOC	SV
Oregon chub	*Oregonichthys crameri*	T	T
Pacific lamprey	*Lampetra tridentate*	SOC	SV
Chinook salmon	*Oncorhynchus tshawytscha*	T	
Steelhead trout	*Oncorhynchus mykiss*	T	SV
Fender's blue butterfly	*Icaricia icarioides fenderi*	E	

Federal lists: Endangered (E), Threatened (T), Candidate (C), Species of Concern (SOC), [no Proposed species in Willamette Valley]. State Lists: Threatened (T), Sensitive-critical (SC), Sensitive-vulnerable (SV).

[22] USFWS. 2011. Federally listed, proposed, candidate, delisted species and species of concern under the jurisdiction of the Fish and Wildlife Service which may occur within Oregon. U.S. Fish and Wildlife Service, Oregon Office. Portland, OR. Accessed at: http://www.fws.gov/oregonfwo/Species/Lists/Documents/OregonStateSpeciesList.PDF

[23] ODFW. 2008. Oregon Department of Fish and Wildlife sensitive species: frequently asked questions and sensitive species list. Oregon Department of Fish and Wildlife. Salem, OR. Accessed at http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_taxon.pdf

Using Online Tools for Farm Assessments

Landowners have a wealth of online tools and databases that make it easier than ever to find out about local wildlife and other natural resources. All of the satellite imagery, maps, wildlife lists, and landscape metrics used in the Cook Family Farm Study can be obtained for any other location in Oregon on publicly accessible websites. Note—most of these websites require a high-speed internet connection and some require software such as *Flash Player*™ or *Java*™, both of which are free and are pre-installed on many computers.

Wildlife Information

The *Oregon Wildlife Explorer* is one of the best resources for finding information about common to very rare vertebrate species and their habitats in the state. Users can find individual species profiles, range maps, and complete lists of wildlife species by county or watershed.

Another useful site for finding an information summary for almost any wildlife species, plus many insects and plants is *NatureServe Explorer*.

Mapping and Imagery

The Oregon Imagery Explorer is an online geographic information system (GIS) that allows users to view satellite photos and to make custom maps of roads, terrain, water bodies, vegetation types, plus dozens of other themes. Users are provided advanced mapping tools to measure lengths or areas of natural features. Location portals such as the *Willamette Basin Explorer* offer more in-depth content about the natural history, human population, land use, and conservation issues in specific regions of the state.

Users can use Oregon Department of Forestry's *LocatOR* GIS to find the latitude/longitude, watershed, elevation, ownership class, and other information with just a click on the map. LocatOR can also be used to measure landscape features and to print topographic maps.

Google Earth provides an alternative approach to viewing satellite imagery and measuring landscape features. Google Earth also allows the user to map locations from coordinates exported from a GPS.

Finally, the Oregon Conservation Registry Portal is a source for information about habitat management and restoration projects, conservation education, and research activities in the state. The Conservation Registry also posts opportunities for funding and other resources in support of wildlife projects.

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The Oregon Wildlife Institute is a non-profit organization dedicated to the conservation and enhancement of wildlife resources in both native and human-altered environments through research, education, and conservation planning. Visit our website at *www.oregonwildlife.org*

APPENDIX: COMMON AND SCIENTIFIC NAMES OF PLANTS AND ANIMALS

Non-native species indicated by underlined type

Grasses/Forbs

American vetch (*Vicia americana*)

Blue wildrye (*Elymus glaucus*)

Camas (*Camassia* spp.)

California oatgrass (*Danthonia californica*),

Creeping spikesedge (*Eleocharis palustris*)

Meadow checkermallow (*Sidalcea campestris*).

Roemer's fescue (*Festuca roemeri*)

Spring gold (*Lomatium utriculatum*)

Tarweed (*Madia* spp.)

Tufted hairgrass (*Deschampsia cespitosa*)

Wappato (*Sagittaria* spp.)

Western buttercup (*Ranunculus occidentalis*)

Western rush (*Juncus occidentalis*)

Woody Plants

Black cottonwood (*Populus trichocarpa*)

California hazelnut (*Corylus cornuta var. californica*)

Common snowberry (*Symphoricarpos albus*)

Douglas-fir (*Pseudotsuga menziesii*)

Douglas' spiraea (*Spiraea douglasii*)

Indian-plum (*Oemleria cerasiformis*)

Oceanspray (*Holodiscus discolor*)

Oregon ash (*Fraxinus latifolia*)

Oregon white oak (*Quercus garryanna*)

Pacific ninebark (*Physocarpus capitatus*)

Ponderosa pine (*Pinus ponserosa*)

Red alder (*Alnus rubra*)

Red elderberry (*Sambucus racemosa*)

Red-flowering currant (*Ribes sanguineum*)

Red-osier dogwood (*Cornus sericea*)

Tall Oregon grape (*Berbis aquifolium*)

Thimbleberry (*Rubus parviflorus*)

Western hemlock (*Tsuga heterophylla*)

Western redcedar (*Thuja plicata*)

Western serviceberry (*Amlanchier alnifolia*)

Willow (*Salix* spp.)

Invertebrates

Fender's blue butterfly (*Icaricia icarioides fender*)

Rusty crayfish (*Orconectes rusticus*)

Fish

Chinook (*Oncorhynchus tshawytscha*)

Longnose dace (*Rhinichthys cataractae*)

Oregon chub (*Oregonichthys crameri*)

Oriental weatherfish (*Misgurnus anguillicaudatus*)

Peamouth (*Mylocheilus caurinus*)

Reticulated sculpin (*Cottus perplexus*)

Sand roller (*Percopsis transmontana*)

Steelhead (*Oncorhynchus mykiss*)

Amphibians

Bullfrog (*Rana catesbeiana*)

Oregon spotted frog (*Rana pretiosa*).

Reptiles

Common snapping turtle (*Chelydra serpentine*)

Western fence lizard (*Sceloporus occidentalis*)

Western pond turtle (*Actinemys marmorata*)

Birds

Acorn woodpecker (*Melanerpes formicivorus*)

American kestrel (*Falco sparverius*)

Band-tailed pigeon (*Patagioenas fasciata*)

Barn owl (*Tyto alba*)

Black-capped chickadee (*Poecile atricapillus*)

California quail (*Callipepla californica*)

Cassin's vireo (*Vireo cassinii*)

Common nighthawk (*Chordeiles minor*)

European starling (*Sturnus vulgaris*)

Grasshopper sparrow (*Ammodramus savannarum*)

House sparrow (*Passer domesticus*)

Hairy woodpecker (Picoides villosus)

Lewis' woodpecker (*Melanerpes lewis*)

Red-tailed hawk (*Buteo jamaicensis*)

Sandhill crane (*Grus Canadensis*)

Savanna sparrow (*Passerculus sandwichensis*)

Streaked horned lark (*Eremophila alpestris strigata*)

Vesper sparrow (*Pooecetes gramineus*)

Western bluebirds (*Sialia mexicana*)

Western meadowlark (*Sturnella neglecta*)

Western scrub-jay (*Aphelocoma californica*)

Western wood-pewee (*Contopus sordidulus*)

White-breasted nuthatch (*Sitta carolinensis*)

White-crowned sparrow (*Zonotrichia leucophrys*)

Wild turkey (*Meleagris gallopavo*)

Mammals

Black-tail deer (*Odocoileus hemionus*)

Bobcat (Lynx rufus)

Columbia white-tailed deer (*Odocoileus virginianus leucurus*)

Vagrant shrew (Sorex vagrans)

Western gray squirrel (*Sciurus griseus*)