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Wildlife Habitat Relationships for the Cascades Guide:

Field workers occasionally have noted relationships of certain plant communities with wildlife species, but to date no studies have been undertaken with the specific intent of relating wildlife use to published plant associations (with the exception of deer and elk use tallied during a portion of early data gathering efforts). Wildlife discussions in this guide are meant to serve as a brief introduction and overview of current knowledge and hypotheses about wildlife in forest ecosystems within the range addressed by this guide.

Four headings are included in this portion of the guide:

- Overview of wildlife numbers and diversity
- Ecosystem components that encourage wildlife diversity
- Disturbances that affect wildlife habitat
- Consideration of specific species and groups

You will find a list of common and scientific names of vertebrates that regularly utilize terrestrial habitats of the Northern Cascade range at the end of this document.

Overview of wildlife numbers and diversity:

Approximately 137 species of birds, 72 mammals, 20 amphibians, and 15 reptiles carry out a significant part of their life cycle within terrestrial habitats in the area covered by this guide. Over 75 additional species of birds have been recorded only a few times, are strictly aquatic, only occur in non-forest habitats, or regularly overfly the region. While most mammal, amphibian, and reptile populations within the area considered are resident, only about 26 of the regularly occurring bird species are largely resident. Another 51 migrate annually, bringing different individuals of the same species here during different seasons; about 56 are present only during migration and summer; about 3 only during migration and winter; and 1 species is present predominantly during migration.

Ecosystem components that encourage wildlife diversity:

While a large number of factors determine presence and abundance of wildlife in any particular landscape, the following habitat components are known to have a relatively strong influence on biodiversity in mountain forests covered in this guide. See also Brown (1985), Bunnell and Kremsater (1990), Hansen et al. (1991), McComb et al. (1993), Hunter (1997), Marcot (1997), O'Neil et al. (2000), and Johnson and O'Neil (2001).

Dead and partly decomposing trees--Approximately one-third of bird and mammal species in forested landscapes use tree cavities for denning, nesting, or roosting. Snags, dead tree tops, and otherwise decayed portions of live trees provide opportunity for woodpeckers and other species to create holes. These cavities are in turn used by secondary cavity-nesters that search for and use these cavities, rather than create their own. Cracks, crevices and loose bark also provide nesting and roosting substrates for bats and brown creepers. Probably the rarest structures in the forest important to vertebrates, and most difficult to duplicate, are large hollow trees. These are often western redcedar or incense cedar, but can be just about any species of tree. Some trees are hollow from the bottom up, some from the top down, some only in the middle (but the latter are very difficult to find). Bears, bats, swifts, and other mammals and birds utilize these structures. Vaux's swifts nesting in forests exclusively use these structures.

Down wood--Logs are used by a wide variety of wildlife, but small mammals and amphibians are probably the groups most dependent upon these structures. Some species prefer more sound structures, utilizing the space created by loose bark, while others predominate in more decayed structures that are soft enough to tunnel through or that have a matrix of navigable cracks due to the work of brown cubical rot. Many species utilize logs simply for hiding cover, nesting cover, travelways, or perches.

Diversity of tree species--Different tree species germinate in different ground conditions, grow at different rates, exhibit

different shapes to their crowns, boles, and leaves, have different susceptibilities to root rots, stem rots, and mistletoes, are differentially resistant to stem breakage from wind, ice, and snow, attract or repel different communities of invertebrates, and finally, different tree species have different maximum heights and senesce and die at different ages. All these differences suggest that a wide variety of nesting, foraging, roosting, hiding, and resting habitats may be produced by different combinations of species, ages, and conditions of trees. Thus, single-species stands typically exhibit less vertebrate diversity than multi-species stands.

Broadleaf trees--Following up on the diversity of tree species, broadleaf trees need particular emphasis. The significant differences between conifers and broadleaf trees cause the combination or adjacency of these species in forest stands and landscapes to significantly increase the number of vertebrates present. For example, warbling vireos are most frequent in areas with abundant broadleaf trees or tall shrubs, and black-throated gray warblers and black-headed grosbeaks prefer mixed habitats. In the Douglas-fir and drier western hemlock associations, broadleaf trees (especially oak) attract western gray squirrels, but in all series, sites dominated by broadleaf trees are likely absent of Douglas squirrels. Broadleaf trees may be important to mollusk diversity.

Shrubs--Forest understory shrubs provide nesting structures for Swainson's thrushes, hermit thrushes, winter wrens, and Wilson's warblers. The Wilson's warbler in particular utilizes tall deciduous shrubs for nesting. Shrubs provide important habitat for invertebrates, browse for deer and elk, and cover for a wide variety of birds, mammals, and reptiles. Patches of older shrubs in particular can be hotspots for arthropod, lichen, and bryophyte diversity.

Fruits, berries, and nuts--Numerous trees, shrubs, and forbs produce seeds and soft fruits that are consumed by a wide variety of birds and mammals. Some of the more common species producing mast include all conifers, maples, and hazel. Oregon

white oak and Pacific madrone occur sparingly, most often in or near the Douglas-fir series. Species producing berries (i.e. seeds with a fleshy outer layer) include dwarf and tall Oregon grapes, salal, several species of blackberry, thimbleberry, several species of manzanita, salmonberry, bitter cherry, snowberry, several species of rose, Pacific dogwood, several species of huckleberry, blue and red elderberry, and cascara.

Soil and forest litter--Soil characteristics combine with annual temperature, precipitation, and solar exposure to determine suitability and growth potential of a site for plant species and communities. Burrowing animals such as gophers, moles, some voles, and mountain beaver prefer relatively porous soil. Oregon slender salamanders may especially prefer loose, porous soil, in which they can readily burrow, or through which they can readily travel. Several species of shrews appear to be particularly abundant where forest floor litter is abundant and deep, and western red-backed voles are especially common in areas with a thick duff layer. Forest floor characteristics are also important to ground-dwelling invertebrate communities.

Rocks, cliffs, caves--Many different structures are created by rock. Cobble-sized talus is common below cliffs and on steep rocky slopes. These habitats may be dominated by several species of amphibians (e.g. western redback salamander, clouded salamander) if wet, and several species of snakes (e.g. northwestern garter snake) and lizards (e.g. northern alligator lizard) if dry, and some communities have both. Mice and voles also inhabit talus. Accumulations of larger rocks provide homes for pika and long-tailed weasel, and potential denning sites for other medium to large mammals. Cliffs provide nest sites for peregrine falcons, common ravens, and violet-green swallows, and caves are often home to turkey vultures, bats, and medium and large mammals. Waterfalls and seepy cliffs are sometimes occupied by the rare black swift. In arid associations, seepy areas provide rare habitats for amphibians and mollusks.

Water--While many animals gain a substantial portion of their water needs from the food they eat, most also require consumption of water on a near-daily basis. While small mammals and birds can often obtain water from condensation on vegetation, larger animals are more dependent upon more substantial water sources such as streams and ponds. In most of the area covered by this guide, open water sources are seldom more than a quarter-mile from any one point, in the thousands of miles of headwater streams. These undoubtedly provide the predominant water source for the majority of birds and mammals in most landscapes. Even migratory birds, presumably unfamiliar with any particular small stream, have an uncanny ability to locate small trickles and pools located on an otherwise dry stream segment under a tall forest canopy. At least some species in all taxa are highly dependent upon or adapted to water.

Streams--Pacific and Cope's giant salamanders, Cascade torrent salamanders, tailed frog, and foothill yellow-legged frog are restricted to breeding in cool, running water. The most common of these, the Pacific giant salamander, contributes significantly to the biomass and predation within small streams. While terrestrial densities of stream-breeding amphibians decrease with distance from streams, stream densities in the area covered by this guide are high enough to obscure any dramatic gradients that would be seen over longer distances. At least two small mammals, the water shrew and the water vole, are also restricted to mountain streams. Little is known about the distribution and life histories of these species.

Ponds--Western toad, Pacific tree frog, Cascades frog, red-legged frog, spotted frog, bull frog, northwestern salamander, long-toed salamander, and rough-skinned newt are restricted to breeding in still or very slow-moving water. Highest terrestrial densities of these species are found in close proximity to these breeding sites, sometimes concentrated on particular hillsides or along particular inflowing or outflowing streams. Some species exhibit substantial dispersal capabilities and may be found in very small numbers several miles from any suitable breeding habitat. While most

species typically breed in small ponds or lakes, others (e.g. Pacific tree frog and Cascades frog) will sometimes breed in very small water, even puddles in abandoned roads, and roadside ditches in open roads. Some require semi-permanent water; for example, northwestern salamanders require more than one season to metamorphose, or may even become neotenic (a permanent "larval" form that is capable of reproduction), particularly at moderate and higher elevations, while others (e.g. Pacific tree frog) can breed in water that dries up during summer, because they metamorphose rapidly. Some (e.g. northwestern salamander, red-legged frog) require substrate such as sedges or woody plant stems for oviposition (egg-laying), while others (e.g. Cascades frog, Pacific tree frog, rough-skinned newt) do not require such substrate, though the newt may have requirements for pond-bottom composition.

The marsh shrew is a common inhabitant of ponds as well as small streamside wetlands. Common garter snakes in particular are attracted to ponds containing frog tadpoles. Marsh shrews also take advantage of this abundant food source. Vaux's swifts, common nighthawks, and several species of swallows and bats obtain water in flight at ponds and still water pools in streams and rivers. These species also forage on flying insects over these waters.

Spatial and temporal relationships--While we tend to think of landscapes as being within a certain range of land area, and patches as being distinct forest stands of a particular range of sizes, animals living in forest landscapes have tremendously differing perspectives on what attributes of their ecosystem serve as landscapes and patches within their home range (e.g. McGarigal and McComb 1995, Wiens et al. 1986). Understanding how an animal views and interacts with its world helps tremendously in anticipating how any particular change in its environment might affect it. A black bear may live 20 years, traverse several miles one year and several tens of miles another year, utilizing a wide variety of habitats as they become available in its landscape. In contrast, a vagrant shrew must reproduce several times and complete its life cycle in less than two years, and in usually within a single acre. A

rufous hummingbird may breed here in the summer and be in South America during our winter. An Oregon slender salamander may remain in the vicinity of the same log most of its life.

Species with much smaller home ranges tend to key in on particular structural attributes within forest stands, while species with larger home ranges additionally look at juxtaposition of multiple communities or forest types. To a bear, a landscape may be several adjoining watersheds including a variety of stand types, while for an Oregon slender salamander, a landscape may be a pile of bark below a snag within a stand. For a bear, a distinct habitat patch may be a lush meadow, while for an Oregon slender salamander a distinct habitat patch may be a specific piece of bark with a precise placement on the ground and a particular network of fungal hyphae. These differences contribute to the nature and magnitude of the effects of forest fragmentation on different species and communities of wildlife. Some species flourish, some decline, some are not affected by the fragmentation of forests, but simply respond to the amount of habitat available (Rosenburg and Raphael 1986, McGarigal and McComb 1995, also see Rochelle et al. 1999).

Disturbances that affect wildlife habitat:

All of the previously described ecosystem components are either created by or subsequently affected by various ecosystem processes. Some processes are perpetual and slow, some periodic and catastrophic. Regardless, wildlife habitat is shaped by these and other processes acting in forest ecosystems. Ecosystem processes should be considered in long-term planning for wildlife habitat in landscapes and watersheds, and consideration of these processes can give insight into the origin of existing wildlife habitat components in forest stands and landscapes. Each of the following paragraphs briefly describe each process and how they influence particular habitat components.

Wildfire--Fire is probably the most widely recognized and influential process operating in forest landscapes in the Cascades.

Intense fires usually kill most or all trees, creating a huge pulse of snags, followed by a huge pulse of down wood (as many of the dead trees fall). Intense fires also usually bring a drastic change in the ground cover for a few to many years (sometimes even changing the composition, for example if ceanothus is germinated), may consume most small logs, slash, and duff accumulated over the mineral soil, and may substantially alter the character of larger logs. Repeat burns can reduce structural complexity and increase homogeneity of regenerating vegetation. Less intense fires kill few or no trees, may remove only a small amount of duff and small-diameter woody debris, and may not kill the roots of any of the major ground cover species, thus setting it back for only a few years. Fires at different times of year likely have different effects on the ecosystem due to seasonal aspects of plant and animal life histories (e.g. flowering and seeding, nesting and dispersal). See Smith (2000).

Floods, debris-flows, landslides, earth flows--Though the effect of floods are predominantly restricted to the stream or river channel and floodplain, associated events such as debris-flows and landslides typically affect upslope areas. Large floods sometimes remove and restart succession of floodplain vegetation, which often has a significant deciduous component. Debris-flows often start in headwall areas of small streams or mini-headwall tributaries of small streams, and along their path they often take with them huge volumes of wood and soil. Landslides, which may or may not end up in a stream channel, similarly transport large volumes of wood and soil, often creating patches of new soil. Slower events, generally called earth flows, sometimes buckle or slump and form small ponds. Locations that have recently experienced a geomorphic event often support vigorous broadleaf tree and/or shrub communities.

Wind—The effects of wind in forest communities are so erratic and unpredictable that it is not surprising no studies have been done on its effects to wildlife habitat in forests of the Pacific Northwest. Nevertheless, field experience suggests an extensive role of wind in forest ecosystems. Most apparent is its role in creating snags or

broken-top green trees by breaking a portion of the upper bole from a tall tree. This action is often in concert with previous effects of stem rots, root rots, deformities, or cavities that served to weaken the bole. Some trees are blown over wholesale, lifting up wide root shelves, exposing mineral soil and creating a variety of structures used as cover by wildlife. Further, this action produces gaps in the forest canopy, which create more diverse canopy structure, as well as allow more light to the forest floor, which may alter the ground cover (e.g. Spies and Franklin 1989, Spies and Cline 1988). Wind is the primary means of dispersal for pollen and seeds of many species of trees (e.g. western redcedar, black cottonwood), seeds of many forbs (fireweed, thistle), spores for many fungi (primarily stem rots), and thalli for many epiphytic lichens. Lichens blown to the ground are eaten by deer, elk, rodents, and invertebrates

Ice--Freezing rain may form a crystal-clear glove of ice over all trees, shrubs, and ground cover on a hillside. The shear weight of this frozen water is enough to break large limbs off of trees, and combined with even moderate winds frequently snaps boles or topples poorly rooted trees. While the ice coating is typically short-term, it has a drastic effect on the accessibility of foods (e.g. seeds, fruits) and foraging substrates (e.g. bark, twigs, and leaves) for numerous species. Ice-melt on temporary or permanent ponds in late winter and spring often marks the beginning of courtship for pond-breeding amphibians at high elevations.

Snow--Though variable, snow is probably one of the more predictable and studied environmental factors influencing wildlife habitat, at least at a broad scale. In the Cascades, long-term effects to ground cover are most prominent in the Pacific silver fir and mountain hemlock zones, and depths and persistence of snow packs are mentioned in those accounts. However, snow causes breakage of limbs and boles in forests at all elevations. Some ground-dwelling species, such as gophers, are able to tunnel through the snow and forage above and below ground even in deep of snow. Snow cover limits ground foraging opportunities for some birds such as varied thrush, American robin, dark-eyed junco, and

winter wren, requiring them to move to lower elevations. Crusty snow cover provides a dispersal surface for mountain hemlock seed, helped along by winter winds. Snow melt in spring adds a tremendous amount of water to the soil, perhaps triggering movement in some terrestrial salamanders. It also increases and/or maintains the flow of some moderate to high-elevation streams. Oregon slender salamanders seem to be easiest to find shortly after snow melt in spring.

Fungi--The symbiotic role of mycorrhizal fungi and many plant species has become well-known, though many specific relationships remain to be investigated. Other forms of fungi attack and/or contribute to decomposition of trees and other plant matter. Without the work of fungi, forest landscapes would undoubtedly be more spatially homogenous and would be lacking in decayed substrates necessary for primary cavity excavators (see Van der Kamp 1991). Root rot creates patches of dead and dying trees. Bark beetles are attracted to the stressed trees, and forb-loving rodents to the increase in ground cover. Because of the variable resistance of tree species to root rots, these patches sometimes encourage heterogeneity of tree species in forest stands.

Animal activity--Many animals affect the habitat in which they live. Many small mammals and even some native mollusks disperse fungal spores through their feces. Similarly, some birds and mammals disperse seeds of berry-producing trees and shrubs. Some plant seeds are specifically designed to attach to mammal fur, accomplishing transport to new locations. Some rodents, particularly squirrels and chipmunks, collect and stash conifer seeds and/or cones that, if not eaten, later sprout under proper conditions. Deer, elk, and rodents consume large amounts of vegetation, and if populations are large enough, may actually alter the vegetative species composition of particular sites. While many species of rodents burrow in the soil, no activity is more apparent in forested landscapes than that of the mountain beaver. Aquatic beavers create ponds that are used by fish, amphibians, and predators of several taxa. Beavers can topple numerous trees in nearby forests, and their ponds often create snags by drowning.

Mountain beaver and bears can girdle trees, killing them or making them susceptible to stem rots.

Timber harvest--The effects of timber harvest to wildlife is probably one of most well-studied topics in Pacific Northwest forests. While much remains to be learned, certain things are fairly well known. One is that different communities of vertebrates exist (with some overlapping species) in different seral stages (e.g. Meslow and Wight 1975). Another is that canopy cover matters. A range of overstory retention is common in harvest areas today. Depending on the density, such retention may render the habitat unsuitable to some early seral species, encourage use by some species, and be inadequate for species preferring more closed canopy and understory layers (Hansen et al. 1995). Lastly, and perhaps most importantly, recent traditional timber harvest and silvicultural practices (1950s-1980s) typically reduced the number and volume of large snags and logs, the number of tree species, and the diversity of tree sizes compared to unmanaged stands of the same age (Spies and Franklin 1991). While more recent forest practices have lessened some ecological contrasts between managed and unmanaged stands in areas where they are implemented, it must be realized that timber harvest requires a reduction in volume and/or duration of certain forest components, most notably dead standing and down wood.

Controlled burning--Few studies have been made of the effects of controlled burns on wildlife in western Oregon. Controlled burns can be implemented in a variety of ways to achieve specific objectives, thus are typically mild, consuming small and medium-sized fuels, but may be very hot in places, and may even be used purposely to injure or kill standing live trees to create snags. As with wildfires, the timing and intensity of controlled burns may influence the pioneering plant community. Nevertheless, little study has been accomplished to allow managers to predict such consequences in detail.

Road-building--Almost nothing has been investigated in regard to the effects to wildlife of building, maintaining, and using roads in

forest landscapes in the Pacific Northwest, except in regard to the disturbance to elk. Nevertheless, field observations indicate that roads have negative and positive impacts on native plant and animal communities in forested landscapes. The most well known negative effect is the widespread introduction of exotic plants to landscapes.

On the other hand, some sun-loving native plants find suitable habitat on road cut banks. Many species of wildlife respond positively to the habitat created by mountain forest roads; not necessarily the road surfaces themselves, but in particular the associated cut and fill banks. Western fence lizards in particular take advantage of rocky cut banks for foraging and nesting. Alligator lizards and snakes likewise use the habitats at least for foraging. Townsend's solitaires occasionally nest in rocky cut banks, while dark-eyed juncos occasionally nest in grassier slopes. Belted kingfishers and rough-winged swallows excavate nest burrows where a soft layer is present in vertical cut banks. Common nighthawks (widespread) and killdeer (in valleys and near wetlands) occasionally nest on abandoned roads or landings. Closed roads in remote areas are favorite travelways and loafing sites for many species of medium and large mammals. Amazingly, there are no published negative effects of roads (as habitat) on wildlife in mountainous, forested areas.

In rare instances, high densities of roads may fragment the forest canopy to such a degree that it becomes unsuitable for interior forest species. Roads may also restrict burrowing and dispersal of some low-mobility organisms, but this has not been studied in this ecoregion. Roads certainly reduce the amount of the habitat they replace in the landscape. Reports of road-builders discovering wildlife hiding places, such as bats in crevices of rocks being excavated, are not uncommon. Less studied in the Pacific Northwest is the effect of mortality due to traffic on forest roads. Areas of most concern probably would be the juxtaposition of heavy traffic and relatively rare organisms that may cross roads (e.g. red-legged frogs or western pond turtles). Bridges, depending on construction and context, may provide roosting sites for bats

and birds, and nesting sites for the American dipper, swallows, and other species. Lastly, roads can have significant effects on routing of subsurface water, stability of slopes, and paths of debris-flows.

Recreation--Little study has been made of the effect of recreation on wildlife in forest landscapes, except for the direct effects of disturbance and hunting. In general, recreational uses are low-density over most of the forest, and concentrated in a few areas. The effects of human presence in forest landscapes is difficult to determine. In some areas animals become accustomed to regular presence of humans, while in others a rare visit creates great fright in animals. Off-road vehicle may have deleterious effects to sensitive habitats such as wet meadows.

Dams--Reservoirs created by dams have attracted a substantial assembly of still-water-loving wildlife. Most reservoirs in mountainous areas carry a substantial population of rough-skinned newts where few existed previously. These newts disperse up to several miles from their natal sites. Reservoirs with fish attract a variety of waterfowl, and Bald Eagles now nest at most large flood control reservoirs in western Oregon (changes in fish stocking policy would likely change this situation). Earthen or rock dams create a unique habitat in themselves. Rock Wrens are sometimes found on larger rock dams, and the larger dams occasionally create updrafts used by local and migrating raptors. Some concrete structures associated with dams are used by colonies of cliff swallows for nesting, while reservoir shorelines are used for gathering mud.

Consideration of specific species and groups:

The following short accounts discuss deer and elk, mountain beaver, fruit eaters, broad-leaf nesters, cavity nesters and reptiles. These and other species are discussed in more detail in Black (1992).

Deer and elk--Home ranges are usually <1 mi^2 for black-tailed deer, and 1-10 mi^2 for elk. Extent of seasonal movement is

generally associated with the magnitude of seasonal change in available habitat, and can very tremendously among individuals and herds—some being relatively sedentary and others nomadic or migratory. Key components in the home range of deer and elk include forage, cover, and water, and the nearness of each component to the other reduces energy expenditures.

Cover comes in a wide variety of forms, and functions in a variety of ways. For example, shrubs and small trees, and topography, whether in forests or openings, serve as hiding cover. Dense tree canopies may serve as shelter from wind, rain, and snow, and from hot and cold extremes. So-called "optimal" cover serves all these functions, and additionally provides a substantial food source (Witmer et al. 1985).

Topography and location of water influence the use of particular areas. Moderate slopes (15-30%) typically receive greatest use, while slopes >90% receive little use; nevertheless, juxtaposition of food, cover, water, and predators (including humans) during different seasons strongly dictate patterns of use. South aspects (especially early seral stages) are often used for sunning in cool seasons, and north aspects for refuge from heat (primarily Cascades). Calving areas for elk are typically on gentle slopes, or level pockets surrounded by steep ground, and often near water (Witmer and deCalesta 1983).

Diets of deer and elk overlap to a large degree, with deer generally being more selective for digestible forage. Availability in large part determines what deer and elk eat. General trends in foraging habits are listed below (primarily from Rochelle 1992, but also Friesen 1991, Stussy 1994):

> Spring. Forbs, grasses, and new growth on shrubs and trees. Examples are velvet grass, false dandelion, sedges, trailing blackberry, salal, huckleberries, Douglas-fir. Diet reflects a transition from winter to summer foods.

Summer. Forbs, grasses, ferns and shrubs (leaves, twigs and fruit). Examples are fireweed, false dandelion, trailing blackberry, vine maple, thimbleberry, red huckleberry, sedges, and legumes.

Fall. Shrubs, forbs and grasses. Examples are trailing blackberry, red huckleberry, salal, thimbleberry, red alder, fireweed, dandelion, sedges and legumes. Shrubs increase in importance, and fruits commonly are utilized at this time.

Winter. Winter-active grasses and forbs, shrubs, and conifers. Examples are trailing blackberry, elderberries, sedges, false dandelion, salal, red huckleberry, ceanothus spp., Oregon grape, Douglas-fir, western redcedar and western hemlock.

Managers have sometimes focused on either summer or winter range forage with regard to concerns over elk survival and reproduction. Friesen (1991) conducted studies during a time when winter range cover and forage was thought to be the most important factor in elk survival and reproduction, and that burning of harvest units improved forage quality. However, Friesen (1991) found that "burning did not promote a detectable increase in quality for [the forage taxa studied], and it decreased the quality of species sensitive to site conditions." Friesen (1991) suggested, "elk forage enhancement in winter range should be evaluated on a site-specific basis." Given the variation in herds, populations, and environments occupied, this attitude is suited for all aspects of big game management.

Observations in the Coast Range suggest that vehicle access can influence movements and survival rate of elk (Cole et al. 1997), and use of cover by elk cows increased during the hunting season (Witmer and deCalesta 1983).

Mountain beaver--This interesting animal is very sensitive to temperature extremes, and its inefficient kidneys require it to obtain approximately one-third of its body weight in water each day (Johnson 1971). It is not surprising then that the species occurs

predominantly in areas with relatively high rainfall and soil conditions providing succulent vegetation and high burrow humidity (Voth 1968). Soils need to be soft for burrowing, and steep and porous soils to reduce likelihood of flooding tunnels (Hacker and Coblentz 1993). They generally are found more on north (Hacker and Coblentz 1993) slopes and wet draws, but can be found in most any area where water or abundant herbaceous growth are present (Cafferata 1992). They consume a wide variety of plants but primarily ferns; lactating females consume significant amounts of conifer and grasses for the additional protein (Voth 1968). Conifers are not a preferred food source, but are consumed when availability of alternate foods is limited, such as during the winter (Voth 1968) or during canopy closure (Neal and Borrecco 1981). Nests and feeding chambers are often under woody debris, either logs or slash, or even thick shrub patches, perhaps for protection from predators such as coyote and bobcats (Maser et al. 1981). Dispersing juveniles have been tracked one-third of a mile (Martin 1971).

Fruit-eaters--While berries on forest understory shrubs are consumed by several species of birds and mammals, the number and diversity of bird species that forage on berries in relatively open-canopied areas is much greater than that present in the forest understory. Further, most favorite berry-producing plants (e.g. elderberries and cherries) are typically more abundant and productive in open-canopy environments. Therefore, managers interested in providing for berry-loving birds in forested landscapes should consider management of these species in early seral stages.

Broadleaf nesters--Broadleaf nesters such as the warbling vireo typically breed in relatively young forests and riparian areas, where deciduous trees are more abundant, and less so in mature and old forests where deciduous trees are often shaded out or widely spaced. Therefore, managers interested in increasing broadleaf nesters should concentrate on retaining hardwoods during harvest operations and early seral stages (e.g. shrub and sapling-pole), or

by creating gaps in the conifer canopy around existing broadleaf trees or saplings.

Cavity-nesters--Fairly standard management practices exist for cavity-nesters, derived mostly from Neitro et al. (1985). However, the preference of some species for different seral stages and/or canopy closure is not often acknowledged in management guidelines or analyses for cavity-nesters. For example, while red-breasted sapsuckers and chestnut-backed chickadees prefer moderate to closed-canopy forests, northern flickers and western bluebirds prefer stands that are relatively open, the latter even requiring some open ground for foraging. Similarly, distributions and associated tree species are rarely considered. For example, downy woodpeckers are largely restricted to broadleaf habitats in riparian areas and occasional hillside patches, while black-backed woodpeckers and three-toed woodpeckers are restricted to high-elevation habitats. Lastly, the longevity of large Douglas-fir and western redcedar snags compared to that of softer wood has been rightly acknowledged and utilized in long-term snag management. However, harvest units with only large, fresh, created snags of these species will lack substantial substrate for excavation during the earliest seral stages that are preferred by species such as the western bluebird. While relatively small Douglas-fir and western redcedar snags, and any size broadleaf, hemlock, and true fir snags fall relatively quickly, these provide relatively immediate substrate for woodpeckers and secondary cavity-nesters in early seral stages, as do remnant snags from former stands.

Reptiles--While frequently evaluated as a group, reptiles are tremendously diverse in their habitat use. They range from the seasonally aquatic western pond turtle to the hot- and dry-loving western fence lizard. The range of the racer and gopher snake barely extends into dry areas at lower elevations in the south. Ringneck snakes occur a bit more extensively at lower elevations, while western fence lizards occur to moderate elevations. In contrast, northwestern and common garter snakes are virtually unlimited in forested zones, the latter commonly searching for amphibian prey in moist riparian and pond habitats. Very little

study has been made of reptiles, and new discoveries of the distribution of these species are still being made. Management of reptiles requires a species-specific approach, or at least identifying several species with similar or overlapping habitat requirements.

SERIES DISCUSSIONS

Pacific silver fir

Go to Pacific silver fir chapter

Forest species occurring in this series are quite similar to those in the western hemlock series (see that series). Some of the lower-elevation species, such as black-throated gray warbler and Hutton's vireo, and those strongly associated with deciduous trees, such as warbling vireo and black-headed grosbeak, are absent or greatly reduced in this zone and at higher elevations because of the scarcity of their habitats. This series is the stronghold of several early seral or open-canopy species in this region: Lincoln's sparrow (primarily wet meadows), fox sparrow (shrubs), dusky flycatcher (shrubs), and Townsend's solitaire. Each of these is found to some degree in adjacent western hemlock and mountain hemlock zones. Mountain bluebirds, more common east of the Cascade crest, are sometimes found in open habitats with snags in this and the mountain hemlock zone. Dark-eyed juncos, varied thrush, and olive-sided flycatchers, while present at all elevations, probably breed in greatest densities here.

This series is generally the lower limit of occurrence of Cascades frog, golden-mantled ground-squirrel, heather vole, and black-backed woodpecker. This series may constitute the upper end of the distribution of Oregon slender salamanders and rubber boa, and the upper end of the stronghold of tailed frog breeding sites (Hunter 1998). Neotenic northwestern salamanders are relatively common in this zone and at higher elevations. Deer and elk in this zone and higher generally have migratory tendencies, and some even migrate across the crest of the Cascades rather than to lower elevations in the western Cascades.

Grand fir

Go to grand fir chapter

The occurrence of this series is so patchy and widespread (some low and some high elevation) that no specific wildlife associations are known with it. Common forest species are likely similar to those listed for the western hemlock zone (see that series). Both the canopy and understory are often quite diverse, so it is likely that a wide variety of species occurs in this series.

Douglas-fir

Go to Douglas-fir chapter

Both the canopy and understory are often quite diverse, so it is likely that a wide variety of species occurs in this series. Common forest species are likely similar to those listed for the western hemlock zone (see that series). The common presence of bigleaf maple, Pacific madrone and/or chinkapin in the canopy or subcanopy suggests that many sites in this series might be favored by the black-headed grosbeak, and Hutton's and Cassin's vireos. This series probably contains the upper limit of reproducing western gray squirrels, southern alligator lizards, and gopher snakes, although these species may occasionally occur in lower elevations of the western hemlock zone. Western fence lizards, alligator lizards, racers, and ring-necked snakes are more regular in this series than in more mesic series. Oregon slender salamanders probably do not occur in this series, while the ensatina probably dominates terrestrial amphibian communities on most sites in this series.

Western hemlock

Go to western hemlock chapter

Nearly all studies of vertebrates in western Oregon forests have been conducted in this zone. More is known about vertebrates in this series than in any other series in the area covered by this guide. Most of the information in "Wildlife and vegetation of unmanaged Douglas-fir forests" (Ruggiero et al. 1991) refers to forests in this series.

Common forest birds breeding in this zone include hermit warbler, winter wren, chestnut-backed chickadee, Hammond's flycatcher, Pacific-slope flycatcher, red-breasted nuthatch, and varied thrush (Gilbert and Allwine 1991). Species more abundant in older forests include Vaux's swift, pileated woodpecker, red crossbill, hairy woodpecker, and red-breasted nuthatch. Warmer sites often have bigleaf maple, Pacific madrone and/or chinkapin in the canopy or subcanopy, the mix attracting species such as the black-headed grosbeak, and Hutton's and Cassin's vireos. Black-throated gray warblers occur in younger forests and deciduous or mixed forests that flank the western foothills and make their way up river valleys and adjacent slopes; Hutton's vireos display a similar pattern, and dusky-footed woodrats may follow a similar, but truncated pattern. Similarly, thick, tall, deciduous understory shrubs favored by Wilson's warblers and Swainson's thrushes are more frequent at lower elevations in this series. Similarly, open canopy deciduous shrubs and small trees, such as willows and cherries, are more abundant at lower elevations. Willow flycatchers are especially more abundant at low and mid-elevation shrub stages in this series, and numerous fruit-eating birds are more abundant during the breeding season at lower elevations where fruit-bearing plants are more abundant.

Common ground-dwelling mammals in mature and old forests include Trowbridge's shrew, western redbacked vole, Townsend's chipmunk, shrew-mole, deer mouse, and several other shrew species (Gilbert and Allwine 1991b, Maser et al. 1981, Verts and Carraway 1998). Common canopy-dwelling mammals, which also visit the forest floor, include northern flying squirrel, Douglas squirrel, and red tree vole (Maser et al. 1981, Gilbert and Allwine 1991c, Verts and Carraway 1998). The most abundant and ubiquitous amphibians in forests include ensatina and rough-skinned newt. Terrestrial mphibian communities on warmer, drier sites are often dominated by the ensatina.

In the area covered by this guide, this zone includes the upper limit of the opossum, brush rabbit, black-capped chickadee, Bewick's wren, northern red-legged frog, western pond turtle, ringneck

snake, racer, and sharptail snake. Roads and timber harvest have encouraged expansion of the western fence lizard within this zone, which largely contains the upper limit of its occurrence (occasional in the Pacific silver fir zone). Upper elevations in this series, and the adjacent Pacific silver fir series, represent the stronghold of tailed frog breeding sites in this region. Nearly the entire Oregon breeding population of harlequin ducks occur in riparian areas slicing through landscapes dominated by this series in the area covered by this guide, with only token records elsewhere in the state. Within the area covered by this guide, this series constitutes the bulk of the range of the spotted owl, Cascade torrent salamander, Oregon slender salamander, and red tree vole, and the lower limit for the pika, snowshoe hare, water vole, and Townsend's solitaire.

Mountain hemlock

Go to mountain hemlock chapter

In the area covered by this guide, the mountain hemlock series, upper elevations of the Pacific silver fir series, and a variety of adjacent or inclusive types (e.g. lodgepole pine, subalpine fir, Engelmann spruce) define the spotty range of the black-backed woodpecker and the northern three-toed woodpecker. Also, Cassin's finches, Williamson's sapsuckers, and red-naped sapsuckers, common east of the Cascade crest, are rare but occasionally found in this zone on the west side. Townsend's warbers breed in this zone, particularly where true firs comprise a substantial portion of the canopy. Boreal owls, rediscovered in Oregon in the 1980s, have been found almost exclusively in this zone; breeding has not yet been verified. Probably due to a relatively sparse shrub understory at this elevation, Swainson's thrushes and Wilson's warblers are relatively rare and are concentrated in areas providing such cover, often near water or on moist slopes. In contrast, hermit thrushes and varied thrushes are more frequently encountered here than Swainson's thrush. Open shrubby patches in this zone are home to fox sparrows and dusky flycatchers, species rarely found below the Pacific silver fir zone in the western Cascades. Two cavity-nesting ducks, the bufflehead

and Barrow's goldeneye, nest almost exclusively in this zone and to some degree in the Pacific silver fir zone.

Broadleaf trees are quite rare in this series. They are predominantly located adjacent to streams and ponds, or concentrated in open wetlands, each of which allows adequate light for growth. Therefore, species such as black-capped chickadee, downy woodpecker, black-headed grosbeak, and black-throated gray warbler are largely absent, and are only occasionally found even where concentrations of deciduous trees occur.

Woodland and stream-breeding amphibians are relatively rare in this series, while pond-breeders are fairly common. Most western Cascade populations of long-toed salamander and western toad occur in areas dominated by this series, and occasionally in the Pacific silver fir zone. Cascades frog is largely limited to this and the Pacific silver fir zone. Neotenic northwestern salamanders are relatively common in this zone. Reptiles other than garter snakes are rare in this zone. A rare population of short-horned lizards occurs on pumice soil in eastern Linn County. Little is known about mammal communities in this series. Northern flying squirrel and Douglas squirrel are probably common canopy-dwellers, both of which also visit the ground, while the western red-backed vole, golden-mantled ground squirrel, snowshoe hare, and western pocket gopher are likely more common ground-dwellers, the latter three especially in more open or early seral habitats.

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COMMON AND SCIENTIFIC NAMES OF VERTEBRATES THAT REGULARLY UTILIZE TERRESTRIAL HABITATS OF THE NORTHERN CASCADE RANGE

Mammals (common name)	**Mammals (latin)**
Virginia Opossum	Didelphis virginiana
Baird's Shrew	Sorex bairdi
Pacific Water or Marsh Shrew	Sorex bendirii
Montane or Dusky Shrew	Sorex monticolus
Pacific Shrew	Sorex pacificus
Water Shrew	Sorex palustris
Fog Shrew	Sorex sonomae
Trowbridge's Shrew	Sorex trowbridgii
Vagrant Shrew	Sorex vagrans
Shrew-mole	Neurotrichus gibbsii
Coast Mole	Scapanus orarius
Townsend's Mole	Scapanus townsendii
California Myotis	Myotis californicus
Long-eared Myotis	Myotis evotis
Little Brown Myotis	Myotis lucifugus
Fringed Myotis	Myotis thysanodes
Long-legged Myotis	Myotis volans
Yuma Myotis	Myotis yumanensis
Hoary Bat	Lasiurus cinereus
Silver-haired Bat	Lasionycteris noctivagans
Big Brown Bat	Eptesicus fuscus
Townsend's Big-eared Bat	Corynorhinus townsendii
American Pika	Ochotona princeps
Brush Rabbit	Sylvilagus bachmani
Snowshoe Hare	Lepus americanus
Mountain Beaver	Aplodontia rufa
Yellow-pine Chipmunk	Tamias amoenus
Allen's Chipmunk	Tamias senex
Siskiyou Chipmunk	Tamias siskiyou
Townsend's Chipmunk	Tamias townsendii
Yellow-bellied marmot	Marmota flaviventris
California Ground Squirrel	Spermophilus beecheyi
Golden-mantled Growun Squirrel	Spermophilus lateralis

Mammals (common name)	Mammals (latin)
Western Gray Squirrel	Sciurus griseus
Douglas' Squirrel	Tamiasciurus douglasii
Northern Flying Squirrel	Northern flying squirrel
Western Pocket Gopher	Thomomys mazama
American Beaver	Castor canadensis
Deer Mouse	Peromyscus maniculatus
Bushy-tailed Woodrat	Neotoma cinerea
Dusky-footed Woodrat	Neotoma fuscipes
House Mouse	Mus musculus
Western Red-backed Vole	Clethrionomys californicus
White-footed Vole	Phenacomys albipes
Heather Vole	Phenacomys intermedius
Red Tree Vole	Phenacomys longicaudus
Long-tailed Vole	Microtus longicaudus
Creeping Vole	Microtus oregoni
Water Vole Townsends's Vole	Microtus richardsoni
Townsend's Vole	Microtus townsendii
Pacific Jumping Mouse	Zapus trinotatus
Common Porcupine	Erethizon dorsatum
Coyote	Canis latrans
Gray Wolf	Canis lupus
Red Fox	Vulpes vulpes
Black Bear	Ursus americanus
Ringtail	Bassariscus astutus
Common Raccoon	Procyon lotor
American Marten	Martes americana
Fisher	Martes pennanti
Ermine	Mustela erminea
Long-tailed Weasel	Mustela frenata
Mink	Mustela vison
Wolverine	Gulo gulo
River Otter	Lutra canadensis
Western Spotted Skunk	Spilogale gracilis
Striped Skunk	Mephitis mephitis
Mountain Lion	Puma concolor
Lynx	Lynx canadensis
Bobcat	Lynx rufus

Mammals (common name)	Mammals (latin)
Elk or Wapiti	Cervus elaphus
Black-tailed and Mule Deer	Odocoileus hemionus

Birds (common name)	Birds (latin)
Great Blue Heron	Ardea herodias
Green Heron	Butorides virescens
Turkey Vulture	Cathartes aura
Wood Duck	Aix sponsa
Harlequin Duck	Histrionicus histrionicus
Barrow's Goldeneye	Bucephala islandica
Bufflehead	Bucephala albeola
Hooded Merganser	Lophodytes cucullatus
Common Merganser	Mergus merganser
Osprey	Pandion haliaetus
Bald Eagle	Haliaeetus leucocephalus
Sharp-shinned Hawk	Accipiter striatus
Cooper's Hawk	Accipiter cooperii
Northern Goshawk	Accipiter gentilis
Red-tailed Hawk	Buteo jamaicensis
Golden Eagle	Aquila chrysaetos
American Kestrel	Falco sparverius
Merlin	Falco columbarius
Peregrine Falcon	Falco peregrinus
Blue Grouse	Dendragapus obscurus
Ruffed Grouse	Bonasa umbellus
Wild Turkey	Meleagris gallopavo
Mountain Quail	Oreortyx pictus
Solitary Sandpiper	Tringa solitaria
Band-tailed Pigeon	Columba fasciata
Western Screech-Owl	Otus kennicottii
Great Horned Owl	Bubo virginianus
Northern Pygmy-Owl	Glaucidium gnoma
Spotted Owl	Strix occidentalis
Barred Owl	Strix varia
Great Gray Owl	Strix nebulosa
Long-eared Owl	Asio otus

Birds (common name)	Birds (latin)
Boreal Owl	Aegolius funereus
Northern Saw-whet Owl	Aegolius acadicus
Common Nighthawk	Chordeiles minor
Common Poorwill	Phalaenoptilus nuttallii
Black Swift	Cypseloides niger
Vaux's Swift	Chaetura vauxi
Calliope Hummingbird	Stellula calliope
Rufous Hummingbird	Selasphorus rufus
Belted Kingfisher	Ceryle alcyon
Lewis's Woodpecker	Melanerpes lewis
Red-naped Sapsucker	Sphyrapicus nuchalis
Red-breasted Sapsucker	Sphyrapicus ruber
Williamson's Sapsucker	Sphyrapicus thyroideus
Downy Woodpecker	Picoides pubescens
Hairy Woodpecker	Picoides villosus
Three-toed Woodpecker	Picoides tridactylus
Black-backed Woodpecker	Picoides arcticus
Northern Flicker	Colaptes auratus
Pileated Woodpecker	Dryocopus pileatus
Northern Shrike	Lanius excubitor
Cassin's Vireo	Vireo cassinii
Hutton's Vireo	Vireo huttoni
Warbling Vireo	Vireo gilvus
Red-eyed Vireo	Vireo olivaceus
Gray Jay	Perisoreus canadensis
Steller's Jay	Cyanocitta stelleri
Clark's Nutcracker	Nucifraga columbiana
American Crow	Corvus brachyrhynchos
Common Raven	Corvus corax
Olive-sided Flycatcher	Contopus cooperi
Western Wood-Pewee	Contopus sordidulus
Willow Flycatcher	Empidonax traillii
Hammond's Flycatcher	Empidonax hammondii
Dusky Flycatcher	Empidonax oberholseri
Pacific-slope Flycatcher	Empidonax difficilis
Horned Lark	Eremophila alpestris
Purple Martin	Progne subis

Birds (common name)	Birds (latin)
Tree Swallow	Tachycineta bicolor
Violet-green Swallow	Tachycineta thalassina
Northern Rough-winged Swallow	Stelgidopteryx serripenis
Barn Swallow	Hirundo restica
Cliff Swallow	Petrochelidon pyrrhonota
Black-capped Chickadee	Poecile atricapillus
Mountain Chickadee	Poecile gambeli
Chestnut-backed Chickadee	Poecile rufescens
Bushtit	Psaltriparus minimus
Red-breasted Nuthatch	Sitta canadensis
White-breasted Nuthatch	Sitta carolinensis
Brown Creeper	Certhia americana
Rock Wren	Salpinctes obsoletus
Bewick's Wren	Thryomanes bewickii
House Wren	Troglodytes aedon
Winter Wren	Troglodytes troglodytes
Golden-crowned Kinglet	Regulus satrapa
Ruby-crowned Kinglet	Regulus calendula
Western Bluebird	Sialia mexicana
Mountain Bluebird	Sialia currucoides
Townsend's Solitaire	Myadestes townsendi
Swainson's Thrush	Catharus ustulatus
Hermit Thrush	Catharus guttatus
American Robin	Turdus migratorius
Varied Thrush	Ixoreus maevius
Wrentit	Chamaea fasciata
European Starling	Sturnus vulgaris
American Pipit	Anthus rubescens
Cedar Waxwing	Bombycilla cedrorum
Orange-crowned Warbler	Vermivora celata
Nashville Warbler	Vermivora ruficapilla
Yellow Warbler	Dendroica petechia
Yellow-rumped Warbler	Dendroica coronata
Black-throated Gray Warbler	Dendroica nigrescens
Townsend's Warbler	Dendroica townsendi
Hermit Warbler	Dendroica occidentalis
American Redstart	Setophaga ruticilla

Birds (common name)	Birds (latin)
Northern Waterthrush	Seiurus noveboracensis
MacGillivray's Warbler	Oporornis tolmiei
Common Yellowthroat	Geothlypis trichas
Wilson's Warbler	Wilsonia pusilla
Western Tanager	Piranga ludoviciana
Green-tailed Towhee	Pipilo chlorurus
Spotted Towhee	Pipilo maculates
Chipping Sparrow	Spizella passerina
Savannah Sparrow	Passerculus sandwichensis
Fox Sparrow	Passerella iliaca
Song Sparrow	Melospiza melodia
Lincoln's Sparrow	Melospiza lincolnii
White-crowned Sparrow	Zonotrichia leucophrys
Golden-crowned Sparrow	Zonotrichia atricapilla
Dark-eyed Junco	Junco hyemalis
Black-headed Grosbeak	Pheucticus melanocephalus
Lazuli Bunting	Passerina amoena
Red-winged Blackbird	Agelaius phoeniceus
Brewer's Blackbird	Euphagus cyanocephalus
Brown-headed Cowbird	Molothrus ater
Bullock's Oriole	Icterus bullockii
Gray-crowned Rosy Finch	Leucosticte tephrocotis
Pine Grosbeak	Pinicola enucleator
Purple Finch	Carpodacus purpureus
Cassin's Finch	Carpodacus cassinii
House Finch	Carpodacus mexicanus
Red Crossbill	Loxia curvirostra
White-winged Crossbill	Loxia leucoptera
Pine Siskin	Carduelis pinus
American Goldfinch	Carduelis tristis
Evening Grosbeak	Coccothraustes vespertinus
House Sparrow	Passer domesticus

Reptiles (common name)	Reptiles (latin)
Western Pond Turtle	Clemmys marmorata
Northern Alligator Lizard	Elgaria coerulea

Reptiles (common name)	Reptiles (latin)
Southern Alligator Lizard	Elgaria multicarinata
Short-horned Lizard	Phynosoma douglassii
Western Fence Lizard	Sceloporus occidentalis
Western Skink	Eumeces skiltonianus
Rubber Boa	Charina bottae
Racer	Coluber constrictor
Sharptail Snake	Contia tenuis
Ringneck Snake	Diadophis punctatus
Gopher Snake	Pituophis catenifer
Western Terrestrial Garter Snake	Thamnophis elegans
Northwestern Garter Snake	Thamnophis ordinoides
Common Garter Snake	Thamnophis sirtalis
Western Rattlesnake	Crotalus viridis

Amphibians (common name)	Amphibians (latin)
Northwestern Salamander	Ambystoma gracile
Long-toed Salamander	Ambystoma macrodactylum
Cope's Salamander	Dicamptodon copei
Pacific Giant Salamander	Dicamptodon tenebrosus
Cascade Torrent Salamander	Rhyacotriton cascadae
Rough-skinned Newt	Taricha granulosa
Dunn's Salamander	Plethodon dunni
Larch Mountain Salamander	Plethodon larselli
Western Red-backed Salamander	Plethodon vehiculum
Ensatina	Ensatina eschscholtzii
Clouded Salamander	Aneides ferreus
Oregon Slender Salamander	Batrachoseps wrighti
Tailed Frog	Ascaphus truei
Western toad	Bufo boreas
Pacific Treefrog	Pseudacris regilla
Red-legged Frog	Rana aurora
Cascades Frog	Rana cascadae
Spotted Frog	Rana pretiosa
Foothill Yellow-legged Frog	Rana boylii
Bullfrog	Rana catesbeiana