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# Wildlife Ecology and Forest Habitat

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**Helping You Put Knowledge To Work**

# Wildlife Ecology and Forest Habitat

Habitat is "the physical and biological surroundings of an organism." Good wildlife habitat supplies all the elements an animal needs for survival. These elements include food, cover, water, and space. However, each animal varies in its requirement of these elements. When wildlife biologists and managers design programs to improve wildlife habitat, they take into account all the plants and animals that may be affected by their decisions.

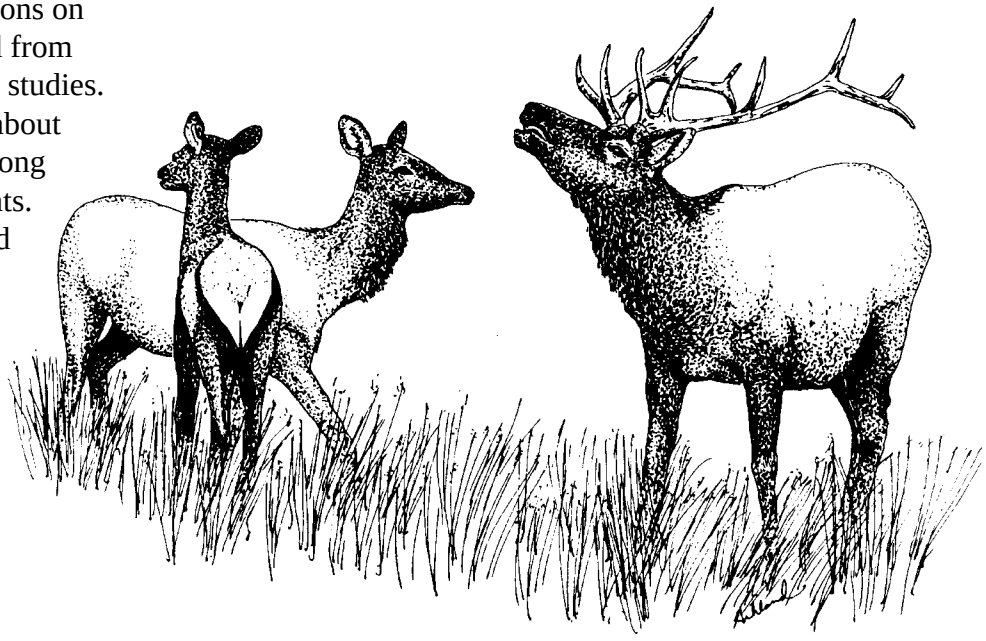
Wildlife populations in forested habitats are dynamic because the forest is always changing. Plant succession, or the gradual replacement of one plant community with another, is an important aspect of wildlife habitat. Every successional plant stage, or habitat type, has a specific community of animals associated with it. Close relationships among animals and environments illustrate how alterations to the habitat dramatically affect wildlife populations. This publication provides basic information about wildlife ecology and presents ideas on improving forested habitats for wildlife.

## A Brief History

Before the 1960s, wildlife management focused primarily on maintaining game animals, such as deer, elk, and grouse. As knowledge evolved about the interactions of animal and plant communities, wildlife agencies became concerned with nongame animals. Animals such as songbirds and amphibians can be as important to a healthy and fully functioning ecosystem as big game species are. Today, wildlife managers base decisions on biological information gained from scientific field and laboratory studies. Managers are learning more about the complex relationships among animals and their environments. They need scientifically based information to make intelligent management decisions.

## Animals and Their Environment

Animals are closely linked to their environment. Both living and nonliving components influence their lives. Factors such as climate, soil, topography, and geographic location determine the composition and distribution of the plant and animal communities. Within these communities, plant species help determine the species of wildlife that are present. Also, the interaction *among* animals, that is, the competition for resources such as food, space, or mates, also influences wildlife populations. Because of these relationships, the best way to manage wildlife is to manage the habitats in which they live.



# Landscape Ecology

One important concept in habitat management is landscape ecology. We usually look at wildlife habitat on a relatively small scale, such as an individual forest stand. Landscape ecology views wildlife habitat on a much larger scale: such as a national forest, a mountain range, or an entire region. The reason for this landscape approach is simple: many wildlife species move regularly because of seasonal changes in food supply. Therefore, changes in habitat over a much wider range affect some wildlife populations directly.

Viewing wildlife on a regional scale may not be practical, or even necessary for a private forest owner. Look at your own land in relation to properties around you and ask, "How am I influencing the wildlife?" For example, does a fence on your property force deer onto your neighbor's property, or vice-versa? Have you seen increases in animal damage, or experienced more wildlife-human confrontations? Many changes in local wildlife populations are due to cumulative effects over a larger area. Landowners can play a significant role in alleviating some of these.

## Succession

It is impossible to talk about wildlife habitat without discussing plant communities and succession—the gradual replacement of one plant community with another *over time*. For example, vegetation changes occurring within a forest stand after a fire illustrate succession. Composition and structure of the habitat change from grasses and forbs, to shrubs, to saplings, and then to mature forest; old growth occupies the final stage (Fig. 1). As plant communities change from one stage to the next, animal communities change as well. Some animals, such as bobwhite quail and elk, require more than one successional stage. Other species, like marten and spotted owl, rely on only one stage of succession for survival. Because each stage of plant succession has an animal community associated with it, an extremely important concept in habitat management follows: Managing for one animal community may be detrimental to another. To encourage a certain animal or group of animals, you have to manage succession.

Succession develops as a result of land management practices or catastrophic disturbance, such as fire, wind, or flood. Natural disturbances take place periodically in nature. Fires or flooding occur with relative frequency. Under natural conditions, unmanaged stands of Ponderosa pine have a parklike understory as periodic fires kill off younger, smaller trees. This cycle of disturbance and recovery is natural for ponderosa pine. Plants and animals in these landscapes have adapted to the conditions. Fire prevention alters succession in these stands, and prescribed fire or thinning becomes necessary to maintain a more natural state.

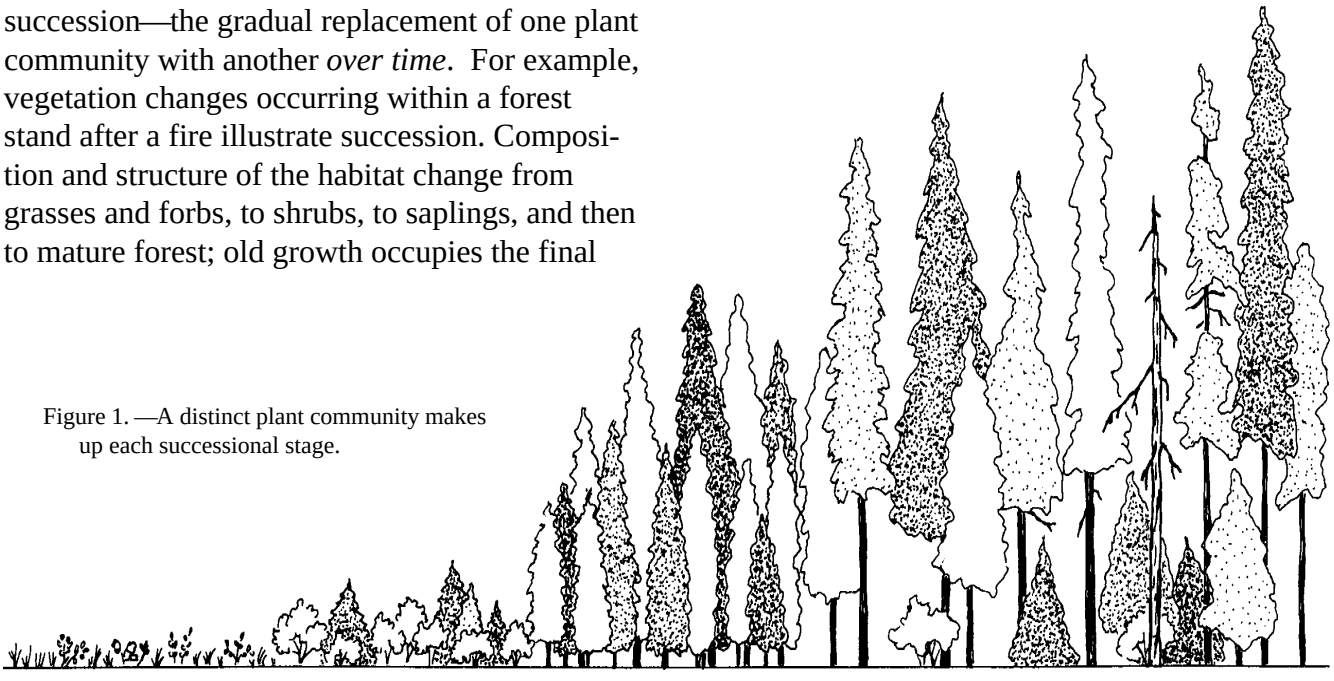


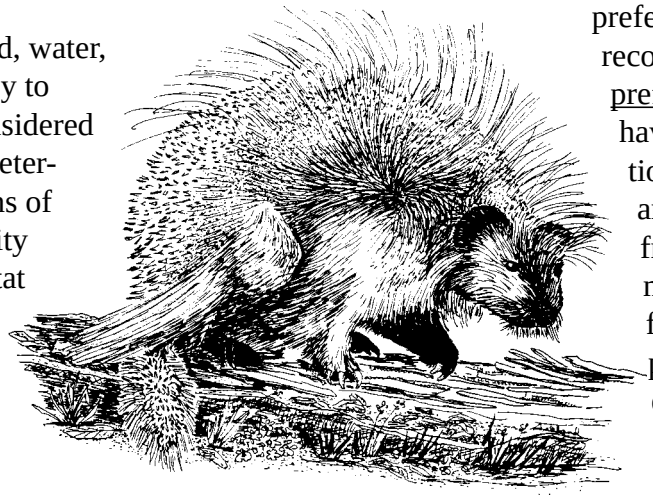
Figure 1. —A distinct plant community makes up each successional stage.

# The Basics of Survival

Producing healthy offspring is the most important factor in maintaining wildlife populations. Many species of North American wildlife only mate during certain times of the year. Species having a relatively small window of opportunity are under increased pressure to find a healthy mate. Healthy mates are more successful at finding food and defending a territory; they may produce more offspring, and are better able to protect their offspring from predators. Healthy parents also will pass on those genes that make them successful. This drive to reproduce healthy offspring creates intense competition among animals for resources of food, water, and cover.

## Carrying Capacity

The basic needs of wildlife are food, water, and cover. Elements too low in supply to support breeding and survival are considered "limiting factors." Limiting factors determine the numbers, types, and locations of wildlife populations. Carrying capacity reflects the number of animals a habitat can maintain in a healthy condition. Limiting factors of food, water, or cover determine this number. Identifying and controlling limiting factors is one way to manage wildlife habitat.



## Limiting Factors

### *Food*

One way to categorize mammals is by the foods they eat. For example, cougar, wolf, and fox are primarily meat eaters, or carnivores. Elk and deer are examples of herbivores; they eat plant material exclusively. Rabbits and rodents are primarily herbivorous. Bears, though classified as carnivores, are more omnivorous in terms of diet, eating a wide variety of both plant and animal foods. Classifications are based, in part, on the types of teeth these animals have. Birds have no true teeth, but they eat anything from small mammals (raptors) to conifer needles (spruce grouse).

Wildlife foods are generally described by their availability and palatability. Availability refers to the season the food is present in the habitat, how much food there is, and how easily animals can access food. For example, an area that provides browse for deer in the spring and summer may have no value as a foraging area during the winter. Yet an area that has the potential to provide excellent winter range for elk may go unused because the browse is too difficult for elk to reach.

Palatability describes the nutritive and digestible qualities of food. Wildlife select and eat palatable foods more often than other foods. Different levels of wildlife food preferences are recognized: 1) preferred foods have high nutritional value and are eaten more frequently; 2) moderate value foods, or staples, provide adequate nutrition but are usually the animal's second choice; and 3) stuffing or emergency foods provide low nutritional value. Wildlife eat these foods in large amounts only when nothing else is available. Food preference relates directly to nutritional quality.

Assessing food quality is an important issue when managing for herbivores, such as deer. The quality of vegetation relates to the fertility of the soil. The higher the soil fertility, the better the nutritional quality, or palatability, of the vegetation. Many young plant shoots are extremely palatable early in the growing season. Concern for food quality does not pertain so much when managing flesh eaters; meat protein is meat protein, whether it comes from a mouse or a moose.

Table 1. —Preferred foods of some Northwest wildlife species.

| | | | | |
|---|---|---|---|---|
| **WHITE-TAILED and MULE DEER** | | | | |
| Thimbleberry | Snowberry | New growth Douglas-fir | Bitterbrush | Willow |
| Mock orange | Cherry | Red stem ceanothus | Ninebark | Wild rose |
| Currant | Serviceberry | Western redcedar | Snow brush | Salal |
| Buckbrush | Elderberry | Huckleberry | Vine maple | Blackberry |
| Chokecherry | Raspberry | Red-osier dogwood | Deer brush | Alfalfa |
| Clover * | Balsamroot | Bluebells | Burnet | Hawkweed |
| Prickly lettuce | Dandelion | Twinflower | Trefoils | Deer-fern |
| Deer vetch | Fireweed | Pearly everlasting | Vetch | Bulrush |
| Cat's ear | Swordfern | Creeping Oregon grape | Elk sedge | Mushrooms |
| Lichen | Bluegrass | Orchard grass | Oats | Wheat |
| **ELK** | | | | |
| Vine maple | Salal | Cascades mahonia | Salmonberry | Willow |
| Serviceberry | Ceanothus | Red-osier dogwood | Chokecherry | Aspen |
| Bitterbrush | Currant | Cowparsnip | Fireweed | Rose |
| Swordfern | Trefoil | Arrowleaf groundsel | Clover * | Wildrye |
| Idaho fescue | Timothy * | Yellow salsify | Dandelion | Elk sedge |
| Bluegrass | Needlegrass | Orchard grass | Rough fescue | Redtop |
| | | Bluebunch wheatgrass | | |
| **BLACK BEAR** | | | | |
| Douglas-fir | Lodgepole pine | Engelmann spruce | Silver fir | Birch |
| Red alder | Subalpine fir | Western hemlock | Buffaloberry | Cherry |
| Currant | Elderberry | Western larch | Devil's club | Snowberry |
| Serviceberry | Salmonberry | Western redcedar | Huckleberry | Bearberry |
| Fescue | Bluegrass | Wheatgrass | Brome | Ferns |
| Horsetail | Lichens | Mosses | Mushrooms | Asters |
| Biscuitroot | Bluebells | Cow parsnip | Dandelion | Phlox |
| Mustards | Everlasting | False Solomon's seal | Ants | Honey |
| Beetles | Bees | Flies/wasps | Rodents | Fish |
| | Elk calves | Elk/deer (usually carrion) | Deer fawns | |
| **UPLAND BIRDS** | | | | |
| Aspen | Alder | Huckleberry | Salal | Clover * |
| Blackberry | Gooseberry | Wild strawberry | Chokecherry | Hazelnut |
| Cottonwood | Buttercup | Lupine | Vetch | Teasel * |
| Wild carrot | Wild rose | Snowberry | Hawthorn | Legumes |
| Oaks | Wild grape | Native grass seeds | Sumac | Ash |
| Kinnikinnik | Elderberry | Insects | Bunchberry | Cascara |

*(continued on p. 5)*

Wildlife scientists who manage food resources for wildlife want to provide high quality foods. They also are concerned with food quantity: is there enough food to go around? The quantity of available food often is the strongest limiting factor in food resources. Encouraging natural regeneration of native plant species is the best way to improve food resources for wildlife. However, if these plants are naturally in short supply, then transplanting or propagating is the next best thing. Table 1 lists native Pacific Northwest plant species which supply food for many species of wildlife.

*(Table 1. cont.)*

| | | | | |
|---|---|---|---|---|
| **BIRDS OF PREY** | | | | |
| Carrion | Fish | Small mammals | Snakes | Birds |
| Rodents | Frogs | Rabbits | Grouse | Insects |
| | | Waterfowl | | |
| **COUGAR, LYNX and BOBCAT** | | | | |
| Carrion (untainted) | Rodents | Deer | Hares | Rabbits |
| Elk calves | Deer fawns | Livestock (occasionally) | Birds | |
| **WOLVES, COYOTE and FOX** | | | | |
| Deer ** | Caribou ** | Rabbits and Hares | Rodents | Birds |
| Eggs | Insects | Any small mammal (very opportunistic feeders) | Fruits | Nuts |
| **MUSTELIDS** (skunk, weasel, marten, fisher and mink) | | | | |
| Insects | Birds | Any small mammal | Carrion | Porcupine *** |
| Eggs | Fruits | Rabbits | Hares | Amphibians |
| | | Crayfish | | |
| **RODENTS** | | | | |
| Fruits and Nuts | Insects | Vegetation | Seeds | Eggs |

* nonnative species
** Primarily wolves
*** Fisher only

### *Water*

Water is vital for wildlife survival. All animals need water to maintain healthy metabolic processes. Amphibians and waterfowl rely on water for basic life cycle processes, such as reproduction and rearing young. Water must be available all year round. Water comes in the form of rain, snow, or even dewdrops on leaves. Some animals, especially in arid regions, meet their need for water through the moisture in the foods they eat.

Protect any natural source of water present on your woodland, including ponds, catchment basins, natural springs and seeps. Leave debris and trees that naturally fall into creeks, ponds, and streams because they help provide important habitat for fish and amphibians. If debris makes the water unavailable to wildlife, some debris clearing may be necessary. Since many species of wildlife use watering areas, maintain nearby vegetation to provide cover or escape from predators.

Reliable water sources become more important in dry climates. On rangelands, the easiest way to provide water is by making a wildlife "guzzler," a rainwater-filled tank. Guzzlers were originally designed to provide water for ground birds, such as grouse, and are sometimes referred to as "gallinaceous" guzzlers. For information on constructing a wildlife guzzler, contact the habitat development specialist at your state Fish and Wildlife office or the Natural Resource Conservation Service.

In forested areas where water is limiting, building a pond may be a good option. Site conditions, such as soil type and aspect, will dictate the design and construction of a woodland pond. Revegetation will be an important consideration. Water transports materials into and out of ecosystems. Use only native plants and not exotic species in pond revegetation. For more information on pond construction, contact the Department of Ecology or your state Fish and Wildlife office.

If you've decided to develop a watering area on your property consider these points. First, choose the location for your watering area carefully. Severe trampling and overgrazing of riparian vegetation can increase the risk of soil compaction and erosion. Place watering structures where they will not be subjected to flood waters or silt collection during spring runoff. Second, the addition of a water source may attract a disproportionate numbers of predators to the area. Make sure enough vegetation is growing nearby for escape cover and protection from predators. Unnatural increases in predation could have dramatic effects on prey populations.

### *Cover*

Wildlife cover is any physical feature that provides an animal with shelter, protection or concealment. Cover most often consists of vegetation, but rocky outcrops, caves, and even abandoned cabins also are useful to wildlife. Cover comprises three general types: 1) hiding or escape cover for use by animals who seek protection from predators; 2) thermal cover, for protection from elements such as wind, rain, and temperature extremes, and 3) reproductive cover, for use by nesting animals such as birds and squirrels.

Though all wildlife needs cover, some animals have very specific cover requirements. For example, wild turkeys require roosting cover. Quail need cover for roosting, concealment and resting. A stand of coniferous trees, greater than 40 feet in height, with a canopy coverage of more than 70% provides good thermal cover for deer and elk. This configuration protects deer and elk from severe cold weather.

Not all cover is of equal value to all animals. Good hiding cover in the spring does not necessarily mean good thermal cover in the winter. For many animals, cover requirements change with the seasons.

If you wish to increase cover, you can make small-scale improvements fairly easily. Add hiding and escape cover for birds and smaller mammals by leaving slash or brush piles. Use the by-products from other land management practices—a timber harvest or a thinning—for brush-pile construction. You also can place woody debris along fence lines and encourage vegetation growth, thus forming more permanent structures. Use existing fences to develop hedgerows by planting woody, shrubby plants along the fence line. Hedgerows supply important hiding and nesting cover for small mammals and birds. They also provide good food resources and can offer important migration paths for many wildlife species.

Cover improvements for larger mammals (deer and elk), may require long-term planning. Adequate hiding cover will hide 90% of a standing deer or elk up to a distance of 200 feet. Tall woody shrubs and short trees should provide enough cover to meet these requirements. The value of cover for larger game animals also depends on the surrounding landscape features. Supplying a good foraging area may not be enough. Foraging areas for elk and deer should be less than 600 feet from hiding cover. Elk and deer are influenced by the larger habitat mosaic and respond to seasonal changes in food supply by migrating. To improve habitat conditions for large animals, work across individual ownerships if possible. Your land may have great thermal cover for elk and deer while your neighbors' land may provide excellent winter forage. Together, you can improve the health and well-being of the wildlife in your area.

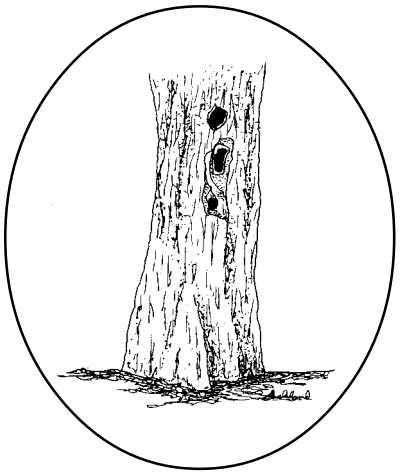
# Structural Diversity

The structural diversity of the landscape affects wildlife populations because it dictates the availability and accessibility of food, water, and cover. Structural diversity refers to the vertical and horizontal features of the landscape. The layering of canopy and understory vegetation within an individual stand makes up the vertical plane. Different successional stages across the landscape, such as agricultural lands adjacent to a forest, or a river and its floodplain, create the horizontal features. These structural differences influence both the movements and types of wildlife populations living within forest ecosystems. The following sections identify basic structural features and discuss their value for wildlife.

## Snags and Cavity Trees

Providing snags and cavity trees is an effective way to increase habitat for wildlife. Snags are standing dead trees, and cavity trees are standing live trees that have natural internal cavities. Ideally, both structures should be at least 6 feet tall and have a diameter at breast height (dbh) of at least 4 inches. However, smaller stumps also can be useful as foraging and nesting habitat for some bird species. Snags are categorized as being either *hard* or *soft*. Hard snags are composed of harder wood, generally branched and showing no signs of decay. Soft snags show advanced stages of decay, resulting in softer wood. We most often associate snags and cavity trees with woodpeckers, chickadees, and birds of prey. Many other species depend on snags during some stage of their life cycle. Snag users are either primary or secondary cavity nesters. Primary cavity nesters consist entirely of birds and include the woodpeckers, chickadees, and flickers. They actively excavate cavities. Whether they use hard or soft snags depends on the bird species in question (Table 2). Secondary cavity nesters—a wider variety of wildlife species—include mammals and some waterfowl. These animals use both natural cavities and cavities excavated by a primary excavator. It is not unusual to find both primary and secondary cavity nesters using the same snag at the same time (though not in the same cavity).

Snags are places of great diversity because, like a forest, they also experience successional changes over time. Figure 2 shows the transition of a snag from death to complete decomposition. As the snag decays, a different subset of the community develops within each decay stage. In other words, snags provide communities within communities.



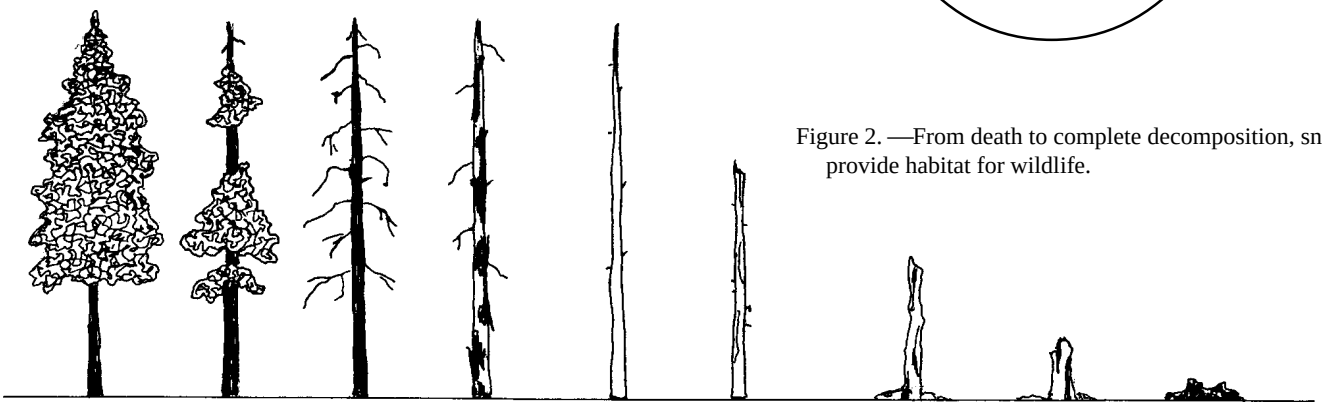


Figure 2. —From death to complete decomposition, snags provide habitat for wildlife.

Table 2. —Types of snags used by primary and secondary cavity nesters *(From Thomas et al., 1979)*

| Species | Snag Type | Snag Size | |
|---|---|---|---|
| | | minimum nesting height (feet) | minimum dbh (inches) |
| **Primary Cavity Nesters** | | | |
| Black-capped chickadee | soft | 6 | 4 |
| Mountain chickadee | soft | 6 | 4 |
| Chestnut-backed chickadee | soft | 6 | 4 |
| Downy woodpecker | hard | 15 | 6 |
| Hairy woodpecker | hard | 15 | 10 |
| Yellow-bellied sapsucker | hard | 15 | 10 |
| Pileated woodpecker | hard | 31 | 20 |
| Common flicker | hard | 6 | 12 |
| Red-breasted nuthatch | soft | 15 | 12 |
| **Secondary Cavity Nesters *** | | | |
| Black-capped chickadee | - | 6 | 4 |
| Mountain chickadee | - | 6 | 4 |
| Chestnut-backed chickadee | - | 6 | 4 |
| Tree swallow | - | 15 | 10 |
| Brown creeper ** | - | 15 | 10 |
| Red-breasted nuthatch | - | 15 | 12 |
| Common flicker | - | 6 | 12 |
| Mountain bluebird | - | 6 | 10 |
| American kestrel | - | 15 | 12 |
| Pygmy owl | - | 30 | 12 |
| Barred owl | - | 30 | 20 |
| Big brown bat ** | - | 15 | 12 |
| Common merganser | - | 6 | 20 |
| Wood duck | - | 6 | 20 |
| Marten | - | 15 | 15 |
| Fisher | - | 30 | 20 |
| Short-tailed weasel | - | 6 | 10 |

* Uses both natural cavities and those made by other species

** May also use space underneath loose bark

Consider these points when planning for snag retention. First, larger diameter snags provide more room for nesting and raising young, offer more effective protection from predators, and provide better insulation against severe weather. Second, planning for a mix of both soft and hard woods will attract a variety of snag users in the area. If this is not possible or desired, manage for woodpeckers (hardwood), and over time all other cavity users will follow. Table 3 provides information regarding the numbers of snags needed for attracting woodpeckers at different population levels. Finally, retain snags within as many different successional stages as are present on your property. Some snag dependent species prefer cavity trees found within specific successional stages. For example, pileated woodpeckers prefer hardwood snags in mature forests, while bluebirds prefer previously excavated snags in grass-forb or shrub-seedling stages.

## Nest Boxes

Snag management takes preparation and planning, and it may be some time before any results are realized. In the meantime, an effective method for attracting cavity nesters might be the

Table 3.— Snag Management for Woodpeckers (Primary Excavators) *(From: Thomas et al. 1979)*

Ponderosa Pine / Mixed Conifer Community

| If Snag DBH is > 10 $in^2$ | | If Snag DBH is > 20 $in^2$ | |
|---|---|---|---|
| Potential population | Number of snags per 100 acres * | Potential population | Number of snags per 100 acres * |
| 20% | 15 | 20% | 3 |
| 40% | 30 | 40% | 5 |
| 60% | 45 | 60% | 8 |
| 80% | 60 | 80% | 11 |
| 100% | 75 | 100% | 14 |

Riparian (Cottonwood / Alder) Community

| If Snag DBH is > 6 $in^2$ | | If Snag DBH is > 12 $in^2$ | |
|---|---|---|---|
| Potential population | Number of snags per 100 acres * | Potential population | Number of snags per 100 acres * |
| 20% | 30 | 20% | 20 |
| 40% | 60 | 40% | 40 |
| 60% | 90 | 60% | 60 |
| 80% | 120 | 80% | 80 |
| 100% | 150 | 100% | 101 |

* For areas less than 100 acres, number of snags/acres may be calculated proportionately.

use of artificial nesting structures. Nest boxes and nesting platforms are a good temporary option, but they should never be used in place of snags. Natural snags and cavity trees supply food resources as well as nesting habitat, and are preferred by most cavity nesting species. However, many species will use artificial structures. These structures are useful during reforestation periods because they encourage cavity nesting owls and raptors. These birds serve as excellent controls of rodent populations during seedling establishment. If you use nest boxes, maintain them in good condition. Clean out nest boxes before each consecutive nesting season or, over time, they will become unusable. The size of the box, shape of the entrance hole, and placement of the box in the environment varies for some species. Table 4 describes the nest box specifications of some selected cavity nesting birds.

## Large, organic debris (LOD)

Large, organic debris, also known as coarse, woody debris, is the dead woody material that accumulates on the ground after windstorms, snowslides, timber harvest, and flooding. Although we realize LOD can be a fire hazard, we recognize the importance of this material to the functioning of forest ecosystems. As woody debris slowly decays, it provides a suitable medium for microorganisms and bacteria that aid in the decaying of woody material. As this material is broken down, nutrients return to the soil, where they become available to plants, which in turn provide food for animals.

LOD provides many resources to many animals. Slash piles provide roosting cover for quail and wild turkey, and hiding cover for small mammals. Downed logs offer protective passage for amphibians, and serve as “drumming” logs for

Table 4.—Specifications for Selected Bird Nesting Boxes; (*Source*: Washington Department of Wildlife)

| SPECIES | Cavity floor (inches) | Cavity depth (inches) | Entrance above floor (inches) | Size of entrance (inches) | Height above ground (feet) | Placement |
|---|---|---|---|---|---|---|
| American kestrel | 8 x 8 | 12-15 | 9-12 | 3 | 10-30 | In open areas near fields or water. |
| Barn owl | 10 x 18 | 15-18 | 0-4 | 6 | 12-18 | Near buildings, barns or open fields. |
| Barn swallow | 6 x 6 | 6 | * | * | 8-12 | Put 2-3 shelves together under building eaves near water. |
| Downy woodpecker | 4 x 4 | 9 | 7 | 1.25 | 5-15 | Open wooded areas on dead trees; pack with wood shavings. |
| Chickadees | 4 x 4 | 9 | 7 | 1.125 | 4-15 | In wooded areas or old orchards, prefer rustic houses. |
| Flicker | 7 x 7 | 16-18 | 14-16 | 2.5 | 6-30 | Open wooded areas on dead trees; pack with wood shavings. |
| Hairy woodpecker | 6 x 6 | 12-15 | 9-12 | 1.625 | 12-20 | Open wooded areas on dead trees; pack with wood shavings. |
| Nuthatches | 4 x 4 | 9 | 7 | 1.125 | 5-15 | In wooded areas or old orchards, prefer rustic houses. |
| Purple martin | 6 x 6 | 6 | 1 | 2.25 | 10-20 | Use a colony of houses together with pond or stream nearby. |
| American robin | 6 x 8 | 8 | * | * | 6-15 | In shaded parts of trees or under eaves of house or shed. |
| Screech owl | 8 x 8 | 15-18 | 9-12 | 3 | 10-30 | Open wooded areas on dead trees. |
| Tree swallow | 5 x 5 | 6-8 | 4-6 | 1.5 | 4-15 | Place 2-3 boxes together on a post or dead tree near water. |
| Violet-green swallow | 5 x 5 | 6 | 4-6 | 1.5 | 10-15 | Place under eave of house. |
| Western bluebird | 5 x 5 | 8 | 6 | 1.5 | 5-10 | In open sunlit areas on fence posts or trees. |
| Wood duck | 12 x 12 | 22 | 17 | 3.5-4 | 10-20 | Place facing water, add four inches of wood shavings. |
| Wrens | 4 x 4 | 6-8 | 6 | 1-1.25 | 4-10 | In any partly sunny spot, may be hung from a tree limb. |

* Two or more sides may be open

the courtship displays of ruffed grouse. Because decaying woody material houses many invertebrates, it also provides forage for many species from porcupine to grizzly bear.

## Edge

Edge is the area formed between two different successional stages, or plant communities, such as a forest and a meadow. Edges typically are areas of highly diverse wildlife communities.

There are two kinds of edge: *inherent* edge and *induced* edge. Inherent edge forms naturally due to the differences in soils, climate, and topography across the landscape. Induced edge results from land-management practices such as cattle grazing, fire, and timber harvest. Edge management involves the preservation of inherent edge and the creation of induced edge. It is a powerful tool in the management of wildlife habitats.

Each successional stage, or plant community, has a wildlife community associated with it. Where stages meet, animal communities overlap. This area of overlap is called an *ecotone*, and the subsequent mixing of wildlife communities is called the edge effect (Fig. 3). The ecotone attracts species of wildlife such as elk, deer, moose, and some songbirds. These species require more than one habitat type to meet their survival needs. Edges also attract many predators because they find large numbers of prey animals in these habitats. The chance of attracting wildlife that use edges will increase with the amount of edge present on the landscape.

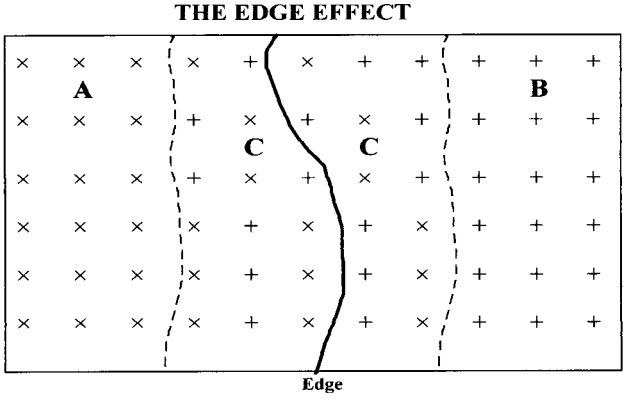



Figure 3. —Community C (area of increased diversity) results because of the overlap formed between communities A and B. *(From Thomas et al., 1979)*

However, the amount of edge is not the only issue; how that edge is arranged across the landscape also is important. Use edge carefully. Induced edge increases the numbers and diversity of wildlife species. However, too much edge may have adverse effects on animals that require larger, continuous blocks of forest for survival. Unfortunately, little research has been completed regarding the sizes of habitat blocks needed by birds and other "edge-sensitive" species.

The creation of edges increases horizontal diversity, which is the mix of successional stages across the landscape. The arrangement of different habitat types dictates the distribution of many wildlife species, especially those using more than one successional stage, such as elk and deer, and probably predators. Cougars may use early successional areas (i.e., edges and clearings) for hunting, yet they tend to bed down in mature forest stands where more resting cover is available. The need for more than one kind of habitat may be a necessity for many predators because it is also a necessity for prey.

## Forest Fragmentation

The close relationship between wildlife and the environment calls for a wide variety of habitats. This goal can be achieved *across* ownerships. Properties of many sizes make up the nonindustrial private forest lands in the Northwest. Landowner management decisions directly affect neighboring lands and associated wildlife populations. Some areas of conservation science have voiced concern that forest fragmentation may be increasing as forest lands are divided into smaller parcels.

The theory of forest fragmentation is based on observations of wildlife populations living on islands. When the island is bigger, more species inhabit the island. Conversely, when the island decreases in size, so does the number of species. Some conservation biologists are concerned that as forests become increasingly "islandlike" through natural disaster or extreme land-use practices, the number of species may be shrinking. As forests become smaller and are separated by greater distances, wildlife populations may suffer. (Fig. 4a.)

Forest fragmentation restricts wildlife mobility and impacts the health of local wildlife populations. To maintain healthy populations, many animals must migrate away from the birthplace. This dispersal prevents breeding among related individuals. Forest fragmentation may restrict the movements of animals and increase the risk of inbreeding. Over time, this may result in the extinction of that local population. Fragmented forests also may impact migrating animals by limiting their access to food and water.

Several studies have focused on the harmful effects of forest fragmentation on songbirds. Some show a reduction in the number of nesting birds in highly fragmented forests. The decline in breeding songbirds is most noticeable in forests of the eastern United States; however, the western states are beginning to show similar trends. Many impacted species seem to be sensitive to increased amounts of induced edge and to resulting environmental changes. Edges may attract a disproportionate number of predators; or exotic plants and noxious weeds may become established and out compete native species. Changes in temperature and relative humidity within the forest stand may alter the vegetative composition. All of these changes can impact wildlife communities. Maintaining larger "blocks" of habitat may lessen the impact of ecological changes. Appropriate block size is still under debate and will most likely be site and species specific.

## Corridors

Until more information is available regarding the effects of forest fragmentation, corridors can serve as forested "links" between two similar habitat patches. Corridors may provide safe travel routes between habitat "islands," reducing the negative impacts of forest fragmentation on wildlife populations (Fig. 4b). Corridors provide more continuity to a landscape, and may help landowners achieve their management goals, while providing for wildlife.

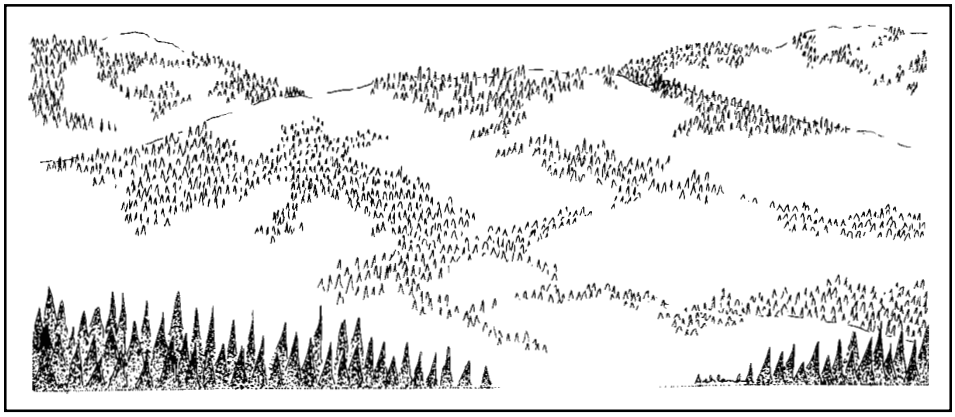


Figure 4a.—Fragmentation in forests creates small "islands" of habitat, which may limit resource availability to wildlife.

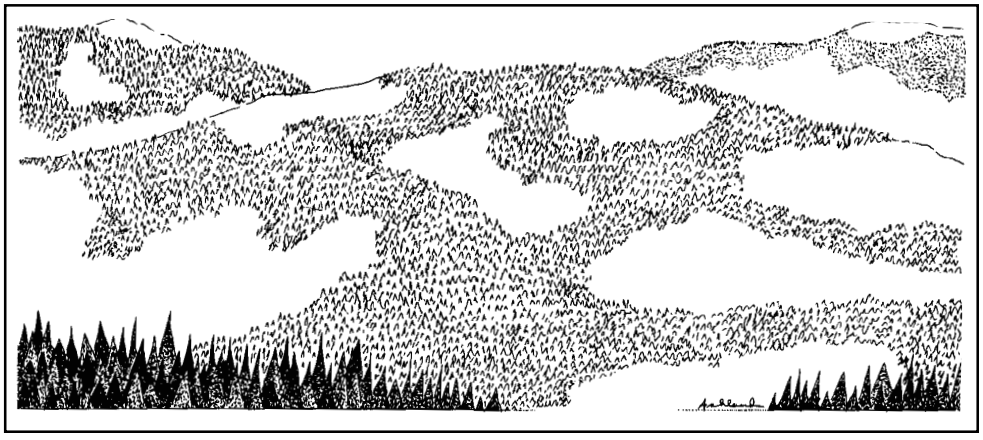


Figure 4b.—Corridors may reduce the effects of fragmentation by providing wildlife with vital links to resources.

# Riparian Habitat

Riparian zones are areas that surround water sources. They support high soil moisture and associated moisture-loving vegetation. These areas of high biodiversity often provide the necessary elements for survival—food, water and cover—in the same location. Changes in soil moisture characteristic of riparian zones promote many different plant communities within a relatively small area. Diverse plant communities support more species of wildlife (Fig. 5). Riparian zones are also areas of edge, associated with increased wildlife diversity.

The most important consideration in riparian zone management is avoiding stream bank erosion. Soil erosion occurs primarily because of vegetation removal through livestock grazing, road building, or tree harvest. If vegetation is removed, the resulting changes in water chemistry and temperature may harm fish, aquatic invertebrates, amphibians, and many songbirds. Riparian zones are integral parts of entire watersheds. Removal of riparian vegetation impacts water quality downstream and throughout the watershed. Riparian areas may be extremely sensitive to disturbance. Changing riparian habitat impacts a higher proportion of wildlife than is indicated by the amount of area disturbed. Thus, maintaining riparian vegetation communities becomes extremely important in riparian management.

Figure 5.— Due to changes in soil moisture, riparian zones support many different plant communities in a relatively small area.

# Conclusion

Wildlife managers can support wildlife by managing the habitat. This publication has focused on managing wildlife communities, not a single species. The community management approach may not be possible given environmental limitations, or landowner choice. The questions that you as a landowner must ask yourself are, "What does my land provide for wildlife right now?" and "What do I want my land to provide in the future?" Identify how the wildlife use the land before implementing any management activity. Take an inventory, determine site limitations, then define specific objectives. Always keep a landscape perspective. Wildlife management across ownerships may be difficult, but not impossible. You and your neighbor may have similar goals regarding wildlife. Working together can offer good opportunities for forming effective and ecologically sound management strategies.

Wildlife means different things to different people. Whatever values you place on wildlife, the importance of sustaining good quality habitat never varies. Owners of forestlands take on the special responsibility as stewards of that land. Wildlife does not recognize differences in ownerships or property lines. Rather, wild animals recognize areas where they can get food and water, or hide from predators, or safely raise their young. It is up to us to understand the needs of wildlife, and the ways in which we impact wildlife populations, if we are to share the world with them.

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# Glossary

**ASPECT:** The compass direction which a slope faces.

**BIOLOGICAL DIVERSITY:** Richness and abundance of species, and variety of natural communities in any environment. Both the number of species and the number of individuals of each species are important in considering the extent of biological diversity in an area. Also referred to as biodiversity.

**BRUSH:** Commonly refers to shrubs and small trees; sometimes undesirable.

**CARNIVORE:** A meat-eating animal and, rarely, a plant, (examples are cougars and pitcher plants).

**CARRYING CAPACITY:** The number of animals a habitat can maintain in a healthy condition.

**CAVITY TREES:** Standing live trees which have natural internal cavities.

**COMMUNITY:** A natural assemblage of different organisms living and functioning together in a particular area, with some degree of influence on each other. Usually named for the dominant plants, animals, or major physical components of the area.

**CONSERVATION SCIENCE:** The science of diversity, scarcity, and survival of species. Deals with active management to protect and maintain genetic variety within species. Deals also with the concept of sustainability and relationships between living and nonliving resources.

**CORRIDORS:** Generally linear strips of habitat linking isolated patches of natural habitat in the landscape.

**COVER:** Vegetation or other natural shelter serving to conceal wildlife from predators. Also refers to the protective shade vegetation provides to wildlife, fish, and the forest floor.

**DISTURBANCE:** A natural or human-caused event, such as a forest fire, disruptive wind storm, or insect infestation, that alters the structure and composition of an ecosystem.

**ECOLOGY:** The science that studies the interaction of plants and animals with their environment.

**ECOSYSTEM:** Ecological system. An interacting system of living organisms and their environment. The dynamic relationships of living and nonliving components of a region, as well as the forces, such as weather and wildfire, that affect them.

**ECOTONE:** A transitional area between two vegetation communities containing the characteristic species of each as well as characteristics of its own. A point of abrupt change, such as a prairie-forest junction or a land-water interface.

**EDGE:** The contact zone between two different types of habitat. There are two kinds of edge: *inherent*—which is natural edge due to differences in soils, climate, topography; and *induced*—which is the result of human practices such as grazing, road building, and timber harvest.

**EDGE EFFECT:** The tendency toward greater species variety and greater density of animal and plant life in the margin where two different vegetative communities meet. *(See also* Ecotone)

**EDGE SENSITIVE:** Any animal or plant species which is negatively impacted by induced edge. Species tend to be extremely sensitive to alterations in the local environment, such as changes in climate and vegetative composition, and increases in predator populations.

**ENVIRONMENT:** The external conditions, both physical and biological, in which an organism lives. Includes climate, soil, topography, food supply, and all other influences affecting development.

**FRAGMENTATION:** The breaking up of a large forest area into patches either by natural processes or through management or conversion to other land uses. Natural habitats may become separated into isolated segments or “islands.”

**GAME ANIMALS:** Animals traditionally hunted for sport and used as a resource, (examples are elk, grouse, and ducks).

**HABITAT:** The local environment in which a plant or animal naturally lives and develops.

**HABITAT MOSAIC:** The physical layout of habitat types over a large area. (*See also* Landscape)

**HABITAT TYPE:** Classification of a land area according to dominant plant forms (usually trees and shrubs) and physical characteristics. Can help to indicate the biological potential of a site.

**HERBIVORE:** A plant-eating animal, (examples are deer and rabbits).

**LANDSCAPE:** A large land area composed of interacting groups of ecosystems, including all the physical and biological aspects of such an area regardless of ownership.

**LANDSCAPE ECOLOGY:** The study of biological interactions across a large land area, or watershed.

**LIMITING FACTORS:** Environmental factors that far outweigh other factors in restricting normal increase of a species.

**NONGAME:** Animals not typically hunted for sport or used as a resource, (examples are songbirds, amphibians).

**NUTRIENT CYCLING:** The biological, geological, and chemical circulation of inorganic elements such as nitrogen, phosphorus, and potassium through the soil, living organisms, water, and air, thus providing nutrients to animals and vegetation in the process.

**OMNIVORE :** An animal that regularly eats both plant and animal foods.

**ORGANIC DEBRIS:** Material produced by plants and animals, such as leaves, branches, logs, bones, hair, etc.

**PALATABILITY:** The degree to which something tastes good; the better something tastes, the greater the palatability.

**POPULATION:** Organisms (trees, shrubs, herbs, animals, insects, etc.) of common ancestry that occupy a particular area.

**RIPARIAN :** Pertaining to the area along the banks of a river, stream, or lake.

**SHRUB:** A low-growing perennial plant with a woody stem and low branching habit.

**SILVICULTURE:** The art, science, and practice of establishing, tending, and reproducing forest stands with desired characteristics, based on knowledge of species characteristics and environmental requirements.

**SLASH:** Nonmerchantable residue left on the ground after logging, thinning, or other forest operations. Includes tree tops, broken branches, uprooted stumps, defective logs, and bark. Slash has certain ecological benefits, such as adding nutrients to the soil or providing wildlife habitat.

**SLOPE:** The incline of the terrain usually expressed as the amount of incline in feet over a hundred feet of horizontal distance.

**SNAG:** The upright trunk of a dead or dying tree.

**SOIL COMPACTION:** The process by which soil particles are squeezed or compressed, reducing air and water spaces.

**SPECIES:** A group of organisms (plants or animals) that are very similar genetically and can interbreed freely with each other but not with other groups.

**SPECIES COMPOSITION:** The mixture of plant and animal species found in a defined area.

**STAND:** A recognizable area of the forest that is relatively homogeneous and can be managed as a single unit.

**STRUCTURAL DIVERSITY:** Refers to the horizontal and vertical features of an area.

**SUCCESSION:** The predictable changes in the kinds and numbers of plants and animals that will inhabit a given place over a long period of time.

**UNDERSTORY:** That portion of the trees or other vegetation below the canopy in a forest stand.

**WETLANDS:** Marshes, swamps, and other water-saturated soils. These areas offer important habitat for wildlife, significant support of nutrient cycling in ecosystems, and protection against the severity of storms and floods. Wetlands are among the lands most vulnerable to destruction and conversion to other uses.

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