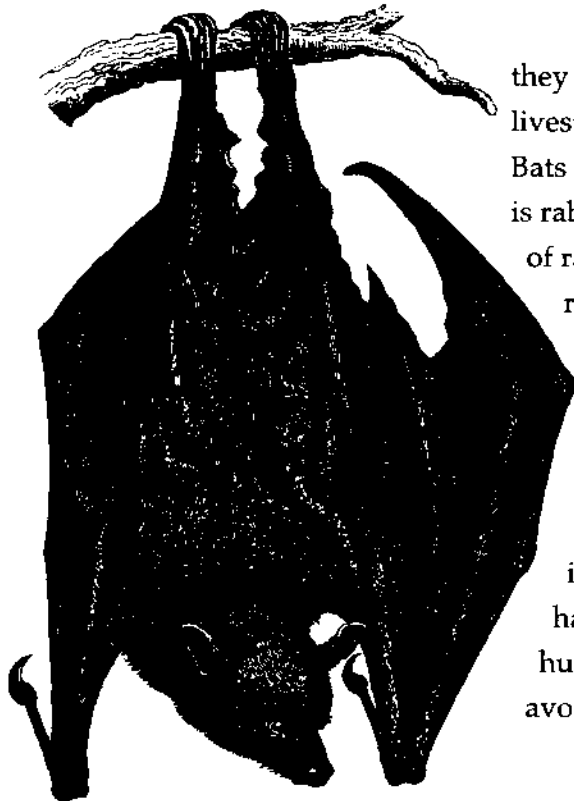




# Woodland Fish and Wildlife

## *Habitat Management for Bats on Small Woodlands*



Not everyone likes bats. Like many species of predators, bats are maligned and misunderstood. They have been the subject of folklore and mythology and are unfairly treated in literature. The result is an almost universal fear of bats. No real basis exists for these fears. Vampire bats do feed on the blood of animals, but they prefer blood from birds and livestock to blood from people. Bats carry diseases, one of which is rabies. However, transmission of rabies from bats to humans rarely occurs and is easy to avoid. Bats don't fly at people and purposely tangle themselves in their hair; though sometimes they may accidentally fly into someone. While bats have adapted to living with humans, they try hard to avoid any contact.

For some people, bats are not a problem. For others, bats can cause worry, especially when they become unwanted guests in an attic, an outbuilding, or inside the walls of a home. Regardless of personal feelings and experiences with bats, we can live with them and appreciate what they can do for us. We may even learn to like them a little.

### **SOME BAT ECOLOGY**

#### *Who's Who?*

Bats make up one of the largest groups of mammals, second only to the rodents. Bats give birth to live young, usually one at a time. The females have mammary glands that produce milk to feed their offspring. Almost 900 known species of living bats, or *Chiropterans*, exist. They occupy almost every environment on earth, except for the arctic and polar regions, and some oceanic islands. Most bats are tropical or sub-tropical; they reach their greatest species diversity in the tropics.

There are two types of bats: the fruit eating bats (Megachiropterans) and the insectivorous and carnivorous bats (Microchiropterans), which include vampire bats. The two groups differ in some important ways. The microchiropterans are what many of us imagine when we think of bats. These bats are *nocturnal* (active only at night). Many use a foraging method known as *echolocation* to locate and identify the insects they eat. Seventy percent of the living species of bats eat insects. Some also feed on fish, frogs, and fruit. The vampire bat is a specialist, feeding exclusively on blood. No vampire bats live in the Pacific Northwest.

We will focus our discussion on the microchiropterans, or insect-eating bats of the Pacific Northwest. Many northwest species of insect-eating bats hibernate during the winter months. *Hibernation* is an adaptation that allows bats to occupy a wide range of environments, because they "sleep" through periods of colder weather when

insect populations are low. Insect-eating bats are relatively small in body-size (0.2 to 1.5 ounces) compared with their fruit eating cousins. Wing spans for this group range from 8 to 15 inches.

Fruit eating bats (Megachiropterans) by contrast, may weigh more than 2 pounds, and sport wing spans up to 3 1/2 feet. Fruit-eaters do not live in North America. They are strictly tropical or sub-tropical. They do not hibernate, and most do not use echolocation to identify and locate their prey. Because they seek out fruit to eat, most rely on vision and sense of smell for survival.

#### *Benefits from Bats*

Bats are extremely beneficial to humans. They provide a natural biological control for insects. Studies suggest a single bat can consume thousands of insects in a single night, thus having a substantial effect on insect numbers. Bat waste, or *guano*, is an excellent fertilizer. In some areas of the United States, people harvest and sell bat guano commercially for use in home gardens. In the tropics, many species of bats play important roles as plant pollinators, especially those that feed on nectar.

#### *Flight*

Bats are remarkable creatures in many ways, and flight is one of their most impressive abilities. Because bats can fly, people once assumed a relationship between bats and birds. This is not the case. The wing of a bat has a developmental origin different from a bird's wing. A bat's wing is a modified hand, while the wing of a bird is a modified arm. The Latin name for bats, *Chiroptera*, means "hand wing." Flying allows bats to exploit food resources in a way unique to mammals. No other species of mammals hunt at night...while flying! (By the way, flying squirrels do not actually fly, they glide.)

#### *Echolocation*

The origin of the phrase "blind as a bat" arises from the observation that most bats are active at night when it is dark. However, this phrase is a misnomer. Bats are not blind at all. More accurately, bats have the ability to perceive their world through sounds in roughly the same way other animals do through sight. Bats essentially "see" in the dark using a combination of neuromuscular and behavioral adaptations called *echolocation*. During hunting, some bats emit extremely high frequency sounds.



When a bat encounters an insect during flight, sounds "bounce back" to the bat from the insect. The bat locates the position of the prey simply by interpreting the reflected sounds.

### *Hibernation and Torpor*

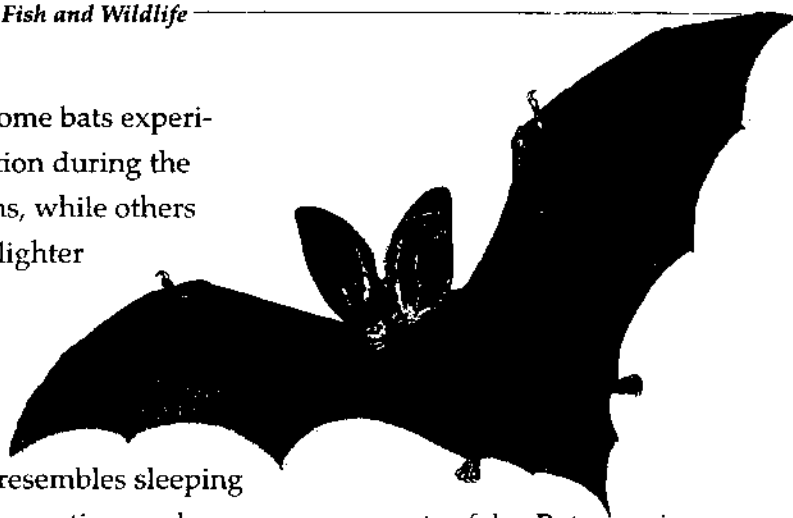
**B**ats are champions in energy conservation. Cold winters force many bat species in the temperate regions of North America to hibernate. Some bat species migrate to hibernation sites, while others may hibernate locally. Still others migrate to more favorable climates, remaining active year-round. Like all warm-blooded animals, bats need to maintain a relatively constant body temperature to survive. During periods of cold weather this process can be costly in terms of energy expenditure. Bats lower their internal body temperature during hibernation; thus avoiding the high costs of maintaining internal temperatures at a higher level. This process of hibernation is an ability bats share with other mammals such as ground squirrels and chipmunks. Hibernation seems to be a response to a decrease in the ambient temperature, rather than a decrease in food supply. Through hibernation, bats adapt to cold winter temperatures by reducing their metabolic rates to near-death

low levels. Some bats experience hibernation during the winter months, while others experience a lighter phase called *daily torpor*, during the summer.

Daily torpor resembles sleeping more than hibernation, and animals are easily roused. During periods of daily torpor normal body functions are slowed down, but not as profoundly as during winter hibernation. It is common for insectivorous bats in temperate regions of North America to hibernate during the winter, to have daily torpor periods during the summer, or to experience a combination of both. Whether a bat experiences daily torpor or a winter-long deeper hibernation depends on the region where the bat lives and how cold the winters are.

### *Habitat Requirements*

**F**or nocturnal animals like bats, daily torpor has important advantages. Since bats restrict their activity to the nighttime, they must conserve energy during the daylight hours. Daily periods of torpor help them do this. For torpor to be effective, bats must have appropriate sites where they



can roost safely. Bats require different habitats for roosting, hibernation, foraging, and rearing young. A single bat may roost during the summer months underneath the bark of a tree, hibernate in an abandoned mine shaft during the winter, and raise its young in the attic of an old building during the spring. Bats have different needs during different stages of their lives.

### *Roosting*

**B**ats choose roost sites for a number of reasons, including safety from predators, flight access, and suitability of temperature and humidity. During daily torpor, bats constantly adjust their body temperatures in response to changes in the surrounding air temperature. Basically, bats must maintain lower body temperatures during the day, then slowly warm up towards evening. Good roosting habitat provides enough areas of different temperatures, allowing excess heat generated by the bat's body to

Table 1. Common bat species of the Pacific Northwest and their associated habitats.<sup>1</sup>

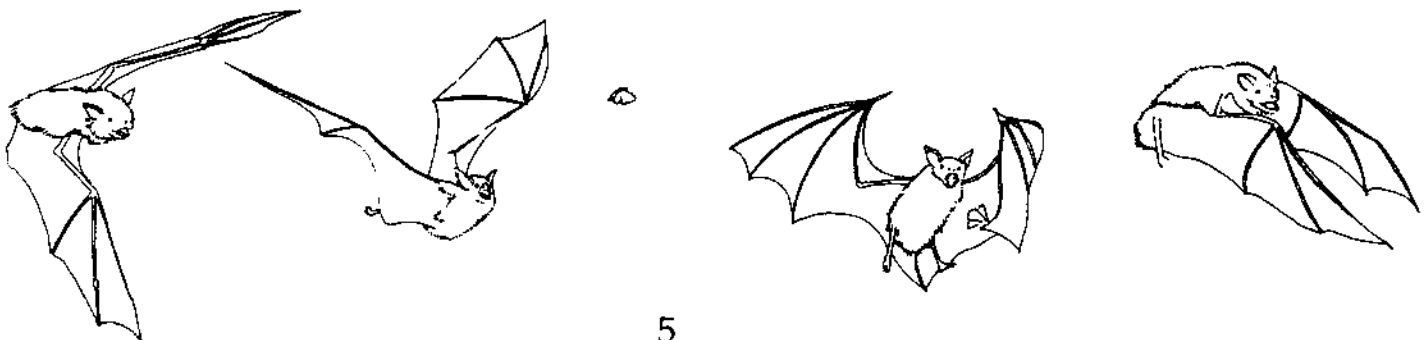
Source: *Atlas of Oregon Wildlife and Terrestrial Mammals of Washington State: Location data and predicted distributions.*

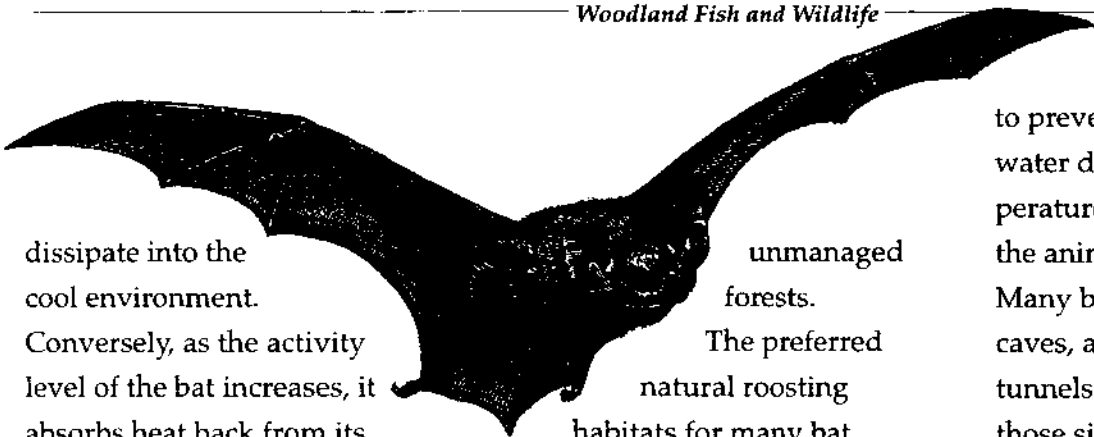
Species	Comments
<b>Little brown bat</b> ( <i>Myotis lucifugus.</i> )	Most widespread and abundant species in PNW; prefers forested areas but are also in urban environments. This species is most likely to roost in buildings.
<b>Yuma bat</b> ( <i>Myotis yumanensis</i> )	Occurs in lower elevation coastal forests and arid grasslands of Washington State. In Oregon it is most commonly found in older forests and woodlands in the western part of the state. This species flies close to the ground and hangs in clumped groups while roosting. It is often confused with the little brown bat.
<b>Long-eared myotis</b> ( <i>Myotis evotis</i> )	Most common in forests east of the Cascades in Washington; but is widespread in forested habitats in Oregon. May be seen flying at high altitudes in early evening, though it often forages on the ground. It does not occur in large groups.
<b>Long-legged myotis</b> ( <i>Myotis volans</i> )	Prefers cool and wet higher elevation coniferous forests in Washington and Oregon. May also occupy riparian areas in more arid regions.
<b>California myotis</b> ( <i>Myotis californicus</i> )	Common in forested and rocky habitats near open water in Washington and Oregon. May occur along well-vegetated watercourses in the Central Basin of Washington. Forages near trees, rarely higher than 15 ft. above ground.
<b>Western small-footed myotis</b> ( <i>Myotis ciliolabrum</i> )	This species prefers open, arid country with rocky cliffs in Washington and Oregon. It is absent from forested habitats. It appears early in the evening, and feeds low over trees and brush.
<b>Keen's myotis</b> ( <i>Myotis keenii</i> )	This species prefers low elevation, mature coniferous forests in the Puget Sound region and Olympic Peninsula of Washington State. It is absent from Oregon. It often roosts alone but may hibernate in large groups of up to 350 individuals.
<b>Fringed myotis</b> ( <i>Myotis thysanodes</i> )	This species is associated with dry forests and arid grasslands. In Oregon, it is most commonly found at the Oregon Caves Monument in the southwestern part of the state. It hangs in clumps when using caves. May forage insects off the ground.
<b>Big brown bat</b> ( <i>Eptesicus fuscus</i> )	Very common bat found in all habitat types in Washington and Oregon, but less common in steppe regions. Prefers deciduous forests, but will use human structures. It can be distinguished from the myotis bats by its larger size. Forages on the ground as well as during flight.

Table 1 continued

<p><b>Pallid bat</b> (<i>Antrosouz pallidus</i>)</p>	<p>This species is found in the arid and desert regions of Oregon and Washington, and in open forests of eastern Oregon. Feeds entirely on the ground, preying on scorpions, grasshoppers, crickets, and beetles. Good controller of insects that bother humans.</p>
<p><b>Spotted bat</b> (<i>Euderma maculata</i>)</p>	<p>Has a limited distribution in the desert regions of Washington and Oregon. Prefers high cliffs for foraging and roosting. They are aerial feeders that hunt a variety of insects, but prefer moths.</p>
<p><b>Townsend's big-eared bat</b> (<i>Corynorhinus townsendii</i>)</p>	<p>This bat is rare in Washington. It occurs in low- to mid-elevation forests throughout the state. In Oregon, there are two subspecies: one occurs in some forested habitats in the west, and the other in the arid east. Can be identified by extremely large ears (about 1/2 its body length). They are extremely sensitive to human disturbance, which often results in increases in mortality. This bat is federally listed as an endangered species.</p>
<p><b>Hoary bat</b> (<i>Lasiurus cinereus</i>)</p>	<p>Occurs in all forested regions of Washington and Oregon. Hunts at high altitudes for moths and mosquitoes. Gleans insects from foliage and off the ground.</p>
<p><b>Western Pipistrel</b> (<i>Pipistrellus hesperus</i>)</p>	<p>Washington State is the northernmost part of this species' range. It occurs only along the deep river canyons of the Columbia and Snake rivers. It occurs in Oregon's Blue Mountains, and in the desert southwest. Flies early in the evening. Lives in fairly arid conditions, and found near watercourses.</p>
<p><b>Silver-haired bat</b> (<i>Lasionycteris noctivagans</i>)</p>	<p>Occurs near wetlands in the forests of Washington and Oregon. It seems to prefer snags in older Douglas fir and western hemlock forests. These bats feed among trees and are very slow flyers.</p>
<p><b>Brazilian free-tailed bat</b> (<i>Tadarida brasiliensis</i>)</p>	<p>Southwest Oregon is the northernmost range limit for this bat. It prefers hollow trees and caves. This species can form very large colonies (up to 20 million individuals in a Texas cave.)</p>

<sup>1</sup> Many bats in the Pacific Northwest are considered sensitive species, though at the time of this writing they have no official status as threatened or endangered. Many species are currently being studied and may eventually be recommended for protection under the Endangered Species Act.





dissipate into the cool environment. Conversely, as the activity level of the bat increases, it absorbs heat back from its surroundings. Species such as the little brown bat (*Myotis lucifugus*) may roost in groups in the cooler morning hours and adjust their position as temperatures increase. Studies suggest that many local species of bats generally roost in older conifer trees, usually underneath loosened bark, within the foliage, and inside hollow snags and stumps. They also roost between rocky crevices, under bridges, under the eaves of buildings, and in attics. Roosting requirements vary with species. Most bats will use a variety of roost sites and types depending on location in relation to foraging sites, availability of suitable roost sites, and their foraging strategies. Of the 16 species of bats known to occur in the Northwest, 11 use foliage for foraging and roosting. They may roost in the upper canopy within dense foliage, on limbs, adjacent to openings, in the subcanopy layer, or in the understory. They prefer a mixture of forest structure and location most commonly found in older

unmanaged forests. The preferred natural roosting habitats for many bat species are still unknown. We do know the use of artificial structures is well documented for some species. The attics and walls of some buildings offer bats excellent roosting habitat. This is probably due to the amount of room supplied, the relative humidity, and the temperature. Some bat species use other artificial roosting sites, such as bat houses. As forests in the Pacific Northwest come under more intensive management, artificial roosts may become increasingly important in bat conservation, but only in localized situations. Design and construction of bat houses and forest management will be discussed in more detail later.

### **Hibernaculum**

The *hibernaculum* is the site where a bat hibernates. A good hibernaculum supplies protection from predators, light, noise, and other disturbances. It must provide temperatures low enough to allow the bat to maintain a low body temperature and humidity high enough

to prevent the bat from losing water during hibernation. Temperatures must not be so cold that the animals freeze to death. Many bat species hibernate in caves, attics, abandoned mines, or tunnels. Some are quite loyal to those sites, and return to the same hibernaculum year after year. Bats are rarely thought to use snags or tree cavities for winter hibernation. However, these structures are very important for bats during other times of the year, and they are used year round by many other species of wildlife. Prior to the hibernation period, bats put on as much extra body fat as possible, usually a maximum of 25% to 30% of their body weight. Once enough fat is stored, metabolic processes slow and the bat enters the hibernation phase. If a bat rouses early from hibernation, it must burn large amounts of those fat reserves to increase its body temperature and to maintain itself while awake. This could seriously deplete much needed energy reserves, putting the bat's survival at risk. The best hibernaculum allows for the slow utilization of fat reserves with little chance of outside disturbance. The length of hibernation varies depending on the species of bat and the climate of the area. In the Pacific Northwest bats generally hibernate from November to April.

### Reproduction

Reproduction in bats is unusual. In most species mating already has occurred as bats enter the hibernation period. This is similar to the process that bears experience. Unlike bears, bats do not give birth during the hibernation period. During hibernation female bats experience a postponement in embryonic development. Reproductive processes resume toward the end of hibernation in late February or March. In many species, female bats leave the hibernaculum around March or April, gather into large unisex groups, and establish *nursery colonies*. Within these colonies females give birth and raise their young. Young bats begin to fly in May or June.

Bat nurseries must be warmer than other roosting sites. Like the hibernacula, bats often use them year after year. Female bats generally take care of their own offspring, but some species may have communal care among nonrelated females. Mother bats establish a distinct vocal communication with their young soon after they are born. This enables the mother to distinguish her own offspring from the hundreds of others residing in the nursery colony. Some vocalizations are portions of the echolocation sounds the female uses

during hunting and feeding. The young eventually learn the appropriate vocalizations they will need for hunting when they mature.

### HABITAT DEVELOPMENT

#### Foraging Habitat

One important feature of good bat foraging habitat is the presence of open water, not only for drinking but also for foraging. Water is essential during the life cycle of many flying insects, and most aerial-feeding bats eat flying insects. Some bats forage while flying over open water while others may hunt insects high in the forest canopy. Regardless of the foraging strategy, the presence of both standing and moving water is important for bats. The location also may be significant. Bat biologists suggest water sources within 1 mile of roosting sites and nursery colonies are the most beneficial. Any enhancements to bat habitat should include protection of riparian areas along streams and pond perimeters. Limit grazing and avoid road construction within these riparian areas to reduce

soil erosion and sedimentation into streams and ponds.

Riparian vegetation is extremely important for aquatic insects upon which bats will eventually feed. Make sure that the water is open and available for bats and that riparian vegetation does not choke the pond or stream. Some aquatic-borne insects attractive to bats will not reproduce in ponds with extremely cool temperatures.

#### Roosting Habitat

An effective way to increase or maintain bat populations is to provide suitable roosting habitat. Most bat species prefer cavities, crevices, and hollows in the trunks of trees, perhaps because of the overall protection these structures offer. Hollows and crevices provide safety from predators; internal cavities also may modify temperature and



humidity important to raising young bats.

### *Hollow Trees*

Large diameter trees vulnerable to heart-rot decay, are preferred cavity trees for many wildlife species including bats. These include grand fir, western red cedar, Douglas fir (in western Washington and Oregon), western larch (in eastern Washington and Oregon), and some hardwoods such as oak. Fungi-infected trees develop hollows within the bole that increase in size as the trees age. When identifying possible bat roosting sites, look for trees with broken tops that have one or more "trunks" growing over the broken area, indicating a hollow trunk. Learn to identify the characteristic rectangular holes of Pileated woodpeckers, or the presence of Indian Paint fungus, indicating decaying heartwood. Large hollow cottonwoods, oaks, and bigleaf maple may be used as roosting habitat. We do not know how many hollow trees per acre to retain for effective bat management. If you plan carefully you can identify and retain living hollow trees for future bat populations.

### *Snags and Cavity Trees*

Retaining snags and damaged trees also may promote

bat populations on small woodlands. Bats readily use the spaces underneath loose bark for daytime roosting during the summer months. Provide snags during the early successional decay stages, when bark is still present. Damaged trees having crevices or cracks in the bark and tree stem supply spaces big enough for a bat to roost. Many hollow snags have live crowns, which increase opportunities for roosting.

You may want to enhance or replace habitat lost during forest management activities. To create snags from poor quality crop trees or deformed trees, tops can be cut out or girdled at the desired breakage point to promote snag development. Plan for snag development during thinning operations. A variable density pattern of thinning can create occasional larger spacing (at least 50 feet in diameter) to encourage foraging activity and a direct flight path into adjacent tree or snag roosts. Maintain snags at the edges or centers of these forest openings. Existing snags or hollow trees that create unsafe working conditions can be left in unthinned or lightly thinned patches to meet safety precautions while preserving bat habitat. These patches, if placed adjacent to or close to existing, perennial water bodies, may be

most effective. Retain stumps three or more feet high with peeling bark for roosting in areas where they will not hinder equipment movement and harvesting operations. Good candidates for stump retention are harvestable trees having excessive butt swell, damage, or rot in the butt. These practices will benefit other cavity nesting and snag dependent wildlife as well.

For more information on snag creation and management, see the Woodland Fish and Wildlife publication, *Managing Small Woodlands for Cavity Nesting Birds*, October 1991.

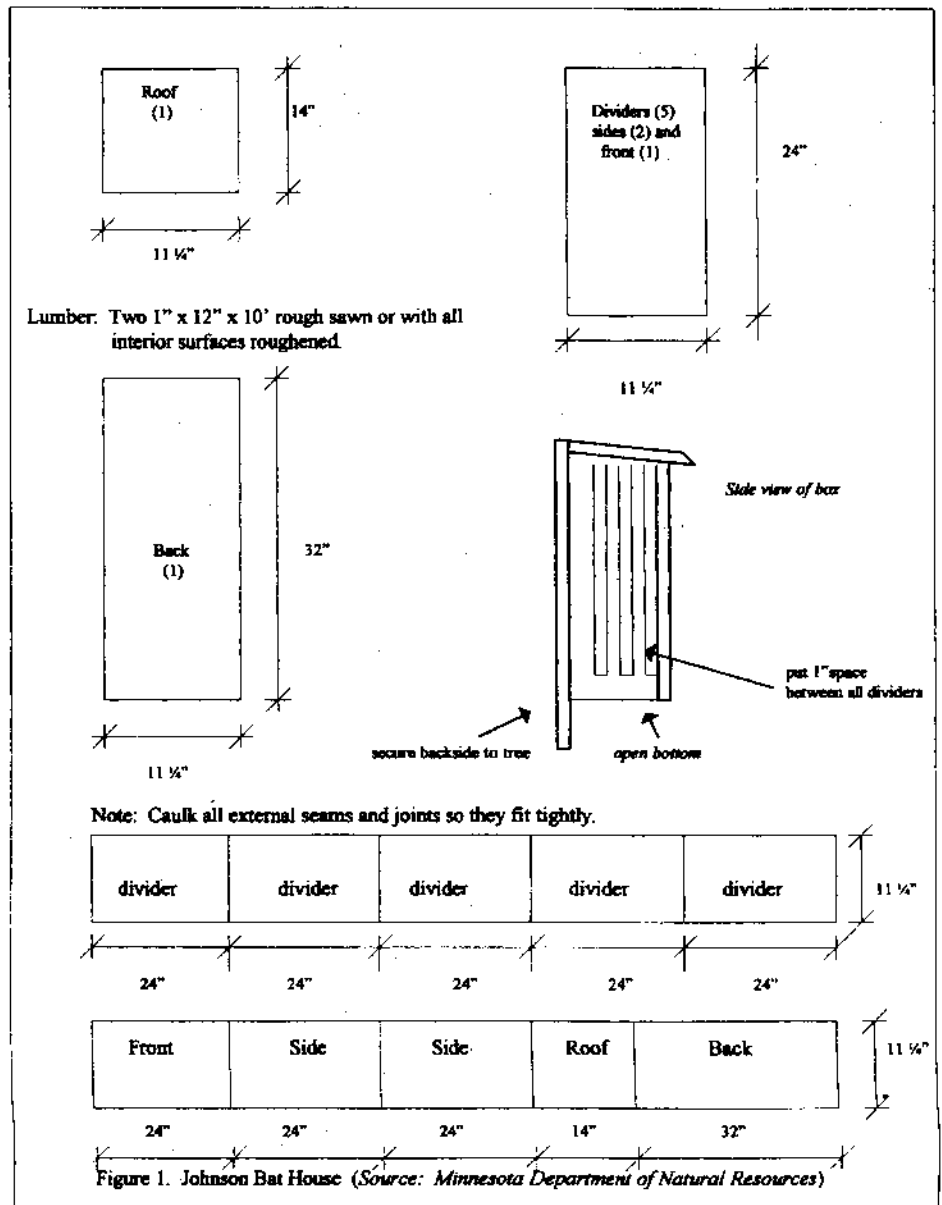
### *Hibernation Habitat*

Suitable hibernaculum habitat is difficult to develop. We know little about where some bat species hibernate. In the Northwest bats either migrate to other areas for hibernation, or find suitable sites not far from where they spend the spring and summer. In eastern Washington and Oregon, caves, abandoned mines, and tunnels offer the best hibernation habitat. In western Washington and Oregon some species of bats readily use old buildings for hibernation. Regardless of what structure bats choose, their hibernacula must supply constant temperatures and safety from any kind of

disturbance. If you discover a hibernaculum, restrict activity in and around the area, especially during the winter months. Hibernating bats are extremely sensitive to disturbance and early arousal from hibernation could prove fatal.

**The Bat House Option**

Providing suitable forest habitat is the best method for encouraging bat populations in small woodlands. Where early decay stage snags are not available artificial roosting habitat such as bat houses may be used in the interim. Bats do not use bat houses for hibernation, but they can be quite important for daytime roosting and the rearing of young during the spring and summer. Bats require space to move around within the house to adjust to daily fluctuations in temperatures during torpor. You may have a better chance of attracting bats if a variety of temperature options exist *within* the house. For example, placing an "attic" in the bat house will provide more opportunities for temperature regulation and control, as will supplying houses with different outside coloration of light and dark. In other words, be creative! Bat house designs should adapt to meet whatever requirements your local bats



have. It may take a little time to find the perfect house design. Figure 1 provides a basic design you can easily modify.

**House Design**

Before you start building a bat house, try to identify what kinds of bats you are likely to have in your area (Table 1). In the Pacific Northwest, the small insectivorous bats (*Myotis* spp.)

are most common. However, even among these small bats body sizes differ. The size of the house will make a difference in terms of its success: after all, what good is a bat house if the bat is too big to get into it?

Regardless of the size, all bat houses must have the following design features:

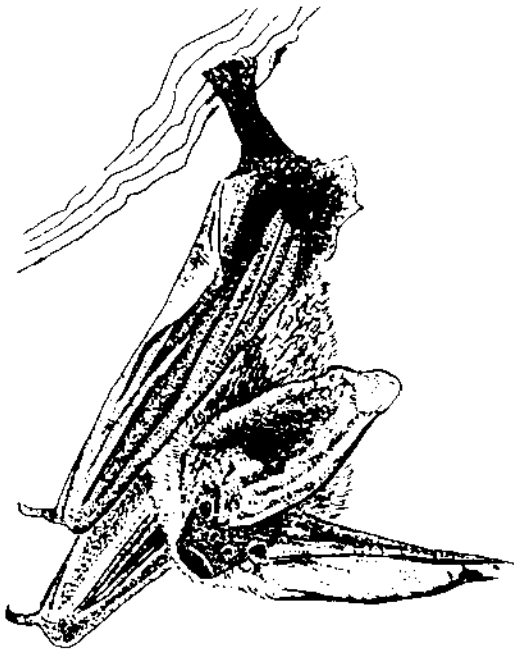
- Most bats prefer houses open on the bottom having internal

vertical slots (see figure 1).

- Each slot should be at least 24 inches high. The total width of the house should be no less than 11 1/2 inches.
- Use roughened boards spaced 3/4 inch to 1 (one) inch apart for internal roosting slots. Larger bats will use the larger openings and smaller bats the small openings.
- Roughen all internal facings or use roughcut unplanned lumber so bats can grip the surfaces with their claws for climbing and moving around.
- Use only untreated lumber. Wood preservatives and paint could harm the bats.

#### *House Placement: where and when*

- Place a bat house where it will receive the maximum amount of morning sun. Small bats



generally prefer temperatures of 90°F, but can tolerate temperatures as high as 104°F. On the other hand, larger bats may leave a roost if it is hotter than 95°F. Bats prefer temperatures between 80°F and 90°F for the nurseries.

- Mount the bat houses on the east- or south-facing exposures of buildings and trees, or wherever summer temperatures are the highest. If possible, put more than one house on the same structure, facing in different directions. This allows bats to move from one house to another depending on the season and their need for temperature regulation.
- Mount houses at a height of 10 feet or more, away from the prevailing winds, and unobstructed by vegetation. Bats need open space for flying in and out of their houses.
- If possible, place the houses within 1 mile of any water source. Many insects live in water during some part of their life cycle. Putting a bat house close to a food source will increase the chances of it being used.

If you have had trouble with bats using attics and walls, you may be able to attract them away from those areas by providing bat houses. Seal off any access to the attic or walls. Place bat

houses on the outside of the house near the old entrance. Since bats tend to return to the same roosting spot year after year they should find the new boxes easily.

Late fall is the best time to exclude bats from a home or cabin, when the building is NOT being used by bats for day roosting, for hibernation, or as nursery colony. Otherwise you may end up trapping and killing any bats left inside, especially flightless young. Wait until *after* the summer months, and *before* the hibernation period to bat-proof a building.

#### *Is Anybody in There?*

In the Pacific Northwest, bats usually hibernate from the beginning of November through mid-April, and will most likely be hibernating in abandoned mines, cliffs, caves, and buildings. Put up your bat house during this time to have summer roosting sites available when the bats come out of hibernation.

It is unclear how soon bats will use the new bat houses. Some people have reported bats moving in within a few days of installation. Sometimes it may take an entire year or more before any activity occurs. Be patient. If the house has not had any use after 2 years, try moving it to another location or altering

its size. Check to see how hot the house gets. If the house is not absorbing enough heat during the day, you might have to insulate the box or wrap it in tarpaper. You may want to place a few bat houses around the trunk of a tree, facing in all cardinal directions. Place the houses as close as possible to a water source to improve the chances that they will be used.

If you want to know if your bat house is being used, quietly lay a tarp or cloth under the house and check it for droppings. You may have to wait a few days before seeing any sign. Another way is to watch at dusk for the bats to emerge from the house. Watch from a good distance away to avoid unduly disturbing them. Sometimes wasps, yellowjackets, or other undesirable insects will move in instead of bats. You can remove them by spraying with a blast from a high-pressure hose. **Never use pesticides**, which can harm any bats that may move in later. If the problem becomes uncontrollable, moving the bat house to a different location is the best option.

Bat houses provide an effective habitat alternative for bats in areas lacking adequate natural structures, such as snags and cavity trees. However, if

managing for bats is one of your objectives, then providing natural roosting structures is preferred. Incorporate snag and wildlife tree retention procedures into your forest management plans, and you will not only provide good habitat for bats, but for many other wildlife species as well.

#### *A Word about Rabies*

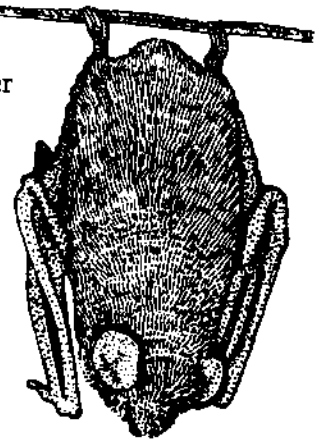
**P**ublic concern often arises about bats and the transmission of rabies. Rabies is a virus that affects the nervous system of all mammals, including humans. If not treated in time, rabies infection usually results in death. In the states of Washington and Oregon, bats are currently the only recognized reservoir of rabies, (all mammals can spread the virus). The degree to which rabies occurs in bat populations in the Pacific Northwest is unknown, but state Health Departments suggest it is probably less than 1%.

#### *Prevention is Easy*

**A**lthough bats in the Pacific Northwest may carry rabies, transmission from bats to humans is extremely rare. The transmission of rabies occurs through a bite or scratch from a rabid animal, or possibly via saliva contact with mucous membranes or an open wound.

The number one rule of rabies prevention is to **avoid handling any bats**.

When bats are sick they can be slow moving and lethargic. It is safe to assume that a bat is sick if it is easily approachable. Avoid these animals. **Do not pick up a bat or touch it in any way**. Report the animal to the local animal control authorities as soon as possible. A domestic animal may become infected with rabies through the bite of a bat. This is a special concern for hunting animals, such as cats. Vaccinating domestic pets against rabies reduces the risks of infection and transmission. If a bat is trapped in the home, turn on the lights and open a window. A healthy bat would prefer to avoid any contact with humans and will try to leave. If bats routinely invade your home, take measures to exclude them. Contact your local Cooperative Extension office, or Department of Fish and Wildlife for more information on bat exclusion methods. For more information on rabies, please contact your local Health Department.



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### A Checklist for Effective Bat Management

#### Foraging habitat

- Pond or stream present
- Some gaps present in forest canopy

#### Roosting habitat

- Snags/cavity trees present
- Large diameter, hollow trees present
- Trees with bark crevices present
- Large, old stumps present
- Old bridge(s) present
- Potential roosts within 1 mile of riparian area
- A variety of tree species and age classes present

#### Habitat for hibernating/raising young

- Caves or mineshafts present
- Wooden building structures present
- Hibernaculum within 1 mile of riparian area

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## A Woodland Fish and Wildlife Project Publication

**P**ublications in this series provide practical information on fish and wildlife management to private woodland owners and managers. Cooperating agencies and organizations for the Woodland Fish and Wildlife Project include: Western Forestry & Conservation Association, World Forestry Center, Oregon Department of Forestry, Washington Department of Natural Resources, Oregon State University Extension Service, Washington State University Cooperative Extension, University of Washington College of Forest Resources, Oregon Association of Conservation Districts, Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Washington Depart-

ment of Fish and Wildlife, USDA Forest Service, USDA Natural Resources Conservation Service.

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**F**or more information on bats, refer to the following items:

*America's Neighborhood Bats* by Merlin D. Tuttle, University of Texas Press, PO Box 7819 Austin, Texas 78713.

*Bats: A Natural History* by John E. Hill and James D. Smith, University of Texas Press, PO Box 7819 Austin, Texas 78713.

*Bats of British Columbia* by David W. Nagorsen and R. Mark Brigham, UBC Press, University of British Columbia, 6344 Memorial Road, Vancouver, BC V6T 1Z2.

*Field Guide for the Identification of Snags and Logs in the Interior Columbia River Basin.* USDA, Forest Service, PNW Region Gen. Tech. Report. PNW-GTR-390. Portland, OR. March 1997.

*Trees and Logs Important to Wildlife in the Interior Columbia River.* USDA, Forest Service, PNW Region Gen. Tech. Report. PNW-GTR-391. Portland, OR. May 1997.

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