Pallid Bat

Antrozous pallidus

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GENERAL RANGE AND WASHINGTON DISTRIBUTION

The pallid bat (*Antrozous pallidus*) is the second largest bat in Washington. The species ranges from central Mexico northward through western Texas, New Mexico, Arizona, southern and western Colorado, south-central Utah, western Nevada, California, Oregon, eastern Washington, western Idaho, and north to the southern Okanagan Valley of British Columbia (Orr 1954, Shryer and Flath 1980, Hermanson and O'Shea 1983, Verts and Carraway 1998).

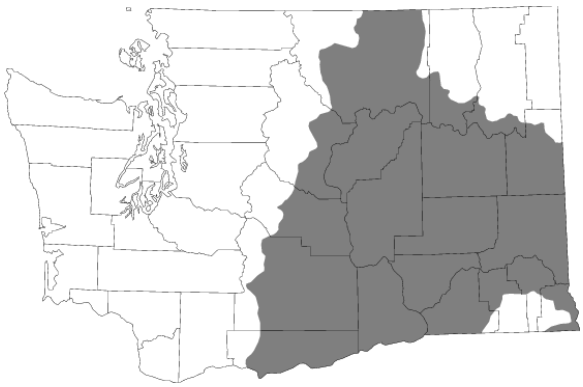

Figure 1. Range of the pallid bat (*Antrozous pallidus*) in Washington (Johnson and Cassidy 1997).

The range of the pallid bat in Washington includes potential locations throughout eastern Washington, with the exception of much of the northeastern corner of the state and the east-slope of the Cascades (see Figure 1; Johnson and Cassidy 1997). The pallid bat has been captured or visually documented in Clark, Skamania, Benton, Douglas, Grant, Klickitat, Spokane, and Yakima counties. Gitzen et al. (2002) captured 16 pallid bats at the Hanford Site where this species comprised 27% of the total number of identified calls. Hibernation behavior is poorly known. O'Farrell and Bradley (1970) reported winter activity in Nevada; however, no winter records are known from Washington or British Columbia (Nagorsen and Bingham 1993).

RATIONALE

The pallid bat is classified as a Priority Species in Washington due its propensity to congregate in large numbers. Significant bat losses can result from individual disturbance events occurring near these congregation areas. The pallid bat is a Threatened species in Canada (Willis 1999, Environment Canada 2003) and critically imperiled in Idaho and Montana (Idaho Conservation Data Center 2003, Montana Natural Heritage Program 2003). The U.S. Forest Service ranks the subspecies *Antrozous pallidus pacificus*, that has a range limited to southwest Oregon, as a sensitive species (P. Ormsbee, personal communication). The pallid bat seems to have suffered declines in some areas, although in other areas it might just be naturally rare (Chapman et al. 1994). Additional research is necessary in Washington because the status and population trends of this species are essentially unknown.

HABITAT REQUIREMENTS

The pallid bat generally inhabits arid areas with rocky outcrops and vegetation dominated by dry shrub or dry forested habitat near water (Orr 1954, van Zyll de Jong 1985). Pallid bats prefer arid and semi-arid climates with an average rainfall of 20-38 cm/year (8-15 in) (Vaughan and O'Shea 1976, van Zyll de Jong 1985) and an average summer daily maximum temperatures up to 38 EC (100 EF) (Vaughan and O'Shea 1976). This species is closely associated with arid desert, canyons, karst formations, and grasslands throughout its range (Hermanson and O'Shea 1983, van Zyll de Jong 1985, Nagorsen and Bingham 1993). It also is associated with rock cliffs in shrub-steppe or desert areas across the west (van Zyll de Jong 1985, Holroyd et al. 1994). Typical shrubs in areas where pallid bats occur include antelope bitterbrush (*Purshia tridentata)*, sagebrush (*Artemesia* spp.), rabbit-brush (*Chrysothamnus* spp.), and forest cover types including ponderosa pine (*Pinus ponderosa*) along lower slopes, and riparian forests (van Zyll de Jong 1985). In British Columbia the pallid bat occurs in arid grasslands and ponderosa pine forests near cliff faces (Nagorsen and Bingham 1993). In western Oregon, this species is associated with oak-woodlands and grasslands, and ponderosa pine forests in the foothills surrounding the Rogue and lower Willamette River valleys (Cross and Waldien 1995, P. Ormsbee, personal communication). Pierson (1998) reported that pallid bats were associated with oak (*Quercus* spp.) woodlands, ponderosa pine, redwoods (*Sequoia sempervirens*) and giant sequoias (*Sequoiadendron giganteum*) in northern California. In Arizona, pallid bats were captured in the arid ponderosa pine-oak habitat (Morrell et al. 1999). Forested habitat selected by this species consists of riparian forest along lakeshores and streams, and dry forest dominated by ponderosa pine on the lower slopes (Genter and Jurist 1995).

Feeding

The pallid bat has been observed foraging close to the ground, along the base of cliffs, and over lava flows (Whitaker et al. 1981). They forage primarily in uncluttered, sparsely vegetated habitats. In British Columbia, radio-tagged pallid bats foraged primarily in large tracts (>0.5 km [0.3 mi] in length) of exposed, sandy soil with sparse vegetation consisting primarily of sagebrush, greasewood (*Sarcobatus vermiculatus*), rabbit-brush, cheatgrass (*Bromus tectorum*), and bunchgrasses (e.g. *Pseudoroegneria spicata*, *Festuca idahoensis*, *Poa sandbergii*) (Nagorsen and Bingham 1993, Chapman et al. 1994).

The pallid bat is a terrestrial forager, taking large, ground-dwelling or slow-flying prey (Hatt 1923, O'Shea and Vaughan 1977, Bell 1982). Pallid bats feed on a variety of invertebrates that include but are not limited to beetles (Coleoptera), moths (Lepidoptera), and crickets (Orthoptera) (Verts and Carraway 1998). While foraging, the pallid bat flies within a few meters of the ground and lands to pursue and capture prey. Bats that are terrestrial foragers search for prey over sparsely vegetated areas locating their prey by the low frequency (4-8 kHz) rustling sounds produced by prey on the ground rather than by using echolocation (i.e., the use of echoes to determine the direction and distance of objects) (Brown et al. 1978, Bell 1982, van Zyll de Jong 1985). Pallid bat populations would likely be adversely impacted if foraging habitats become more densely vegetated as a result of expansion of development, agriculture, or irrigation (Chapman et al. 1994).

Roosts

Pallid bats roost in caves, mines (van Zyll de Jong 1985), open man-made structures such as porches and garages (van Zyll de Jong 1985, Lewis 1996), cliff overhangs (Hermanson and O'Shea 1983, Lewis 1996), rock crevices, trees and tree cavities (Nagorsen and Bingham 1993), and under abandoned bridges (van Zyll de Jong 1985, Lewis 1994, Pierson et al. 1996). In British Columbia, this species uses ponderosa pine as night roosts (Nagorsen and Bingham 1993).

Most pallid bats roost in groups ranging from 20 to 200 individuals (Vaughan and O'Shea 1976). Group size is important to conserve energy and is also important for the growth of young. Young animals occupy the center of clusters while individuals outside of clusters experience higher rates of weight loss (Trune and Slobodchikoff 1976, 1978). Group numbers peak in maternity colonies during late-July and early-August, when young bats are weaned and capable of flight. Prior to this, males roost separately from females (O'Shea and Vaughan 1977). Pallid bats will not use the same roost for both night and day (Lewis

1994). The pallid bat is known to roost with a number of other species of bats, principally Myotis (*Myotis* spp.) and Brazilian free-tailed bats (*Tadarida brasiliensis*) (Vaughan and O'Shea 1976, Tatarian 1999). Bats may switch roosts to reduce their parasite load (Fleming 1988), avoid disturbance or predation (Kunz 1982), acquaint young with future roost sites (O'Shea and Vaughn 1977), or respond to changing roost conditions (Lewis 1995).

Males are relatively nomadic, live singly or in small groups, and can exist in harsher environments than females (Chapman et al. 1994). Males can be gregarious when roosting apart from females. Up to 60 males have been found in day roosts (Dalquest 1947) and over 100 in night roosts (Davis and Cockrum 1963). Males also may select areas of low ambient temperature for hibernation (Chapman et al. 1994). In contrast, both sexes roost together from September through March during hibernation (Chapman et al. 1994).

Day roosts. Pallid bats spend most of their time in day roosts (Vaughan and O'Shea 1976, Chapman et al. 1994). In general, pallid bats show a high degree of flexibility in their choice of day roosts. However, day roosts are usually in more enclosed protected sites as compared to night roosts (Tatarian 1999). The day roost is usually in a warm, horizontal crevice, most often a rock crevice (Holroyd et al. 1994). Pallid bats have also been found roosting in rock cracks, holes, tree hollows, behind tree bark, under rock overhangs, mud tubes or cracks in basalt, bridges, caves, mines, and buildings (e.g., porches, walls, attics, eaves) (Bell 1980, Hermanson and O'Shea 1983, Brown et al. 1997, Tatarian 1999).

Trees selected for day roosting by reproductive females tended to be large in diameter (dbh) (average = 66 cm [26 in] dbh). Roost trees were also surrounded by a higher density of snags, logs, and trees (large diameter [>61.0 cm (24 in) dbh] trees) had a higher surrounding basal area, and were more likely to have loose bark compared to random snags (Rabe et al. 1998). Most females roosted under loose, exfoliating bark of large diameter ponderosa pine snags (Rabe et al. 1998). Roosts often consisted of large sheets of loose bark that surrounded the snag and could provide a variety of microclimates advantageous to bats. Large diameter snags may be selected for their thicker exfoliating bark to provide greater insulation for reproductive females (Rabe et al. 1998). Alternate roosts are chosen frequently during the summer when young first begin to fly. Rallying and relocation of roosts may serve to aid young in achieving skill at finding retreats (O'Shea and Vaughan 1977).

Pallid bats in Oregon and Arizona favor rock slabs on cooler days and rock crevices on warmer days (Vaughan and O'Shea 1976, Lewis 1996). Lewis (1996) also found that roosts tended to open to the south or southeast for morning warmth and protection from intense afternoon sun. Horizontal crevices with stable warm temperatures of 30° C (86E F) are preferred as summer day roosts. Vertical crevices with widely fluctuating ambient temperatures are often selected during cooler seasons (Hermanson and O'Shea 1983).

Maternity roosts. Maternity roosts can serve as day roosts, provide protection from predators, and provide optimal conditions for gestating and lactating females and their developing young (Humphrey 1975). Only females care for young within maternity roosts. Pallid bat maternity roosts have been found in ponderosa pine snags (Rabe et al. 1998), in rock crevices, within spaces behind exfoliating rock , and "potholes" in rock-overhangs (Lewis 1996). A number of maternity sites have been found under bridges in southwestern Oregon, and fidelity to these sites is evident from year to year (P. Ormsbee, personal communication). In central Oregon, reproductive females tended to roost in spaces behind exfoliating rock when the daily maximum temperature was below the summer average (32° C) and in rock crevices when temperatures were higher than average. Maternity roosts faced south-southeast (Lewis 1996). Pregnant pallid bats used both crevices and "slabs," while lactating females used only crevices. Snags used as day roosts were located higher on slopes and closer to water as compared to random snags (Rabe et al. 1998).

Night roosts. Night roosts are very important for pallid bats. Night roosts may be used for digestion and energy conservation, to provide shelter from predators, to serve as centers of information exchange about food resources, and to aid in social interaction. After feeding, pallid bats spend up to several hours at a night roost (Lewis 1994). O'Shea and Vaughan (1977) reported that pallid bats in Arizona spent 40-60% of their entire summer activity period in night roosts. For individual bats (e.g., bats not in maternity

colonies), night roosts are often more open than day roost crevices, but are normally protected from the weather.

Buildings, rock overhangs, bridges (Lewis 1994), caves, and mines (Howell 1980) have been reported to contain roosting pallid bats. In British Columbia, radio-tagged pallid bats used live ponderosa pine trees as night roosts (Chapman et al. 1994). Night roosting appears to be widespread under bridges (Barbour and Davis 1969, Lewis 1994, Keeley and Tuttle 1996, H. Ferguson, personal observation), and these roosts are a reasonable indicator of the presence or absence of pallid bats (Pierson et al. 1996). In California, Pierson et al. (1996) found that concrete girder bridges were used but unmodified box girder bridges were not used for night roosting. This study parallels Lewis's (1994) findings in Oregon, and suggests that bridge structure plays an important role in roost selection.

Lewis (1994) reported night-to-night and year-to-year fidelity to night roosts in a two-year study in Oregon. In Arizona, O'Shea and Vaughn (1977) found that females showed roost fidelity during late pregnancy and lactation, but not during the spring and autumn. In California, pallid bats exhibited fidelity to night roosts (Pierson et al. 1996).

Winter roosts - hibernacula. Pallid bats use buildings, rock crevices, mines, and caves as hibernacula (Nagorsen and Bingham 1993). In areas of mild climate or sites with stable microclimates that permit hibernation (Humphrey 1975), winter roosts may also be used as daytime roosting sites. Winter habits are poorly known for this species and pallid bats are presumed to hibernate. They have been seen hibernating in vertical cracks along the ceiling of a Nevada mine (Alcorn 1944). There is speculation that they hibernate in the vicinity of their summer range; however, there are few winter records to support this assumption. No winter roost sites are known from British Columbia (Nagorsen and Bingham 1993) or Washington.

LIMITING FACTORS

The pallid bat is a colonial species and at times appears to be particularly sensitive to human disturbance (Lewis 1996). O'Shea and Vaughan (1977) found that during warm summer months when night roost temperatures were high, pallid bats showed no tolerance for disturbance by observers. Once the observers were detected, the bats fled the roost immediately; however, during the cooler months bats appeared to enter a deeper state of hibernation and were less susceptible to disturbance (O'Shea and Vaughan 1977). Accordingly, Morrell et al. (1999) suggest that intensive forest management practices in ponderosa pine habitats during the summer months may adversely affect reproductive success. Some researchers have stated that any human activity (e.g., logging, industrial projects, hiking, and rock climbing) that disturbs the bats in their night roost, day roosts, or foraging grounds could potentially cause pallid bats to move out of an area (O'Shea and Vaughan 1977, Hoffmeister 1986, Miller 2000). Fidelity of pallid bats toward roosts, especially night roosts, makes them even more vulnerable to disturbance (Lewis 1994, Pierson et al. 1996).

Use of caves and mines as roost sites also places this species in jeopardy with regards to closure projects (Howell 1980, van Zyll de Jong 1985, Nagorsen and Bingham 1993). Mines are an important roosting habitat that concentrates large numbers of bats. This concentration of bats in relatively few roosts makes them vulnerable to disturbance and eradication (Tuttle and Taylor 1994).

Because habitat loss from conversion of sagebrush-steppe is on the increase in Washington (Washington State Department of Natural Resources 1998), it is likely that this factor has further limited pallid bat numbers. The reduction of open foraging areas due to development and cattle grazing may degrade foraging areas and reduce prey diversity and density (Chapman et al. 1994).

Bridges can be important for night roosting (Barbour and Davis 1969, Lewis 1994; H. Ferguson, personal observation). Bats use parallel box beam design bridges as day roosts more than any other type of bridge. The next most preferred bridge designs are cast in place or made of pre-stressed concrete girder spans (Keeley and Tuttle 1996). A general trend of highway departments is the use of smooth design bridges with few if any crevices, thereby offering little potential roost sites for the pallid bat.

The preference for ponderosa pine trees as night and maternity roosts in British Columbia points to the importance of this tree species to the pallid bat (Chapman et al. 1994). Loss of tree roosts may occur through commercial timber harvest (Morrell et al. 1999).

This species roosts in snags that are often associated with foothill habitats such as ponderosa pine or oak - savanna that are susceptible to urban growth pressures (Pierson and Rainey 1998, P. Ormsbee, personal communication). In addition to direct effects of habitat loss from urban growth, indirect effects also arise from fire suppression activities that modify forest/valley transition areas (P. Ormsbee, personal communication).

Since the pallid frequently uses human structures, the feral domestic cat poses a threat to this species (Tuttle 1996, Coleman et al. 1997, The Mammal Society 1998, Crooks and Soule 1999). Crooks and Soule (1999) estimated that cats surrounding a moderately sized area (approximately 100 residences) returned about 2000 small vertebrates to residences/year.

Pesticides, especially those used in fruit-growing areas, can harm the pallid bat due to poisonings from contaminated insect prey (Collard 1991, Chapman et al. 1994, Environment Canada 2003). Bats in colder regions may be more affected by pesticides than those in warmer climates (Fenton 1983, Collard 1991). There have been records of widespread bat mortality due to bad weather in association with pesticide poisoning (Fenton 1983). Pesticides may have the greatest detrimental affect on young of the year that rely on their fat reserves when switching from nursing to foraging, and later during migration to hibernation (Collard 1991).

Wind power facilities have been shown to adversely impact wildlife, especially birds (e.g., Orloff and Flannery 1992, Leddy et al. 1999, Woodward et al. 2001, Hunt 2002, USFWS 2003) and some bats (Keeley et al. 2001, Johnson et al. 2002, West 2002, Johnson 2003, West 2003). No direct impacts to pallid bats have been reported in these studies. This may be due to the fact that no wind power projects have been situated in known pallid bat habitat.

MANAGEMENT RECOMMENDATIONS

Lack of knowledge about the biology of the pallid bat severely hinders our ability to protect and manage the life history requirements necessary to sustain and enhance Washington populations. Clearly, further research is required to more effectively manage pallid bat habitat. In order to fill these knowledge gaps, surveys need to be conducted in eastern Washington to identify pallid bat roost sites.

Because of habitat loss due to conversion and development (Chapman et al. 1994), all known roost sites of the pallid bat need to be protected from human activity when there is potential conflict (especially hibernacula and maternity roosts). Given that pallid bats are closely associated with steep rocky cliffs and rock outcrops in arid habitats (particularly those near water) (Orr 1954, Vaughn and O'Shea 1976, Whitaker et al. 1981, van Zyll de Jong 1985,), these areas should be preserved and protected where pallid bats are known to occur. In light of the fact that conversion of sagebrush-steppe is increasing in Washington (Washington State Department of Natural Resources 1998), future conversions should be avoided and restoration of potential habitat is recommended. Minimizing conversion of foraging habitat that is in close proximity to suitable roosting habitat is most important from a conservation perspective.

In areas where large maternity or hibernacula roosts are known to exist, applying either spatial or temporal restrictions can minimize the impact of forest management practices. Logging operations in areas with known maternity colonies should be restricted during May to August. If operations must take place during these months, a buffer area around the maternity site should be identified. A qualified wildlife biologist with a background in bat ecology should be consulted when setting buffer widths. These same restrictions should be applied to other activities (e.g., industrial, hiking, rock climbing, etc.) that may impact a maternity site or hibernaculum because many researchers have identified potential impacts (see O'Shea and

Vaughan 1977, Hoffmeister 1986, Miller 2000), especially during the warm summer months (O'Shea and Vaughan 1977, Lewis 1996).

Since pallid bats use caves and mines as roost sites (Howell 1980, van Zyll de Jong 1985, Nagorsen and Bingham 1993), all caves and mines within the range map of the pallid bat should be surveyed to determine the presence or absence of bats following appropriate survey protocols (Tuttle and Taylor 1994, Washington Department of Fish and Wildlife [WDFW] 1994, Altenbach 1995, Riddle 1995). If bats are detected and if there is potential for human disturbance in a cave, then bat-friendly gates should be installed (Dalton and Dalton 1995, Pate 1995, Riddle 1995). Some other general recommendations for bat-occupied caves are: buffer zones should be established when appropriate; all efforts should be made to reduce or eliminate access; avoid activities that affect the climatic quality of the cave; logging should not occur around the cave; caves containing maternity colonies should be closed from 1 May through 30 August; and, caves containing hibernacula should be closed from 1 November through 1 April (WDFW 1994).

Bridges have also been shown to be important night roosts for the pallid bat (Barbour and Davis 1969, Lewis 1994). Therefore, as many new bridges as possible should incorporate bat-friendly designs (Keeley and Tuttle 1996, 1999), and older bridges should be retrofitted following bat friendly designs (Keeley and Tuttle 1996). Bat-friendly habitat can be provided in either new or existing bridges or culverts, at little or no extra cost. For a thorough discussion of bridge construction and retrofitting see www.batcon.org/bridge/ambatsbridges/index.html.

To reduce bat predation near residential areas, pet-owners should refer to www.abcbirds.org /cats/brochure/brochure.htm for recommendations.

Because pesticides can potentially harm the pallid bat (Collard 1991, Chapman et al. 1994, Environment Canada 2003), the use of pesticides within the range of this species should be minimized, particularly around areas with known maternity colonies and hibernacula. In general, pesticide use around caves, wetland and riparian areas should be restricted or closely controlled. Review Appendix 1 for contacts to assist in assessing the use of chemicals and other alternatives if their use is planned in such areas.

With the increase of wind power plants in the Pacific Northwest and their potential negative impact on bats (Keeley et al. 2001, Johnson et al. 2002, West 2002, Johnson 2003, West 2003), all proposed projects within the range of pallid bats need to identify potential impacts, especially if a project is near a maternity or hibernacula site. The impact of wind power on pallid bats and other bat species needs further study.

Because some researchers suspect that foraging areas are impacted by livestock grazing (Chapman et al. 1994), it is suggested that land managers reduce grazing, use deferred rotation or rest-rotation grazing systems, and space water developments to disperse livestock to mitigate the effects of grazing on this species' habitat.

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PERSONAL COMMUNICATIONS

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KEY POINTS

Habitat Requirements

- Pallid bats roost in a variety of substrates in or around grasslands and vegetation dominated by dry shrub or dry forested habitat near water and in arid and semi-arid climates with an average rainfall of 20-38 cm/year (8-15 in) and an average summer daily maximum temperatures up to 38E C (100E F).
- This species has been found to roost in rocky outcrops, karst formations, caves, mines, mud tubes, basalt cracks, open man-made structures (e.g., porches and garages), cliff overhangs, rock crevices, trees and tree cavities, and under bridges.
- Typical shrubs in areas where pallid bats occur include antelope bitterbrush, sagebrush, rabbit-brush, and forest cover types including ponderosa pine along lower slopes, and riparian forests.
- Forested habitat used by pallid bats consists of riparian forest along lakeshores and streams, and dry forest dominated by ponderosa pine on lower slopes.
- They forage primarily in large (>0.5 km [0.3 mi] in length) uncluttered, sparsely vegetated habitats.
- Reproductive female bats select day roost trees that are large in diameter (average = 66 cm [26 in] dbh) having loose exfoliating bark and surrounded by high densities of snags, logs, and trees of large diameter (>61.0 cm [24 in] dbh).
- The pallid bat is a terrestrial forager, taking large, ground-dwelling or slow-flying prey.
- Pallid bats seem to favor rock slabs on cooler days and rock crevices on warmer days.
- Roosts tend to open to the south or southeast for morning warmth and protection from intense afternoon sun.
- Horizontal crevices with stable warm temperatures of 30° C (86E F) are preferred as day roosts during the summer.

Management Recommendations

- Identify pallid bat roost sites.
- Preserve and protect steep rocky cliffs and rock outcrops in arid habitats, particularly those near water.
- Protect pallid bat roost sites, placing these sites off limits to human activity when there is potential conflict (especially hibernacula and maternity roosts).
- Avoid shrub-steppe conversions, especially in close proximity to suitable roosting habitat.
- Avoid disturbance of hibernacula sites at all times if possible, but in particular from May through August. If disturbance cannot be avoided or delayed, establish buffers surrounding site.
- Survey all caves and mines within the range of the pallid bat following appropriate survey protocols. If bats are detected, then bat-friendly gates should be installed.
- Design new bridges and retrofit older bridges following bat-friendly designs.
- See http://www.abcbirds.org/cats/brochure/brochure.htm for information to reduce predation of bats and birds by domestic cats.
- Decrease the use of pesticides within the range of the pallid bat, particularly around areas with known maternity colonies and hibernacula.
- Analyze the impact of all proposed wind power projects within the range of the pallid bat, especially when a project is near a maternity or hibernacula site.
- Reduce livestock grazing, use deferred rotation or rest-rotation grazing systems, and space water developments to disperse livestock to minimize the effects of grazing on pallid bat habitat.