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Conservation Assessment for the Northern Saw- whet Owl in the Black Hills National Forest, South Dakota and Wyoming

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INTRODUCTION

This report assesses the biology and conservation status of the northern saw-whet owl (*Aegolius acadicus*) in the Black Hills National Forest of South Dakota and Wyoming. The goal of this assessment is to assimilate historic and current literature on the northern saw-whet owl and to provide managers and the general public an objective overview of this species' status within the Black Hills. In general, peer-reviewed scientific literature was used in this report; however, use of unpublished federal and state government reports, as well as academic documents (Master's theses) provided additional valuable insight.

Little has been published on the northern saw-whet owl in the Black Hills region of South Dakota and Wyoming. Therefore extrapolation of information across geographic lines was necessary. This extrapolation assumed that behavior and biology of these owls were similar across geographic regions. Efforts were made to use literature that was based on geographic areas as close to South Dakota and Wyoming as possible.

Areas Of Uncertainty

The saw-whet owl is a small, secretive bird. Because of this, exact limits of breeding and nonbreeding ranges are not clearly understood and likely vary annually (Cannings 1993). Some authors show range maps that do not include the Black Hills region in the saw-whet owl's breeding range, while others do show this area as having breeding birds. It is not clear whether saw-whets breed only, winter only, or are present year-round in the BHNF.

Extrapolation of information regarding species across geographic lines can be cause for concern. No region in North America is an exact match in forest composition, elevation etc., so responses of Northern saw-whet owls in the Black Hills may be different compared with habitat selection or prey selection by owls elsewhere. Because little has been published concerning saw-whet owls in the Black Hills, extrapolations were necessary. However, the saw-whet is one of the most common and widespread forest owls in the coniferous forests of the North America, so adequate information on the biology and habits of this bird was available for this report.

CURRENT MANAGEMENT SITUATION

Management Status/Existing Management Plans

Confined to the Northern Hemisphere, saw-whet owls are found throughout southern Canada, the western and northeastern United States. Though present, saw-whets are absent as a breeding species in the Great Plains, and southeastern United States. Neither the U.S. Fish and Wildlife Service nor the U.S. Forest Service lists Saw-whets as having special conservation status. Concurrently, neither the Wyoming Natural Heritage Database (online 2001) nor the Wyoming Game and Fish Department (Luce et al. 1999) lists this species as having special management status.

Within South Dakota, the northern saw-whet owl is a species of special interest and is listed on the Natural Heritage Species List (NHSL). Birds listed are of special interest because of few

sightings, and/or questions about the birds breeding status, abundance and distribution. Species are ranked according to rarity and risk of extirpation on a 1-5 scale, with 1 being the rarest and most at risk and 5 being secure. The northern saw-whet owl is assigned a 3 according to this scale (Peterson 1995).

There are two subspecies of the northern saw-whet owl; *A. a. acadicus*, found throughout northern North America; *A. a. brooksi* found only on the Queen Charlotte Islands off British Columbia. Aside from general habitat preferences, and the fact that its range is restricted to the Queen Charlotte Islands, little is known about this owl. Thus, it has been placed on the British Columbia Ministry of Environment's Blue List of vulnerable taxa (Gill and Cannings 1997).

REVIEW OF TECHNICAL KNOWLEDGE

Systematics/Taxonomy

The northern saw-whet owl is a robin-sized inhabitant of the temperate coniferous forests of North America. Females are generally larger than males averaging 20-21.5 cm in length and weighing between 100 - 150 g. Males average 18-20 cm and weigh about 75 gms. The head is large, round and flat-topped with fine white streaks extending up from the facial disk, over the top of the crown of the head. The facial disk is and the bill is dark. Ear tufts are absent. The irides are generally yellow with golden being a more prominent color in adults (Cannings 1993). The wings are rounded and the tail short; both are spotted white. Adults are brown on the back with white spots. The chest is white with brown streaks (Farrand 1988).

Juvenile saw-whet owls lack the white spotting of the adults on the back but are spotted on the wings and tail. The chest and belly are generally darker brown or buff, and lack spotting. The face is darker, with a blackish-brown facial disk, and possesses a white Y-shaped mark running between and above the eyes (Cannings 1993).

Distribution And Abundance

Overall Range

As stated previously, the northern saw-whet owl's range is exclusive to North America. Resident populations exist along the edge of the boreal forest zone from the southern boundary of Alaska, across most of Canada, into the northern tier of states from Maine to Minnesota. The Rocky Mountains, from British Columbia into Mexico, and the Cascade Range, Coastal Range, and Sierra Nevada Mountains all support year-round populations. Cannings (1993) suggests that saw-whets are found in most woodland habitats, with the highest densities found in coniferous forests at moderate elevations and latitudes. Nonbreeding birds are found in winter throughout the remainder of the United States, presumably at lower elevations and latitudes.

Local Distribution

The South Dakota Breeding Bird Atlas (SDBBA) (Peterson 1995) considers the northern saw-whet owl an uncommon and local bird. It reports 19 sightings, all in the Black Hills region. Only three breeding records were confirmed, two were probable, and 14 were possible (counties included in these sightings were Fall River, Custer, Pennington, Lawrence and Meade). The

SDBBA suggests that although the saw-whet has not been reported outside the Black Hills region, previous records indicate that it should be looked for in other parts of the state. In agreement with this statement, a sighting was recorded in Roberts County, with a historical record from Clay County (South Dakota Ornithologists' Union 1991).

Local Abundance

Based on the few sightings that have been reported in South Dakota, it is easy to assume that the abundance of saw-whet owls is low in the Black Hills. However, saw-whet owls are secretive birds and thus detection can be difficult unless specifically seeking them. Based on suitable habitat existing within the Black Hills National Forest, it is probable that the abundance of saw-whet owls is higher than the SDBBA suggests.

Population Trends

Little information has been published on population trends of the northern saw-whet owl. It is absent from both the North American Breeding Bird Survey (Sauer et al. 2000) and the Christmas Bird Count analyses (Sauer et al. 1996). Cannings (1993) estimated that the entire population was between 100,000 and 300,000 individuals, and that numbers are probably slowly declining with loss of suitable habitat. This probably holds true for saw-whets in the Black Hills.

Broad-Scale Movement Patterns

Significant numbers of saw-whet owls migrate south in autumn, although some birds likely remain in winter throughout the breeding range. Two migration routes have been documented in eastern North America. The first runs from central Ontario through the Ohio River valley and into Kentucky. The second follows the Atlantic Coast from Nova Scotia into North Carolina (Holroyd and Woods 1975). There is also a broad migration front that runs around the Great Lakes, along which birds disperse south and east (Erdman et al. 1997). Migration routes of saw-whet owls in the western United States are unknown (Cannings 1993).

It has been suggested that northern saw-whet owls in the Snake River Birds of Prey Area, Idaho are nomadic (Mraks and Doremus 2000). Between 1987 and 1999, 52 adult owls and 139 nestlings were banded. Only one of these birds was recaptured in the study area. Overall, numbers of saw-whet owls on the study area were positively correlated with an index of rodent abundance. This suggested the owls were settling to breed in areas of greatest food availability (Marks and Doremus 2000).

Habitat Characteristics

General Habitat/Macro And Microhabitat Requirements

Because habitats that are used during migration and for wintering are not very well known, *general* habitat will be used synonymously with *breeding* habitat. Saw-whet owls are versatile in their habitat use; they are found in a variety of woodlands and forest types throughout their range (Cannings 1993, Palmer 1986). However, coniferous forests support the highest known densities, especially along riparian corridors (Cannings 1993, Jones 1991, Palmer 1986, Hayward and Garton 1988). In the western U.S., saw-whets are found in higher densities in the mountains at lower- to middle- elevation coniferous forests; subalpine forests generally support

much lower numbers (Cannings 1993).

Observations of saw-whet owls in the western U.S. have found the birds in areas consistent with general habitat descriptions. Palmer (1986) compared habitat use between boreal owls (*Aegolius funereus*) and saw-whet owls in northern Colorado. Saw-whets inhabited a greater variety of habitats than Boreal Owls, including riparian areas at 1900 meters, and spruce-fir forests at 3000 meters. Both species avoided large unbroken stands of lodgepole pine (*Pinus contorta*). At the microhabitat level, saw-whet owls were found primarily in riparian areas but did use stands of blue spruce (*Picea pungens*), Douglas-fir (*Pseudotsuga menziesii*), and ponderosa pine (*Pinus ponderosa*). Due to the mesic nature of saw-whet territories, ground cover was varied.

Deciduous cover was more prevalent in saw-whet territories, and tree height was shorter than in boreal owl territories. Compared with the boreal owl, the saw-whet was found to be generalist with respect to habitat selection and use.

Other studies in the western U.S. have found similar results. Hayward and Garton (1988) found that saw-whet owls in central Idaho preferred riparian, non-deciduous forest stands with a well-developed mid-canopy layer and low shrubs. Jones (1991) found saw-whets within ponderosa pine forests and ponderosa pine/Douglas-fir forests between 1700-3100 meters in Boulder County, Colorado. Webb (1982) found saw-whets at higher elevations (1930-3100m) in northern Colorado, but they encompassed an array of habitats from Gambel Oak (*Quercus gambelii*)/ponderosa pine ecotones, to aspen (*Populus tremuloides*) surrounded by lodgepole pine, to spruce-fir forests. Marks and Doremus (1988) found the saw-whet in southwestern Idaho nesting in riparian willow/Russian olive amidst shrub steppe desert, a very unusual habitat for the species.

Few studies have been published regarding home range sizes of saw-whet owls. Cannings (1987) reported home ranges for male owls to be 142-159 ha. However, these numbers are based on only two transmittered owls tracked for 20 hours each.

The above descriptions of general habitat in the western United States illustrates the diverse range of habitats that are exploited by saw-whet owls. With such a geographically wide-ranging species, one can expect that saw-whets will be able to use the many different habitats that they encounter both in breeding ranges, migration routes and winter ranges.

Roosting Habitat

Roosting stands tend to be much denser than nesting stands (Hayward and Garton 1984). Thick conifer stands are preferred when available, but saw-whets will also roost in willow thickets along riparian corridors. Roosting occurs during the day. Breeding males may use a different roost daily (Hayward and Garton 1984), while non-breeding birds may use the same roost site for weeks or months at a time (Cannings 1993). Based on four studies, the average roost tree was 13.6 meters tall with a DBH of 32.0 cm, roost height was 3.5 meters, and the bird perched 71.2 cm from the trunk of the tree (Cannings 1987, Hayward and Garton 1984, Grove 1985, Swengel and Swengel 1992).

Foraging Habitat

Foraging habitat appears to be as varied as breeding habitat for saw-whet owls. Hunting occurs along edges or openings in the forest (Cannings 1993). Clearly, habitat occupied will have some

bearing on where hunting occurs. In southwestern Idaho, saw-whet breeding habitat consists of shrub-steppe/sage flats adjacent to riparian corridors. Trees, though scarce, included Willow (*Salix* spp.), Russian Olive (*Elaeagnus angustifolia*), and Black Locusts (*Robinia pseudoacacia*) (Marks and Doremus 1988, Rains 1997). Owls on the Queen Charlotte Islands use the intertidal zone to hunt invertebrates, which illustrates the wide array of foraging habitats and behaviors exhibited by the saw-whet (Sealy 1999).

Food Habits

Food habits of the saw-whet owl are well documented. Small mammals make up the majority of the saw-whet diet, particularly woodland mice (Cannings 1987, 1993). Birds are taken in smaller proportions, mainly in the spring (Hayward and Garton 1988, Johnsgard 1988, Cannings 1993). Some observational studies suggest that prey is taken in proportion to what is available. In Colorado, small mammal trapping in saw-whet territories showed that the deer mouse (*Peromyscus maniculatus*) was most abundant, whereas in boreal owl territories the red-backed vole (*Clethrionomys gapperi*) was the most abundant small mammal (Palmer 1986). Subsequent pellet analysis showed selection for each of these species by the owls.

Similar to findings by Palmer, Cannings (1987) found deer mice to account for 94% of the small mammals trapped in pine/fir study sites in British Columbia. Concurrently, deer mice made up 84% of saw-whet diets in the study. Hayward and Garton (1988) found deer mice to be the most common prey species taken by saw-whets, with shrews (*Sorex* sp.) the next most common.

Small mammals dominate the prey base for saw-whets, but the deer mouse is not the dominant prey item in all parts of their range. In other parts of their range, saw-whets rely on other prey species besides *Peromyscus*. In Idaho, the house mouse (*Mus musculus*), harvest mouse (*Reithrodontomys megalotis*) and the montane vole (*Microtus montanus*) were taken in greater numbers than deer mice in two studies (Rains 1997, Marks and Doremus 1988).

The saw-whet owl is an opportunistic feeder, taking a wide variety of prey species. The literature is not clear whether these owls are taking those small mammals that are most abundant in their territories or selecting territories based on densities of preferred prey species.

Breeding Biology

Palmer (1986) described the phenology of saw-whet owl courtship vocalizations for northern Colorado. Males sing as early as late January and continue until late April. The call is a series of monotonous notes of constant pitch of about 1100 Hz and can be heard from sunset to sunrise (Cannings 1987). Wind and precipitation (especially a combination of the two) can severely affect calling activity, while temperature seems to have little effect (Palmer 1987). Palmer suggested that both saw-whet and boreal owl singing frequency on an annual basis is correlated with prey availability. Males sing more in years of greater small mammal abundance as the odds of raising young will be better in those years.

Courtship Characteristics

Female are attracted to the advertising song of males. Once seen, it has been reported that the female is circled in flight by the male as many as 20 times before alighting next to her. A series of bobbing and shuffling maneuvers ensues, sometimes accompanied by the male giving the

female a “gift” of a mouse or other such prey item. Copulation occurs at mid-height within a tree, lasting only a few seconds, but is repeated several times per night for consecutive nights.

Nest Characteristics

Northern saw-whet owls are secondary cavity nesters, commonly using existing woodpecker nest cavities. Northern flicker (*Colaptes auratus*) nest holes seem especially desirable (Cannings 1993, Farrand 1988, Palmer 1986, Webb 1982). Nest boxes with dimensions of 17.5 cm x 17.5 cm floors and entrance diameters of 75mm are readily used (Cannings 1993). Diameters of trees on which boxes were placed, or trees within stands where boxes were placed were not available.

Clutch Initiation And Size

In southern British Columbia, and southwest Idaho, clutch initiation occurs in mid March but can begin as early as late February (Cannings 1987, Marks et al. 1989, Cannings 1993). Nesting records from New England suggest initiation occurs between late March and mid-April (Johnsgard 1988). Clutch size is largest to the north and decreases to the west (Murray 1976). Usually five or six eggs are laid at two-day intervals. Incubation, by the female only, lasts for 27 - 29 days (Cannings 1987).

Parental Care

During incubation, the female stays in the nest and is provided for by the male. After the youngest nestling reaches 18 days old, the female leaves to roost elsewhere, and either helps the male provide food for the young, or may simply leave. If the female leaves, the male continues to provide the nestlings with food until independence (Cannings 1993).

Mate And Site Fidelity

The saw-whet owl is normally monogamous, but polygyny may occur in years of abundant prey and abundant nest sites (Marks et al. 1989, Cannings 1993). One case of apparent trigyny (one male mating with and providing for three separate females) was reported in Idaho (Marks et al. 1989).

Nest-site fidelity is poorly understood. Cannings (1987) reported that saw-whets are not strongly philopatric. One study found 14 % of birds returning either to the same, or adjacent territories in a seven-year period (Cannings 1993). Philopatry is difficult to assess due to the difficulty of locating all nests and individual birds within territories.

Demography

Demography of saw-whet owls has been described primarily for birds in British Columbia, Canada, the eastern and Midwestern United States, and in Idaho. No information is available about demography of saw-whet owls in the Black Hills.

Life-History Characteristics

Clutch sizes range from five to seven eggs. No data exist describing the age of first reproduction for wild saw-whet owls. Cannings (1993) suggests that breeding begins at one year of age.

Survival And Reproduction

Little information exists about hatching or fledging success; however, in British Columbia, Cannings (1987) reported 75% hatching success, 56% fledging success, and calculated 42% overall success with 2.5 young fledging for each successful nest. One captive owl lived to 16 years of age (Cannings 1993).

Social Pattern For Spacing

Densities of saw-whet owls can vary widely in different geographic regions. In Wisconsin, a maximum density of 15.8/km² of forested area was found (Swengel and Swengel 1987). In British Columbia, it was suggested that densities of saw-whets are 2.5 times as high in deciduous woodlands than in pine-fir woodlands (Cannings 1987). A Colorado study found much lower densities of saw-whet owls; 0.0-0.42 singing owls/km² above 2400m, and 0.01-0.05 singing owls/km² below 2400m (Jones 1991). Cannings (1993) suggests that most breeding habitats can support about 1 pair/ km². For the purpose of this assessment, a realistic density of saw-whets in the Black Hills would be less than one per km² (R. Cannings per. comm.)

Intraspecific territoriality is not well documented in the literature. Along census routes, it is reported that singing owls respond to each other and will investigate other calling owls (Swengel and Swengel 1987).

Local Density Estimates

No information is available regarding local density estimates of saw-whet owls in the Black Hills. The SDBBA considers the northern saw-whet owl an uncommon and local bird. It reported 19 sightings, all in the Black Hills region. Only three sightings were confirmed, two were probable, and 14 were possible sightings (counties included in these sightings were; Fall River, Custer, Pennington, Lawrence and Meade). The SDBBA suggests that though the saw-whet has not been reported outside the Black Hills region it should be looked for in other parts of the state.

Limiting Factors

Because the availability of suitable nesting cavities is a critical component of reproductive success, degradation of breeding habitat should have a greater influence on population trends of saw-whet owls than would degradation of wintering habitat. Nest trees/snags are of particular importance. Saw-whet owls breed in almost every coniferous and mixed-forest habitat that occurs in their range; but in most locales they seem to prefer old-growth stands for breeding (Cannings 1993). In Oregon, 77% of breeding-season roosts were located in sapling understory of old-growth ponderosa pine and grand fir forests (*Abies grandis*) (Boula 1982). Tree sizes and canopy structure were not discussed beyond that the canopy was considered "old-growth". The author stated the importance of sapling thickets beneath old-growth, and that these thickets were not available in managed forests that were searched. Within stands of suitable nesting habitat, whether they are old-growth or not, snags and especially cavities are of critical importance to breeding saw-whets. Logging practices taking old growth trees and accompanying snags and nest cavities will undoubtedly account for the greatest limiting factor.

Community Ecology

Predators And Relation To Habitat Use

Larger raptors are probably the most important predator of northern saw-whet owls. Cannings (1993) reported that larger owls are the main predator threat to saw-whets with long-eared (*Asio otus*), great horned (*Bubo virginianus*), and barred (*Strix varia*) owls all being attracted to imitated saw-whet calls. Voous (1989) reported definitive cases of saw-whet predation by the eastern screech-owl (*Otus asio*), spotted owl (*Strix occidentalis*), great horned owl, broad-winged hawk (*Buteo platypterus*), and Cooper's hawk (*Accipiter cooperii*). Within the Black Hills great-horned owls, and the *Accipiter* hawks are likely the saw-whet predators in greatest abundance. Humans are not considered predators on saw-whet owls, though Bent (1961) and Karalus and Eckert (1974) allude to the possibility of hunters mistaking saw-whets in flight for American woodcock (*Scolopa minor*). Road-killed adult saw-whet owls are common along highways (Cannings 1993). Nest predation is poorly documented. Cannings (1987) reported a northern flicker possibly killing two saw-whet owl nestlings. Information on predation of northern saw-whet owls in the Black Hills is not available.

Competitors

In the western mountains, the breeding habitat of the saw-whet owl completely overlaps that of the flammulated owl (*Otus flammeolus*) and the northern pygmy-owl (*Glaucidium gnoma*) (Cannings 1993). Throughout the northern Rocky Mountains, from British Columbia and Alberta to New Mexico the boreal owl's breeding range also overlaps that of the saw-whet. As all of these owls are secondary cavity nesters there is likely some competition for nest sites. Palmer (1986) reported distinct segregation of habitats used and prey items taken by sympatric populations of boreal and saw-whet owls. Therefore, competition for nest holes can be assumed to be small between these two species. Northern pygmy owls use smaller cavities than saw-whets and flammulated owls nest later in the year than saw-whet owls, so competition between these species for cavities should be small as well. There is one record in Montana of saw-whet and northern pygmy-owls occupying different nest holes in the same ponderosa pine (Norton and Holt 1982).

It is possible there is some interspecific competition for prey items because screech-owls and saw-whets tend to occupy many of the same habitats. However, Rains (1997) found that the western screech-owl's diet is broader than that of the saw-whet owl. Screech-owls were found to have taken a wider variety of prey species than saw-whets, including more small mammal species and (though in small numbers) fish, lizards, and crayfish. The most frequently taken prey item for saw-whet owls was the house mouse, while the screech-owl most often preyed upon harvest mice.

Resource competition is poorly represented in the literature. Numerous owl species including flammulated owls, northern pygmy-owls, boreal owls and western screech-owls share habitat preferences with the saw-whet owl, therefore it is reasonable to assume that some competition occurs for nest sites and prey items. Information relating to resource competition in saw-whet owls in the Black Hills is not available.

Parasites And Diseases

The following have been reported as extoparasites of northern saw-whet owls: Mallophaga (*Kurodaia acadica*, *Strigiphilus* sp.), Siphonaptera (*Echidnophaga gallinacea*, *Orchopeas*

leucopus), and Diptera (*Ornithoica vicina*, *Ornithomyia fringillina*, *Lynchia americana*) (Cannings 1993). A respiratory tract nematode (*Cyathostoma americana*) was identified as the cause of death in a wild Saw-whet owl in Ontario (Hunter et al. 1987). An infestation of the blood-sucking fly (*Carnus hemapterus*) was reported to have killed a brood of four saw-whet owls (Cannings 1987).

Risk Factors

The greatest risk factors that northern saw-whet owls face in the Black Hills region may include loss of mature forest and nest cavities through timber harvest, fire suppression, and human encroachment. Human disturbance may have both direct and indirect detrimental effects on northern saw-whet owls.

Stand-maintaining fires may enhance saw-whet owl habitat. Understory of mature forests is cleaned out, allowing for better hunting habitat. Palmer (1986) suggested however, that the saw-whet is better adapted to hunting in thicker understory than are other small owls. Fire can also create a patch mosaic with greater degrees of edge, along which saw-whets prefer to hunt. Finally, trees that are weakened and/or killed in fires, and left as snags, provide valuable nesting habitat for saw-whet owls. Suppression of natural fire regimes allows for build up of unnaturally large fuel loads. When fires do occur again, they have the potential to be very large, intense fires that burn out of control.

Roads allow access to many parts of the forest that saw-whets inhabit. Saw-whet owls hunt along edges such as those created by road construction and it is common for road kills to occur (Cannings 1993). Finally, though saw-whets will hunt along roadways, areas of heavy traffic will probably hold few birds due to noise.

Response To Habitat Changes

Management Activities

Timber Harvest

Timber harvest has the potential to reduce the suitability breeding habitat in several different Black Hills forest types. Cannings (1993) suggests that saw-whets will breed and nest in coniferous as well as deciduous and mixed forests at lower elevations, such as those that exist in the Black Hills. Mature stands of ponderosa pine and white spruce that exist in the Black Hills are likely important breeding areas for existing populations of saw-whets. Young forests are often too thick and lack the open understory that saw-whets prefer for foraging even though these areas may be used as roost sites (Cannings 1993). Also, as more timber harvest occurs within the limited area of the Black Hills, riparian and associated deciduous forests are likely to be influenced to a greater degree. These mixed mesic forests are important breeding habitats for the saw-whet and impacts to these areas will be detrimental to the species.

The final environmental impact statement for the BHNF breaks down the commercial harvest methods to be implemented in acres per year for 10 years after the plan takes effect (USFS 1996).

The preferred alternative (G) calls for the following treatments:

Treatments	Acres
Commercial thinning	1700
Seed Cut	15,600
Overstory Removal	6,100
Clear-cut	0
Patch Cut	200
Hardwood Restoration	500
Seed Tree Cut	300
Meadow Restoration	1,000
Selection	100
Salvage	0
TOTAL	25,500

Commercial harvest is comprised of several different methods of harvest. “Commercial” implies that trees are within “utilization standards and may be sold for profit. Trees greater than 9 inches DBH may be utilized as sawtimber, and trees between 5 and 8.9 inches DBH may be utilized as products other than logs” (USFS 1996). Commercial thinning is simply the removal of trees within stands that are overstocked and where growth has been slowed because of competition with other trees. Shelterwood cuts are done in two steps. Step one involves removal of all trees except those that will be used as seed trees to regenerate the stand. Step two is overstory removal and involves removing those seed trees after regeneration has begun. In both steps, snags may be left. Seed-tree cuts leave the fewest trees per acre after manipulation. Ten or fewer trees are left per acre throughout the stand and no over story removal occurs. Patch clear-cutting involves area of 10 acres or less and designed so that seed dissemination will occur evenly across the cut area. Of particular importance to saw-whet owls, larger-scale clear-cutting is only considered as a final alternative. Large-scale clear-cutting has the greatest potential to impinge on or completely cover areas of suitable saw-whet habitat.

Harvest methods proposed focus on thinning, opening the forest and creating uneven-aged stands. Based on the literature these methods have the potential to enhance rather than detract from saw-whet habitat in the BHNF. Thinning should open stands that may be too thick to be used as hunting habitat, though they may have been suitable for roosting sites. Shelterwood cuts also may enhance hunting habitat and if snags are left may add nest sites. Patch cuts will create ecotone habitats that should be suitable for saw-whet foraging. Through careful planning of cuts, these timber harvest methods could improve saw-whet habitat. However, unless mature trees and snags are left, this strategy probably would not enhance saw-whet habitat to any degree, and could result in habitat loss. No information was found on optimal snag densities for saw-whet owl breeding habitat.

Recreation

There is little published information that directly addresses the effect of recreation on northern saw-whet owls. In the southern Appalachian Mountains, two transmitters owls in separate campgrounds abandoned their territories when seasonal campers entered the area in the spring

(Milling et al.1997). Also, saw-whet densities appeared to be below normal along heavily used hiking trails in the Appalachians. These same consequences are probably applicable to areas of the Black Hills that are heavily used by hunters and fishermen. Other impacts that can be inferred include destruction of nest trees and possibly active nests by campers seeking wood for campfires. There may also be an increase in road-killed owls as the numbers people driving within the forest increases.

According to the BHNF Forest Development Road System (USFS 1996), the preferred alternative (G) calls for 277 miles of road construction, 139 miles of road obliteration, and 34 miles of roads converted to motorized trails in the first decade after the forest plan is initiated. This converts to a net increase of 104 miles of roads over a ten-year period. Areas where saw-whets may be impacted by recreation include the heavily used Mickelson and Norbeck trail systems. Though not well documented it is presumed that an increase in vehicle traffic will increase numbers of saw-whets killed by vehicles.

Livestock Grazing

There are no studies, currently published, which directly address the impact of livestock grazing on northern saw-whet owls. If any impacts exist they would probably be a result of destruction of small mammal habitat. In heavily grazed areas, understory, ground cover and coarse woody debris may be completely absent, or destroyed. This would result in reduced numbers of small mammals on which saw-whets feed, thus having a detrimental effect.

Mining

There are no studies, currently published, which directly address the impact of mining on northern saw-whet owls. Mining should be considered, however, because the largest underground gold mine in North America exists in the Black Hills at Lead, South Dakota (Knight 1994).

Northern saw-whet owls have been shown to be most dependent on woodland mice as a food source. Henny et al. (1994) conducted a study in northern Idaho along the Coeur d'Alene River. They found high lead levels had accumulated in mice and voles downstream from a lead mine site. Lead levels in local raptors were tested. A conclusion to the study suggested that prey species, such as mice, had accumulated lead, principally in their bone mass. Because hawks and owls do not digest bones, casting them out in pellets, lead was not accumulating in these birds in high enough levels to reduce reproductive success (Henny et al. 1994). Silver and gold have historically been mined in the Black Hills, and tailings may continue to leach into local streams and rivers. This study suggests that though owls may be picking up contaminants, they may not be concentrated enough in the body to have severe detrimental effects.

No information is available on placer mining effects on riparian saw-whet owl habitat.

Prescribed Fire

There is no literature dealing directly with the effect of fire regimes and northern saw-whet owls. It can be surmised, however, that prescribed burns would have more positive effects than negative effects on saw-whets. Direct negative effects on saw-whets include possible destruction of nest snags. Horton and Mannan (1988) found that prescribed fires burned nearly half of the ponderosa pine snags > 15cm DBH. This proportion seems high and may suggest that cavity-

nesting birds such as saw-whet owls would be negatively affected by burning. However the authors note three caveats. First, under repeated burning, fires will decrease in intensity and thus burn fewer snags. Second, live trees killed by burns will over time replace lost snags. Lastly, forest birds occurring in areas that have historically burned will have evolved to cope with fire. Thus, the idea that prescribed burns will directly negatively effect saw-whet nesting sites over the long term is arguable.

An indirect positive effect of prescribed burns on saw-whets may be the response of prey species, such as deer mice to burning. A study specific to the Black Hills showed that deer mouse numbers significantly increased during the first post-fire summer (Bock and Bock 1983). It is noted that during the second post-fire summer, numbers of mice declined to previous levels, or in some cases lower levels. This rise-and-fall effect was probably due to an increase in some unmeasured variable that the fire created. When this variable was depleted the abundance of deer mice declined. Because saw-whets have been shown to prey heavily on deer mice, prescribed burns may indirectly positively affect saw-whet owls in the Black Hills National Forest.

Fire Suppression

No literature is available that directly addresses the effect of fire suppression on saw-whet owls. As mentioned above, however, there are several effects that can be predicted. Fire should naturally enhance northern saw-whet owl habitat. Understory of mature forests is cleaned out, allowing for better hunting habitat. Fire also creates a patch mosaic with greater degrees of edge, along which saw-whets prefer to hunt. Fire has also been shown to, at least temporarily, increase prey species such as deer mice (Bock and Bock 1983). Finally trees that are weakened, and/or killed in fires, and left as snags, provide valuable nesting habitat for saw-whet owls.

Fire naturally occurred in the Black Hills about every 10-25 years between 1820 and 1910 (Bock and Bock 1983). In this region, suppression can result in thicker “dog-hair” stands of ponderosa pine, and increased invasion of saplings into grassland areas. Though Palmer (1986) suggests that saw-whets are physiologically better built for hunting in thicker habitats, they prefer areas with open understory. Ultimately, the result of fire suppression can be large, hot burning wildfires, which would burn large areas of potential owl habitat. Thus, fire suppression in the Black Hills will likely have more detrimental effects than positive effects for populations of northern saw-whet owls.

Non-Native Plant Establishment And Control

The effect of non-native plants on northern saw-whet owls is not known.

Fuelwood Harvest

Because northern saw-whet owls depend on forests for most aspects of their natural history, fuelwood harvest has the capability to be detrimental to them especially if snags are preferentially cut. Removal of snags will decrease possible nest sites. Removal of CWD may negatively affect prey species taken by saw-whets. Buskirk (2001) noted that with respect to marten (*Martes americana*) in the Black Hills, CWD supported populations of red-backed voles. Removal of large-diameter CWD will reduce numbers of these small mammals and possibly other rodent species that are favored by saw-whets. Fuelwood harvest generally connotes taking

of dead and downed wood by individuals for personal use. This will be most detrimental in areas where people tend to concentrate their wood gathering. Places in the BHNF that are most available to people will be probably have the least amount of CWD and standing dead trees left, thus having potential detrimental effects on saw-whets.

Natural Disturbance

Insect Outbreaks

Little information exists that directly addresses the impact of insect outbreaks on saw-whet owls, and none exists with regard to insect outbreaks and owls in the Black Hills. Within the southern Appalachian Mountains in the Great Smokey Mountain National Park, there exist glacial relic spruce-fir forests. Saw-whets nest preferentially in this habitat, which occurs only at the highest points along the mountain range, and is considered the second most endangered ecosystem in the U.S.

The Balsam wooly adelgid (*Adelges piceae*), an exotic pest that preys on fir trees, was introduced to the area via nursery stock from Europe in the late 1960s. Large-scale die-offs of fir began in the late 1970s and currently about 91 percent of Fraser Fir (*Abies fraseri*) stand dead in the park. Records exist for saw-whet owl densities prior to the die off of fir, and have more recently been calculated for post die-off years. Essentially the numbers are identical, suggesting that the large scale Adelgid outbreak had little effect on the saw-whet population. As spruce-fir forests decline, the owls have adapted to the habitat available (Milling et al. 1997).

It may be assumed that within the Black Hills, outbreaks of mountain pine beetle (*Dendroctonus ponderosae*), and pine engraver beetle (*Ips pini*) would not have a large detrimental effect on saw-whet owl populations. Besides obvious impact on general habitat health, die-offs of trees could add nests sites to territories, and increase CWD, which may in some cases, increase small mammal populations.

Wildfires

No information has been published specifically with regard to the effect of wildfires on saw-whet owls. However, some effects can be theorized. In most of the Black Hills, with the exception of the Wind Cave National Park and Devils Tower National Monument areas, a fire suppression regime has been in place (Knight 1994). In areas where prescribed burning has taken place the forests generally affect pre-settlement environmental conditions (Knight 1994). In areas where fire suppression has been implemented, ponderosa pine forests are usually thicker, sometimes developing into dog-hair stands. Younger trees also persist and start to invade grassland areas. Overall in fire-suppressed forests there is an abundance of understory plants and CWD. Therefore, when a wildfire breaks out, these fires tend to be substantial and burn very hot. Wildfires in the Black Hills occurred every 5-25 years in pre-settlement times (Bock and Bock 1983, Knight 1994). Frequent fires kept the fuel supply down to a level where fires would burn cooler, creating surface fires, as opposed to crown fires. Surface fires would kill young ponderosa pine saplings, and spare trees with thicker, protective bark. Because fire suppression has occurred in the Black Hills for many years, the potential for large, hot fires has increased. These fires would have the potential to destroy large tracts of suitable owl habitat.

Fires do, however, tend to create patch mosaics on the landscape (Knight 1994). Rather than

burning extensive tracts in one area, fires will often jump from place to place, creating burnt patches. These areas can create hunting and nesting habitat for saw-whet owls. Overall, the effect of wildfires will depend on the size of the event. Small fires will have the potential to enhance saw-whet owl habitat, while large fires will have the potential of short-term destruction of owl habitat.

Wind Events

Like wildfires, the impact of wind will likely depend on the size of the event. In general, forests that are heavily laden with snow are most susceptible to toppling due to wind (Knight 1994). These events may occur at small scales, which will in effect open the tree canopy in areas. These openings will allow for understory plants to invade and create good hunting habitat for saw-whet owls. Larger-scale wind events, such as happened in the Teton Wilderness in 1987 (6km² flattened), would have detrimental effects on saw-whet owl habitat.

Other Weather Events

Because saw-whet owls have evolved in northern forests that have harsh climates, it is unlikely that normal weather events will effect them. Singing activity has been shown to decrease in high winds and during times of heavy precipitation (Palmer 1986). Anomalous weather events such as extreme cold, ice storms and wet snow followed by high winds may have some damaging effects both on the birds and on their habitat. Large hailstones have been known kill saw-whet owls (SHA).

SUMMARY

The northern saw-whet owl is one of the most common forest owls across southern Canada and the northern United States. A habitat generalist, the saw-whet is able to exploit many different types of woodland and ecotone habitats. Within their range, saw-whets occupy a wide array of habitats from Sagebrush steppe with few trees in southwestern Idaho, to coniferous riparian zones in British Columbia, Colorado and throughout the east. Though moist forests are preferred, saw-whets also breed and roost in dry uplands. Preferring old growth or mature forests for breeding and nesting habitat, more dense tree, and sapling stands areas are used for roost sites. Saw-whet owls are secondary cavity nesters primarily using abandoned northern flicker holes for their nest sites.

The saw-whet feeds primarily on woodland mice with particular emphasis on deer mice in much of its range. Birds and insects are taken when opportunities arise. The Queen Charlotte Islands subspecies is known to hunt intertidal zones for invertebrates, illustrating this species wide-ranging diet and adeptness at catching prey.

One of the most migratory of the non-insectivorous owls (Johnsgard 1988), the saw-whet makes broad-scale north-south movements in parts of its range each fall and spring. In other areas, saw-whets most likely migrate from higher elevations to lower more temperate elevations during the winter (Palmer 1986). This vertical migration is a probable mechanism for those birds in the Black Hills.

The factor most likely to be limiting to the saw-whet owl in the Black Hills is the loss of nesting

snags and cavities due to forest harvest practices. However, scientific literature pertaining to natural history of the saw-whet suggests it is capable of using all forest habitats that are available in the Black Hills. White spruce, found in cold drainages at higher elevations may be most attractive, yet ponderosa pine is used for breeding habitat as well as deciduous habitats. Knight (1994) classified three separate deciduous habitats within the Black Hills region. The first occurs in low elevation riparian zones dominated by bur oak (*Quercus macrocarpa*), box elder (*Acer negundo*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), hackberry (*Celtis occidentalis*) and plains cottonwood (*Populus* spp.). The second occurs in uplands and is dominated by bur oak. The third is aspen dominated. Ponderosa pine is the most harvested wood in the region. As it becomes limiting, saw-whets will likely move territories to other available habitats.

Other human impacts such as recreation, e.g.: hunting, fishing, snowmobiling and off-roading do need to be taken into account when considering the saw-whet. Studies suggest that human presence, especially during early brood-rearing, will have detrimental effects on saw-whets (Milling et al. 1997). Fire suppression will ultimately be deleterious in that it allows proliferation of understory and can lead to dog hair stands of species such as ponderosa pine. Suppression could also lead to intense wildfires that could burn extensive sections of saw-whet habitats. Ultimately, it is important to remember that saw-whet owls have historically been part of western forests; therefore, they will have evolved with natural disturbances. Blow-downs, insect epidemics and wildfires (to an extent) may cause short-term detrimental effects; however, in the long term there may be no overall effect.

REVIEW OF CONSERVATION PRACTICES

Management Practices

Within the current scientific literature we could not identify examples of management practices implemented specifically for saw-whet owls. Within the Black Hills, it is possible to speculate on what practices would be successful for management of saw-whets based on the findings of habitat preferences in other regions. Nesting requirements of saw-whets call for cavities usually excavated by northern flickers. Though not limited to snags, dead-standing trees undoubtedly hold the majority of nests. Anderson (2001) suggested that flickers used significantly more snags than live trees for excavating nest cavities and flickers would use trees or snags with a DBH between 34 and 61 cm. Presumably, saw-whets require trees of at least this diameter for nesting. The Revised Land and Resource Management Plan (USFS 1996) calls for 1.08 snags per 0.4 ha, with a minimum diameter of 25.4 cm. Thus, snag diameter should be increased in the interest of saw-whet owl nesting habitat.

Breeding habitat for saw-whets varies throughout the United States. Within the Black Hills several habitat types may support saw-whet owls. Of particular interest are mature stands of ponderosa pine and white spruce. Several studies suggest these areas are selected by saw-whets (Cannings 1993, Boula 1982). In the interest of management for these owls in the Black Hills, protection or maintenance of mature stands of white spruce and ponderosa pine is important.

Other habitats within the Black Hills are undoubtedly exploited by saw-whets, particularly riparian coniferous stands and deciduous stands with a high aspen association. In western

Wyoming, saw-whets were found at a mean elevation of 2274 m within mixed coniferous/deciduous stands that had $\geq 50\%$ aspen in the overstory, with adjacent coniferous habitat (Anderson and Clark 2001). Average stand size for saw-whets was 312 ha and average distance to a clear-cut was 1285 m. Average clear-cut size associated with saw-whet owls was 19 ha. It is unclear whether patch cuts would have the same effect as larger clear-cuts. Other studies within the western U.S. have found similar habitat associations.

Riparian corridors are important features for saw-whet owls (Palmer 1986, Hayward and Garton 1988, Marks and Doremus 1988). Within the Black Hills, riparian corridors should be considered important for saw-whet owls because of the diversity of vegetation contained therein. Ecotones are important, because saw-whets have been found to avoid unbroken stands of coniferous forest (Palmer 1986). Cannings (1987) described a saw-whet territory that contained stands of open pine forest, dense pine/fir forest, and grassland.

Management considerations for saw-whets in the Black Hills should take into account various habitat types. The first to be considered are mature stands of ponderosa pine and white spruce for breeding and nesting. Snags are an important variable within these areas. Next, mixed coniferous stands along riparian corridors are important for breeding, nesting and foraging. Finally roosting habitat will consist of more dense forest stands. Elevations found within the Black Hills probably are not an issue for saw-whet owls. In Colorado saw-whets are found above 3000 m; the highest point in the Black Hills is Harney Peak at 2202m. We predict that saw-whets may be present at all elevations in the Black Hills.

Models

One excellent source of information on forest owl ecology is the Forest Service General Technical Report NC 190: Biology and Conservation of owls of the Northern Hemisphere (Duncan et al. 1997). Within this document are several articles discussing ideas as to what the best models would be to develop for the northern forest owls. Specifically, Hayward and McDonald (1997) call for use of matrix models, which they feel can help researchers decide how to: (1) focus field efforts toward measuring the most important demographic parameters, and (2) focus on those habitat characteristics with the greatest effect on population dynamics.

Kearns (1997) reported on a workshop that was held to discuss models for owl populations. As a conclusion it was noted that there needed to be integration of population models with habitat suitability index models (HSI) presumably for more complete models. This conclusion implied that there were HSIs created for owls like the saw-whet. The only such models that available however are spotted owls and barred owls. We were not able to locate any models constructed for saw-whets specifically, in the Black Hills or elsewhere in the owl's range.

Survey And Inventory Approaches

Though small and secretive, the saw-whet owl is extremely vocal during the early breeding season. Therefore surveys done at night to locate singing birds are the most common and effective methods for inventorying saw-whet owls (Palmer 1986,1987, Webb 1982). Many different variations of night-time surveys have been utilized; however, they are all based on the principle of locating birds from calling roosts. Males will call from high, but concealed perches to advertise during the breeding season (Cannings 1993). Use of audiotapes is common to elicit responses back from calling males (Milling et al. 1997, Swengel and Swengel 1987). Playback

recording will greatly increase the accuracy of density estimates of birds surveyed (Johnson et al. 1981).

Monitoring Approaches

Monitoring of saw-whet populations has been accomplished through banding operations along migration routes. The main banding stations are located at Hawk Ridge (Duluth, MN), Little Suamico (WI), Casselman River (MD), Turkey Point (MD), Assateague Island (MD), Cape May (NJ), and Cape Charles (VA) (Brinker et al. 1997). These stations accounted for banding more than 5900 migrating owls in 1995. Banding allows for capture/recapture data to be collected and gives insight into where birds are migrating and how the population may, or may not, be fluctuating. This technique is only useful for migrating birds, however.

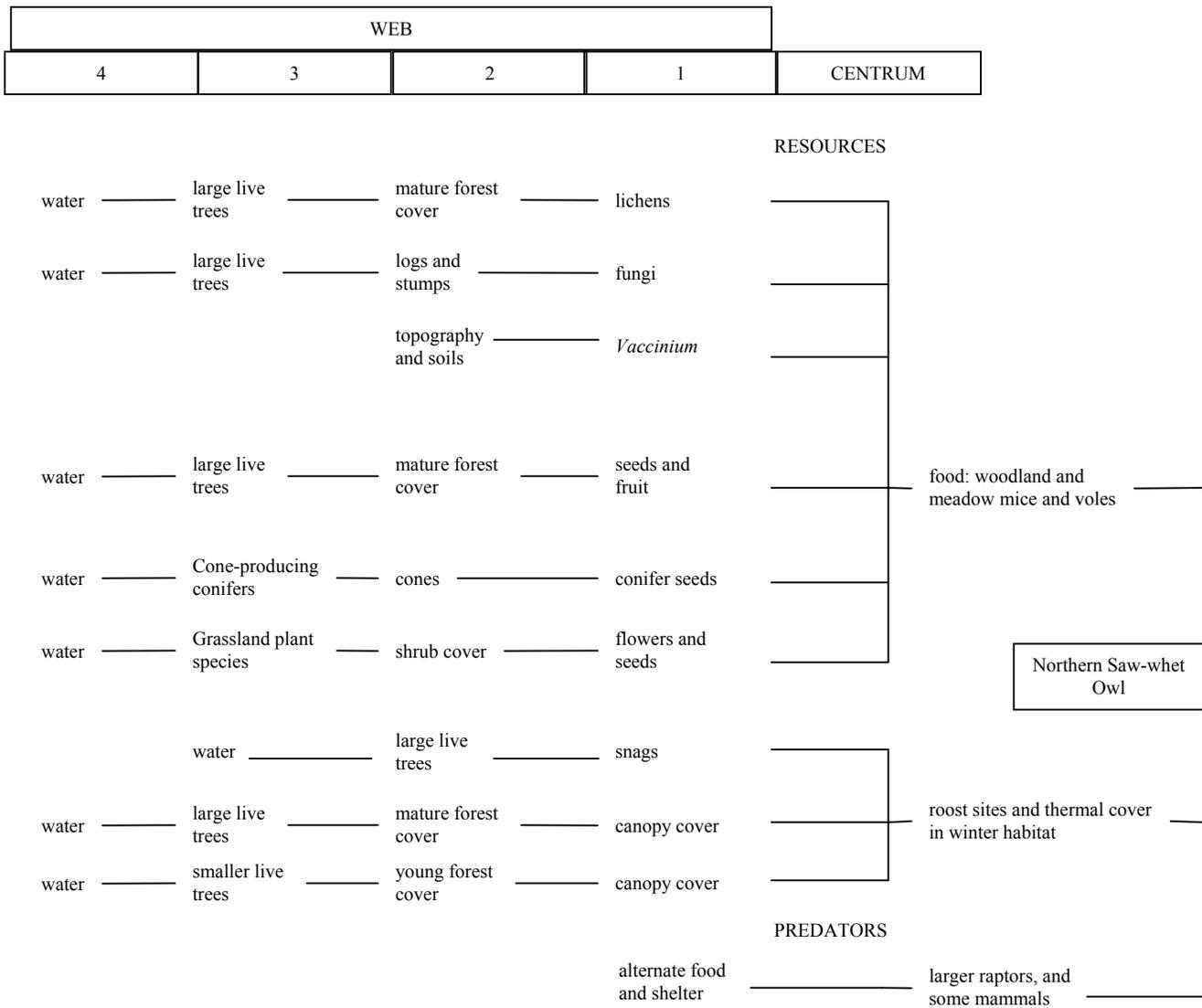
Within the Black Hills it is possible that there are resident owls which, if moving at all, are migrating vertically from higher elevations to lower elevations for the colder winter months. As specific vertical migration routes are probably not used, banding operations are not applicable to this population. Monitoring efforts should focus on survey techniques during early breeding season, when males are broadcasting their calls. Density estimates can be calculated at this time and compared year to year to assess population status.

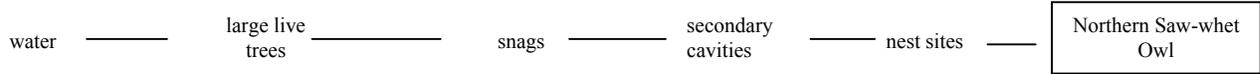
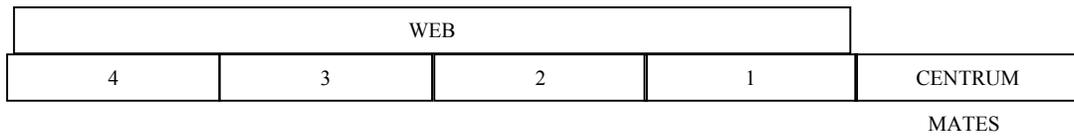
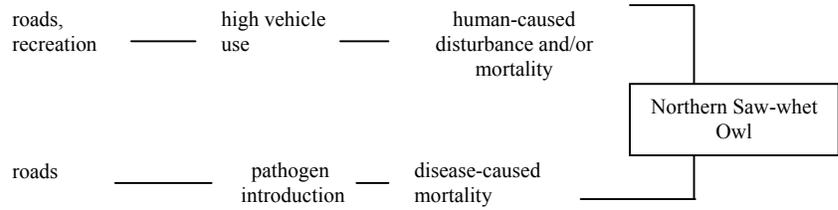
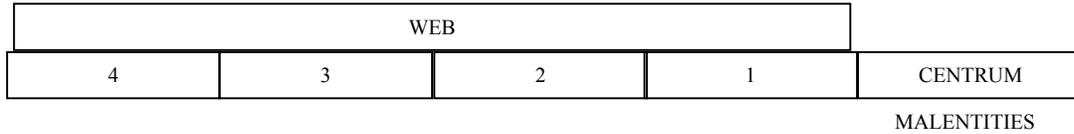
Another monitoring technique for the Black Hills region should involve nest locations and/or nest boxes. Saw-whets readily use nest boxes in the absence of suitable snags or trees (Cannings 1993). Survey techniques described above will allow for the identification of saw-whet territories. Personnel should search these areas for active nests. These nests, along with placement of nest boxes in suitable habitat should yield population estimates that can be compared temporally.

ADDITIONAL INFORMATION NEEDS

Information specific to the northern saw-whet owl in the Black Hills region of South Dakota and Wyoming is absent in the scientific literature. It is important that even small-scale research be carried out in the Black Hills to obtain baseline population estimates of the owls that persist there now. Initially, surveys using taped vocalizations of birds during breeding and winters seasons are needed. These numbers will provide a basis for future management decisions that take the saw-whet into account. As was stated in the introduction, because there is no information specific to saw-whets in the Black Hills, extrapolation of information such as habitat preference and prey selection was necessary. In the interest of accurate management decisions, habitat use specific to the Black Hills should be studied.

Figure 1. Envirogram of the Northern saw-whet Owl in the Black Hills National Forest





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DEFINITIONS

Demography- The study of populations with emphasis on growth rates and age structure.

Ecotones – The boundary at which two habitats meet, creating areas where more than one habitat type are available to an animal.

Macrohabitat – Habitat at a larger scale, landscape scale.

Microhabitat – Habitat at a small scale, specialized habitat components.

Phenology – The study of the influence of climate on annual occurrences such as bird migrations. Can apply to plant or animal life.

Philopatry – The tendency to remain in one locality; a group or species showing little potential to disperse.

Polygyny – The act of a male of a species mating with more than one female simultaneously or in the same nesting season.

Riparian – The land adjacent to a body of flowing water that is, at least periodically, influenced by flooding (Mitsch and Gosselink 2000).

Snag – A dead standing tree.

Temporal – Over time; pertaining to time.