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Conservation Assessment for the Cooper's Hawk and the Sharp-Shinned Hawk in the Black Hills National Forest, South Dakota and Wyoming

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INTRODUCTION

This document assesses the biology and overall conservation status of the Cooper's hawk (*Accipiter cooperii*) and sharp-shinned hawk (*A. striatus*) in the Black Hills National Forest (BHNF). The goal is to provide information that assists the BHNF of South Dakota and Wyoming in managing for the viability of these species. The specific topics of this document include systematics, distribution and abundance, population trends, movement patterns, habitat characteristics, food habits, breeding biology, demography, community ecology, risk factors, response to habitat changes, a review of conservation practices, and additional information needs.

An attempt was made to base this assessment primarily on peer-reviewed literature with a focus on the population in the Black Hills. However, limited data are available on the Cooper's and sharp-shinned hawk in the Black Hills so peer-reviewed literature from other North American studies was also used. When possible, information from areas as close to the BHNF as possible was used. It should be noted that as the distance increased between the Black Hills and the areas from which inferences were made, there is likely to be a large amount of uncertainty that accompanies these inferences. Additionally, information subject to less rigorous review, such as master's theses, doctoral dissertations, State, United States Forest Service (USFS), and U.S. Fish and Wildlife Service (FWS) reports, was used to provide a more thorough understanding of the biology and status of the focal species in the BHNF.

CURRENT MANAGEMENT SITUATION

Management Status

The FWS and the USFS have not designated the Cooper's hawk or sharp-shinned hawk any special conservation status. The Nature Conservancy designates both species with a global rank "G5", meaning they are demonstrably secure, though they may be quite rare in parts of their range, especially at the periphery. In Wyoming (Fertig and Beauvais 1999) and Montana (Bergeron et al. 1992), these hawks are considered to be common and do not have any special conservation status. In South Dakota (South Dakota Natural Heritage Database 2001), the sharp-shinned hawk is designated as "S3" and the Cooper's hawk is "S3B & SZN." "S3" means they are either very rare and local throughout their range, or found locally (even abundantly at some if their locations) in a restricted range, or vulnerable to extinction throughout their range because of other factors. "S3B" is the same as "S3" but with reference to the breeding season. "SZN" means there are no definable occurrences during winter for conservation purposes. In Nebraska, both species are designated as "S1" which means they are critically imperiled because of extreme rarity (often known from 5 or few extant occurrences or very few remaining individuals) or because some factor of a species life history makes them vulnerable to extinction (NatureServe Explorer 2001). Both species are taken for falconry in Wyoming (Oakleaf et al. 1996) and South Dakota.

Existing Management Plans, Assessments, Or Conservation Strategies

The following are species assessments, management plans, or conservation strategies for the Cooper's and sharp-shinned hawk.

Bildstein, K. L. and K. Meyer. 2000. Sharp-Shinned Hawk (*Accipiter striatus*). *In* The Birds of North America, No. 482 (A. Poole and F. Gill, Eds.). The Birds of North America, Inc., Philadelphia, PA.

Herron, G. B., C. A. Mortimore, and M S. Rawlings. 1985. Nevada raptors, their biology and management. Nevada Dept. Wildl. Biol. Bull. No. 8, Reno.

Jones, S. 1979. The Accipiters – Goshawk, Cooper's Hawk, Sharp-shinned Hawk. Habitat management series for unique or endangered species. (Rept. No. 17), USDI-Bureau Land Management Tech. Note 335.

Millsap, B. A. 1981. Distributional status of Falconiformes in west central Arizona with notes on ecology, reproductive success, and management. USDI-Bureau Land Management Tech. Note 355.

Reynolds, R. T. 1983. Management of western coniferous forest habitat for nesting Accipiter hawks. USDA Forest Service Gen. Tech. Rep. RM – 102.

Rosenfield, R. N. and J. Bielefeldt. 1993. Cooper's Hawk (*Accipiter cooperii*). *In* the Birds of North America, No. 75 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

COOPER'S HAWK

REVIEW OF TECHNICAL KNOWLEDGE

Systematics

The American Ornithologists' Union (1998) recognizes the Cooper's hawk as monotypic. They can be easily confused with the other two North American Accipiters, Northern goshawks (*Accipiter gentilis*) and sharp-shinned hawks, as they are midway in size. Cooper's have a more rounded tail than the other two Accipiters. Also, when in flight, the Cooper's head projects far beyond the "wrists" whereas the head of the sharp-shinned hawk barely projects beyond its "wrists".

Distribution And Abundance

Rosenfield and Bielefeldt (1993) reviewed the distribution of Cooper's hawks. During the breeding season, Cooper's hawks are found throughout the conterminous United States, southern Canada, and northern Mexico where suitable habitat exists. Most birds winter within the conterminous U.S., throughout much of Mexico, and perhaps as far south as Columbia. As long-distance migrants, it is unlikely that any populations would be isolated.

In South Dakota, breeding Cooper's hawks are considered 'uncommon' and only occur in the western part of the state (Peterson 1995). During field work for the South Dakota Breeding Bird Atlas (1988-1993), five breeding pairs were 'confirmed', the presence of another seven breeding pairs was 'probable', the presence of another 26 breeding pairs was 'possible', and one other individual was 'observed' but there was no evidence of breeding (Peterson 1995). Reports of Cooper's hawks in South Dakota are evenly divided between upland conifer and riparian deciduous habitats (Peterson 1995).

In Wyoming, the Cooper's hawk is classified as a common summer resident (Wyoming Game and Fish Department 1999). They also occur in southeast Montana during the breeding season and the winter (Bergeron et al. 1992). In northwest Nebraska, the Cooper's hawk is a rare but regular breeder (Mollhoff 2001). Estimates of local abundance of Cooper's hawks are not available for the Black Hills.

Population Trend

Historically, shooting and environmental contaminants have been the most significant threats to Cooper's hawk viability in North America (Elliott and Martin 1994, Henny and Wight 1972). The State of Pennsylvania enacted the hawk-and-owl bounty law in 1885, which provided for the payment of 50 cents for the scalp of any hawk or owl. Within two years 180,000 scalps were brought in (Hornaday 1918 in Henny and Wight 1972). By the mid-1900s, most states offered some form of protection for hawks and owls. In the late 1940s, use of environmental contaminants, such as DDT, for agricultural purposes caused eggshell thinning and nest failure to many raptors. Cooper's hawk populations experienced a downward trend that was correlated with DDT use (Rosenfield 1988). In a survey of Cooper's hawk nest success through the early 1980s, Pattee et al. (1985) reported that after DDT was banned in the 1970s, nest success returned to pre-DDT era levels and populations were increasing.

The North American Breeding Bird Survey (BBS) estimated a population increase of 5.8% per year ($P < 0.01$) between 1966 and 2000 over the entire survey area (Sauer et al. 2001). The 1980 – 2000 BBS estimate for U.S. Fish and Wildlife Service Region 6, which includes the BHNF, did not detect a significant trend (+19.3%; $P = 0.113$) (Sauer et al. 2001). The most recent data available (1959 – 1988) from the Christmas Bird Count (CBC) estimated a population increase of 0.8% ($P < 0.10$; 95% CI = -0.1 to 1.6) over the entire CBC survey area (Sauer et al. 1996). Titus and Fuller (1990) analyzed trends in counts of migrant Cooper's hawks from six hawk lookout stations in northeastern North America and reported an increasing trend from 1972 – 1987. Data from other migration lookout stations throughout northeastern North America also suggest increasing trends of Cooper's hawks (Latta 1998).

Broad-Scale Movement Patterns

The Cooper's hawk is a partial migrant; some individuals stay in the breeding area while others migrate either short or long distances. Populations in the northern portion of the breeding range are thought to be more migratory than populations to the south (Palmer 1988). Migratory Cooper's hawks in the west winter throughout western North America and as far south as central and southern Mexico (Smith et al. 1990), while migratory birds from eastern North America are thought to winter mostly in the central and southern United States (Mueller and Berger 1967). A record of Cooper's hawk migration from northeast Wyoming observed that a nestling was banded near Sheridan on 18 July 1939 and recovered on 11 Sept 1939 near Rogger, Colorado (Patuxent Wildlife Research Center in Meng 1951).

The timing of peak migration for Cooper's hawks in Nevada and Utah occurs during the last 10 days in September, which is 10 – 20 days earlier than in eastern North America (Hoffman 1985). Although there is considerable overlap in the fall migration, juveniles precede adults and females precede males (DeLong and Hoffman 1999). The opposite pattern occurs in the spring with males preceding females and adults preceding yearlings (Meng 1951). Little information is available on the timing of spring migration but the approximate timing is March – May (Meng 1951). The spring migration appears to move quicker and over less definite routes (Meng 1951).

Habitat Characteristics

Nesting Habitat

The Cooper's hawk is a habitat generalist that requires wooded areas for breeding. Nesting habitat of the Cooper's hawk has been described in the northern Great Plains of north central North Dakota (Nenneman et al. [a] *In Review*), the forests of Wisconsin (Trexel et al. 1999), New Mexico (Siders and Kennedy 1996), Oregon (Reynolds et al. 1982), New York and New Jersey (Bosakowski et al. 1992), pine plantations in Missouri (Wiggers and Kritz 1991), suburban Wisconsin (Rosenfield et al. 1996), and urban Arizona (Boal and Mannan 1998) (Table 1; Nenneman et al. [a] *In Review*).

Table 1. Reported Cooper's hawk nest site characteristics (means) for North America (Nenneman et al. [a] In review).

	Nest tree characteristics					Nest site characteristics				
Study Area	Nest height (m)	Tree height (m)	% nest height [a]	DBH (cm)	*n*	Basal area (m^2/ha)	% canopy cover	Dist. to edge (m)	*n*	Source
North Dakota	9.2	13.2	69.7	24.7	48	25.9	63.9	23.9	48	Nenneman et al.[a] In review
North Dakota	6.2	9.5	65.4	20.0	13	NA [b]	NA	150	13	Murphy 1993
NY – NJ	16.7	25.0	67.3	44.0	21	30.9	88.9	120	21	Bosakowski et al. 1992
Maryland	15.4	NA	67.5	44.5	6	24.3	76.0	129	6	Titus and Mosher 1981
Wisconsin	13.1	19.1	69.8	32.6	52	31.6	84.9	58	52	Trexel et al. 1999
NE Oregon	12.1	NA	NA	42.7	31	39.9	NA	NA	31	Moore and Henny 1983
NW Oregon	15.2	22.3	NA	33.2	18	30.7	75.0	NA	4	Reynolds et al. 1982
E Oregon	14.0	22.6	NA	39.6	15	41.3	64.0	NA	5	Reynolds et al. 1982
New Mexico	16.1	24.1	NA	52.1	12	17.0	NA	NA	12	Kennedy 1988
Arizona	15.2	22.1	69.0	79.0	52	15.0	64.8	NA	49	Boal and Mannan 1998
Utah	7.1	12.2	NA	17.6	17	NA	83.1	NA	17	Fischer 1986
Arkansas	16.9	21.4	NA	31.2	12	NA	71.3	51.1	12	Garner 1999

[a] % nest height = Nest height / Nest tree height * 100
[b] NA = No data available

Similarities occur in habitat use between study areas such as the use of nest trees with greater diameter at breast height (DBH), tree height, and higher canopy cover than is randomly available (Boal and Mannan 1998, Bosakowski et al. 1992, Nenneman et al. [a] *In Review*). Selection of these characteristics is likely to occur in the BHNF also. Differences are also apparent between study areas. In North Dakota (Murphy 1993), the average nest tree height was 9.5 m while it was 25.0 m in New York and New Jersey (Bosakowski et al. 1992). Canopy cover has also been observed to vary by as much as 25% between study areas (Bosakowski et al. 1992, Nenneman et al. [a] *In Review*). It is important to take this variability into account when making inferences about habitat use on the BHNF from studies at other locations.

A study in North Dakota (Nenneman et al. [a] *In Review*) is geographically closest to the BHNF; therefore the habitat use characteristics from that study are presented below. Nest sites were found in a variety of different vegetation types including sandhill (18 nests), coulee (17), and floodplain woodlands (12). Nests were built primarily in large, tall, green ash (*Fraxinus pennsylvanica*, 46%), quaking aspen (*Populus tremuloides*, 31%) and five other tree species (23%). More than 77% of the nest sites in North Dakota were in deciduous trees, which were also the main tree type present. Nests were within the lower part of the tree canopy, at slightly more than two-thirds of tree height. Nests averaged 38 cm wide and 31 cm deep. Heights of nest trees and surrounding trees were similar, but nest tree DBH was larger than stand DBH. Nest stand characteristics included: mean tree density = 1,156.3 trees/ha, mean stand DBH = 16.0 cm (SE = 0.3), mean stand basal area = 25.9 m^2/ha (1.5), canopy cover = 63.9%, little slope (< 5°), and close to forest openings ($\bar{x}$ = 24.0 m). Stand age averaged 64 years, but nests occurred in stands as young as 35 years. In landscape-level analysis of habitat use, there was little difference in landcover between Cooper's hawk nest sites, both at the 300 m and 1 km scale) and random sites. Cooper's hawks used areas with a surprisingly small amount of woodland cover (as little as 1.0%), although most nested in areas with > 10% woodland cover. Grassland, woodland, and cropland were the dominant land cover within 1 km of nests. Wetlands, open water, and urban lands generally comprised a small portion of land cover around nests. Distance to water varied greatly between nest sites (34 – 2,000 m); therefore the authors suggest that water is not a limiting factor.

Peterson and Murphy (1992) also reported the landscape characteristics of Cooper's hawk nest sites for another location in North Dakota. Habitat within 2 km of two nests was composed of 70% mixed grass prairie with interspersed shrub (mainly *Crataegus* spp.) draws, 15% cropland, fallow, and hayland, 13% - 26% temporary and permanent wetlands, and 2% tree groves (0.1 – 1.0 ha of aspen).

Though geographically further from the BHNF, a study done in eastern Oregon (Reynolds et al. 1982) may allow for more accurate extrapolation of habitat use in the BHNF due to similarities in forest composition. At an eastern Oregon study area, the dominant tree species was ponderosa pine (*Pinus ponderosa*), which is also the dominant species in the BHNF (84% of the Forest). Of 18 nest sites, 10 were in ponderosa pine, five were in white fir (*Abies concolor*), and three were in Douglas-fir (*Pseudotsuga menziesii*). The results suggest that ponderosa pine might also be used for nesting in the BHNF. Nests were usually on horizontal limbs against the trunk and were commonly in deformed trees infected by dwarf mistletoe (*Arceuthobium* spp.). Average nest tree height was 22.6 m, DBH was 39.6 cm, and mean nest height was 14.0 m. Seventy percent of the nest sites were on north and east aspects with slopes averaging 18%. Nest stands averaged 1,159 trees/ha and 64% canopy closure; these values are almost identical with those reported by Nenneman et al. ([a] *In Review*) in North Dakota. Trees in the nest stand had an average height of 11.6 m and DBH of 21.3 cm. The prey-plucking areas were an average of 54 m from the nest tree.

Boal and Mannan (1998) documented the Cooper's hawks capacity as a habitat generalist and its ability to tolerate humans. In the urban landscape of Tucson, Arizona, Cooper's hawks nested in introduced eucalyptus (*Eucalyptus* spp.; 70.8%), aleppo pine (*Pinus halepensis*; 25.0%) and native cottonwood trees (*Populus fremontii*; 4.2%). Most nest trees were located in the yards of single-family residences (48.3%) and in high-use recreational areas (28.3%). Nest site availability was presumed to influence habitat use more than the land-use within a home range (Mannan and Boal 2000).

Foraging Habitat

Only a few studies have investigated the foraging habitat of Cooper's hawks (Fischer 1986, Mannan and Boal 2000, Murphy et al. 1988). We know little of preferences for stands of differing densities, ages, tree sizes, or edge versus deep forests by Cooper's hawks (Reynolds 1989). However, they appear to use available forests opportunistically provided that the available types are not too dense for flight below or within the canopy (Reynolds 1989).

Mannan and Boal (2000) monitored nine males in Tucson, Arizona during the breeding season. The proportions of land-use categories within home ranges varied widely among hawks so habitat selection was difficult to interpret. However, all hawks avoided roadways, commercial, agricultural, and industrial areas inside of their home ranges. Mannan and Boal (2000) suggested that a high abundance of doves throughout the study was the reason no other trends emerged in the selection between land-use types.

Murphy et al. (1988) monitored one radio-tagged male in a central Wisconsin town during the breeding season. Wooded residential, residential/business, and open areas were avoided while oak-pine woods and shrub savannah habitats were preferred. The hawk's seasonal home range was 784 ha. He spent 88% of daylight hours in 12% of his home range.

Cooper's hawks in Utah preferred oak-maple woodland and oak shrubland/grassland and avoided open montane slopes but individual use of habitats varied considerably and appeared unrelated to prey abundance (Fischer 1986).

From the above information, it can be inferred that Cooper's hawks in the BHNF might also forage in bur oak (*Quercus macrocarpa*) and shrubland habitats. These vegetation types are present on 12,140 acres (<1%) of the BHNF.

Comparisons Of Sharp-Shinned Hawk, Cooper's Hawk, And Northern Goshawk Habitat

Several studies have compared nesting habitat use between coexisting Accipiters in North America (Fischer 1986, Kennedy 1988, Moore and Henny 1983, Reynolds et al. 1982, Reynolds 1983, Siders and Kennedy 1996, Trexel et al. 1999, Wiggers and Kritz 1991). Where these species coexist, a relationship occurs in which tree height and DBH of nest trees increases in proportion to Accipiter body size (Kennedy 1988, Reynolds et al. 1982, Siders and Kennedy 1996). For example, sharp-shinned hawk nest sites in Oregon were characterized as dense, 40 to 60-year-old even-aged conifer stands while Cooper's hawk nest sites were 50 to 80-year-old conifer stands with somewhat larger, more widely spaced trees, and goshawk nest sites were dense, mature conifer stands with varying densities of mature, overstory trees (Reynolds et al. 1982). However, high interspecific overlap occurs between the species in the use of nest site characteristics such as basal area, canopy cover, and tree density (Kennedy 1988, Moore and Henny 1983, Siders and Kennedy 1996). Siders and Kennedy (1996) observed large overlaps between Cooper's hawk and goshawk nest site characteristics while Moore and Henny (1983) reported large overlaps between Cooper's hawk and sharp-shinned hawk nest site characteristics.

Food Habits

Food habits of Cooper's hawks during the breeding season have been well documented (Bielefeldt and Rosenfield 1992, Kennedy 1980, Kennedy and Johnson 1986, Kennedy et al. 1991, Reynolds and Meslow 1984, Snyder and Snyder 1973). They surprise their prey by a sudden, swift dash, pouncing upon it before it has a chance to escape (Bent 1961). The male captures most of the food with the female hunting progressively more as the nestlings get older (Kennedy and Johnson 1986). Food niches of both sexes are similar (Kennedy and Johnson 1986). The diets of Cooper's hawks are diverse and vary geographically but in general, the most common prey are mid-sized birds and mammals that forage primarily on the ground (Rosenfield and Bielefeldt 1993). Typical prey items during the breeding season include American robins (*Turdus migratorius*), jays (*Cyanocitta, Aphelocoma*), Northern flickers (*Colaptes auratus*), European starlings (*Sturnus vulgaris*), and chipmunks (*Tamias, Eutamias*). Information about the diets of Cooper's hawks during winter is scarce. Examples of diets from several studies are presented below.

Bielefeldt and Rosenfield (1992) monitored prey deliveries by adults to nestlings at nests in forested areas and at nests in semi-urban areas in Wisconsin. Identification of the avian species was difficult because they were typically well-plucked, decapitated, and eviscerated, thus, they were usually only able to categorize avian prey by size class. Avian prey accounted for 51 – 68% of the prey items and 40 – 58% of biomass delivered to forested nests and the semi-urban nests, respectively. Avian prey appeared to be more important at the urban nest sites and mammalian prey appeared to be more important at the forested nest sites. Eastern chipmunks (*Tamias striatus*) were strongly the predominant mammalian items delivered to all nests. It appeared that Cooper's hawk preyed most heavily on subadult mammals, and young of the year and nestling birds. Prey that forage primarily or frequently on the ground accounted for nearly all of the mammalian and avian prey items.

Cooper's hawks in Oregon also foraged primarily near the ground (Reynolds and Meslow 1984). In Oregon, Reynolds and Meslow (1984) documented 76 species in the diet of Cooper's hawks. American robins and Steller's jay (*Cyanocitta stelleri*) were the most common avian prey taken while chipmunks and brush rabbits (*Sylvilagus* spp.) were the most common mammalian prey taken.

In North Dakota, Peterson and Murphy (1992) observed that avian and mammalian prey accounted for 70.3% and 29.7% of the prey items delivered to two nests by adult Cooper's hawks. The most frequently delivered prey were between 9 – 70 g. Blackbirds (Icteridae) and sparrows (Emberizidae) were thought to be the most common avian prey items. Thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*) contributed most (23%) as a species to biomass while mice were the most common (13.5%) mammalian prey items. Many other prey species were also reported (Table 2).

Table 2. Prey items of Cooper's hawks in North Dakota (Peterson and Murphy 1992).

Prey	n	% frequency	% biomass
MAMMALS			
Hares (Lepus spp.)	2	2.7	8.8
Thirteen-lined ground squirrels	5	6.8	23.4
Mice (Peromyscus spp.)	10	13.5	5.4
Voles	5	6.8	4.0
Total Mammals	22	29.7	41.6
BIRDS			
(Passeriformes)			
(9-25 g size class) incompletely identified	13	17.6	5.9
(26-40 g size class) incompletely identified	14	18.9	12.4
Western kingbird (Tyrannus verticalis)	1	1.4	1.1
Gray catbird (Dumetella carolinesis)	3	4.1	3.0
Northern Oriole (Icterus galbula)	1	1.4	0.9
(41-70 g size class) incompletely identified	13	17.6	19.2
Brewer's blackbird (Euphagus cyanocephalus)	1	1.4	1.7
Brown thrasher (Toxostoma rufum)	1	1.4	1.8
(71-127 g size class) incompletely identified	1	1.4	2.7
Miscellaneous birds			
American coot (Fulica americana)	1	1.4	4.3
Mourning dove	1	1.4	3.2
Unknown	2	2.7	2.2
Total Birds	52	70.3	58.4

On Lopez Island, Washington, American robins and California quail (*Callipepla californica*) represented 85% of the prey captured by both males and females (Kennedy 1980, Kennedy and Johnson 1986). Townsend's chipmunks (*Eutamias townsendi*) were the third most common prey item delivered to nests.

Dietary overlap between the northern goshawk and Cooper's hawk has been documented. In New Mexico, Kennedy et al. (1991) categorized the prey eaten by goshawks and Cooper's hawks by taxon and reported that no differences were found when ranking. In eastern Oregon, of the 46 species killed by goshawks and 33 species killed by Cooper's hawks, there was an overlap of 20 species (Reynolds and Meslow 1984). Based on the observed trends in dietary overlap in the above-mentioned studies, and the diet of goshawks in the Black Hills (BHNF 1996), the diet of Cooper's hawks in the Black Hills presumably includes red squirrels (*Tamiasciurus hudsonicus*), least chipmunks (*Tamias minimus*), thirteen-lined ground squirrels, bushy-tailed woodrats *(Neotoma cineria*), voles (*Microtus* spp.), Nuttall's cottontails (*Sylvilagus nuttallii*), ruffed grouse *(Bonasa umbellus*), northern flickers, hairy woodpeckers (*Picoides villosus*), black-backed woodpeckers (*P. arcticus*), three-toed woodpeckers (*P. tridactylus*), American robins, Townsends's solitaires (*Myadestes townsendi*), and dark-eyed juncos (*Junco hyemalis*).

Breeding Biology

Phenology Of Courtship And Breeding

Rosenfield and Bielefeldt (1993) reviewed the phenology of courtship and breeding of Cooper's hawks. The breeding season lasts approximately five months from the onset of nest building through fledgling independence. The phenology of courtship and breeding activities varies between and within locations. In Wisconsin, a nesting overlap of six to eight weeks occurs (Bielefeldt et al. 1998). Both sexes are present at the nest stand in Wisconsin as early as 6 March while in North Dakota, they return to the study area in mid-April (Nenneman et al. [b] *In review*). Courtship rituals occur by mid- to late March in New York and Wisconsin. Egg laying occurs in early to late April in Wisconsin, Florida, Arizona, and California; as late as late April to early May in New York and Ontario; and early to mid-May in North Dakota and Oregon. Immature breeders lay about 5 – 10 days later than adults. The average incubation period is 34 – 36 days. The female does nearly all of the incubation and brooding. The average hatch date in Wisconsin is 7 – 8 June (range = 22 May – 20 July; Bielefeldt et al. 1998). Brooding ends when the young are about 14 days old but also occurs during rain for a few days thereafter. The fledging period usually occurs 30 – 34 days after hatching. In Arizona (Millsap 1981) and Wisconsin (Bielefeldt et al. 1998), the average fledge dates were 28 June and 10 July, respectively. Fledglings remain in the vicinity of the nest for at least 10 days after fledging as parents bring food to the fledglings for up to seven weeks (post-hatch) during which feeding rates become slower. Little information is available on dispersal away from the nest but it likely occurs around 50 days post-hatch as feeding by the parents is thought to stop around this time (Bielefeldt et al. 1998).

Nenneman et al. ([b] *In review*) documented the timing of courtship and breeding for Cooper's hawks in North Dakota, which is the geographically, closest known study site to the Black Hills. Cooper's hawks returned to the study area in mid-April. Most females initiated egg-laying by mid-May ($\bar{x}$ = 16 May).

Courtship Characteristics

It is unknown if males or females select the nest site (Rosenfield and Bielefeldt 1993). It is possible that males select nest sites since they migrate earlier in the spring than females (Meng 1951). The male does most of the nest building (Meng 1951). At the onset and throughout the courtship period, the male usually performs a bowing display for the female, which is thought to be a signal demonstrating readiness to nest and/or an appeasement display (Rosenfield and Bielefeldt 1991). During the pre-incubation period, the female remains in the nest stand nearly continuously (Rosenfield et al. 1991b). The male remains near the nest and the female for nearly 80% of the day during the pre-laying and copulatory period (1-month) but leaves the nesting area to hunt for the pair. During this period the male brings prey to the female two to three times per day, providing virtually all the mate's food. Copulation follows most prey deliveries. The female may solicit the male by tilting to horizontal on the perch (Rosenfield and Bielefeldt 1993). The male flies to the female's tree perch, usually mounts her from flight, and balances with spread wings. The total number of copulations per clutch is estimated at 372, which is among the highest reported for birds (Rosenfield and Bielefeldt 1993). Little information is available on the duration of the pair bond. Some pairs have been known to re-mate and some individuals to have new mates in subsequent years.

Nest Characteristics

Rosenfield and Bielefeldt (1993) reviewed nest characteristics of Cooper's hawks. Nests are usually placed two-thirds up the tree in a main crotch or on a horizontal limb against the trunk of a live tree, typically built of sticks into a "cup" lined with bark flakes, and often built atop pre-existing bases such as squirrel or hawk nests, or on mistletoe masses. Nests have been measured at 76 cm in diameter and 15 – 20 cm tall in conifers to 61 cm in diameter and 43 cm tall in deciduous trees. Individuals occasionally use the same nest in successive or intermittent years, but typically build a new nest in the same area. The average distance between initial and alternate nests is 170 m. Cooper's hawks sometimes build more than one nest during the same year prior to incubation (Rosenfield et al. 1991b). No information is available on nest characteristics of Cooper's hawks in the BHNF but it can be inferred that they are similar to the above description.

Clutch Initiation And Size

Rosenfield and Bielefeldt (1993) reviewed clutch initiation and clutch size of Cooper's hawks. The timing of clutch initiation varies within and between regions. Dates reported for egg laying in various states are from early to late April in Florida, Arizona, Wisconsin, and California; late April to early May in New York and Ontario; and early to mid-May in Oregon. Most females initiated egg-laying by mid-May in North Dakota (Nenneman et al. [b] *In review*).

A range of mean clutch sizes of Cooper's hawk nests from several studies in North America is 3.3 to 4.3 eggs with no discernable geographic trends. In Oregon, the mean clutch size of single-year females was significantly lower than that of after-second year females.

Parental Care

Rosenfield and Bielefeldt (1993) reviewed parental care by Cooper's hawks. The female is usually responsible for the incubation of eggs and brooding, which usually occurs until nestlings are 14 days old. The male delivers most of the food to the female (2 – 3 times daily) at a nearby perch and may incubate for 10 – 25 minutes while the female eats. Direct feeding to the nestlings is by the female only, until the young are about 18 – 21 days and able to dismember prey. The rate of feeding varies with nestling size and brood size, and peaks in the fourth week. For the entire nestling stage, the mean number of prey deliveries (broods = 3 – 5) is six to nine items per day.

In what is likely to be very uncommon, Boal and Spaulding (2000) documented a nesting attempt involving three Cooper's hawks, an adult and subadult male and an adult female in Arizona. The adult and subadult male made prey deliveries to the adult female and all three hawks engaged in nest defense. No evidence of intraspecific aggression was observed among the three hawks.

Site And Mate Fidelity

In Wisconsin, male and female Cooper's hawks displayed different patterns of nest site fidelity (Rosenfield and Bielefeldt 1996). No breeding dispersal was detected in males as all 98 recaptures of 65 different males occurred on the same nesting areas where they were initially caught. One male occupied the same nesting area for eight years. Six (15%) of the recaptured females (n = 40) dispersed a mean distance of 4.3 km (range = 1.7 – 4.6 km) to different nesting areas. Only one female dispersed twice. In Oregon, at least three females used the same nest site for two years each (Moore and Henny 1984). Females in Oregon returned to the same territory significantly more often after a successful nest attempt than after a failure. No information is available on site and mate fidelity of Cooper's hawks in the BHNF.

Demography

Life History Characteristics

The maximum reported age of a Cooper's hawk is 12 years and the greatest known age of a breeding bird is at least nine years old (Rosenfield and Bielefeldt 1993). Age of first reproduction is usually not until after the second year for males (Moore and Henny 1984). Older males are presumed to be competitively superior to yearlings with respect to defense of a territory, attracting mates, and provisioning food (Lieske et al. 1997). Second-year females have been known to represent 22% of the breeding females (Moore and Henny 1984). In Oregon, adult females (>2 years) produced an average of 2.5 (3 – 4 weeks old) fledglings versus only 1.75 for the younger, second-year females (Moore and Henny 1984).

Parameters used to estimate reproductive rates of Cooper's hawks include clutch size, mean average number of bandable young per nest, and nest success (Table 3). Definitions of bandable young vary between studies so it is difficult to make meaningful comparisons. In north central North Dakota, there was an average of 2.0 bandable young (>23 days) per active nest (Nenneman et al. [a] *In review*), nest success was 69%, and no information was provided on clutch size. At nests in Wisconsin, mean clutch size was 4.3, the average number of bandable young (>14 days) was 3.5 per active nest, and nest success was 69% (Bielefeldt et al. 1998). In urban Wisconsin, mean clutch size was 4.2, average number of bandable young (age not defined) was 4.0 per nest, which is comparable to the highest reported values for this raptor in North America, and no estimates of nest success were given (Rosenfield et al. 1996).

Table 3. Measures of Cooper's hawk reproductive success (sample sizes in parentheses) (Rosenfield and Bielefeldt 1993).

State	Hatching success (%)	Nest success (%)	Mean no. of Fledglings per active nest1	Mean no. of Fledglings per successful nest
MICHIGAN	74 (54)	na[2]	2.8 (13)	Na
WISCONSIN	96 (111)	69 (83)	2.4 (83)[3]	3.5 (57)[3]
OREGON	74 (50)	69 (29)	2.1 (24)	2.9 (na)
UTAH	na	53 (43)	1.6 (43)	2.9 (23)
ARIZONA	88 (na)	85 (46)	2.6 (46)	3.1 (34)
CALIFORNIA	77 (221)	85 (55)	2.3 (55)	2.7 (47)
IOWA	na	69 (29)	2.1 (29)	3.0 (20)

[1] Active nests defined as those in which eggs were laid.

[2] na = not available.

[3] Number of bandable young aged ≥ 14 days.

Survival And Reproduction

Mortality rates of raptors are highest during the first year of life. During the 1941 – 1957 period, mortality rates of first-year and adult Cooper's hawks were estimated at 72% - 78% and 34% - 37%, respectively (Henny and Wight 1972). No information is available on ecological influences to reproduction or survival rates of Cooper's hawks in the BHNF.

Social Pattern For Spacing

Various methods have been used to estimate home range size of Cooper's hawks during the breeding season. Nest density is used as an index of home range size between birds but it does not take into account overlap of territories. Telemetry studies provide more reliable estimates of home range size and percentages of territory overlap. Estimates obtained from both methods are discussed below.

In the western United States, reported nesting densities of Cooper's hawks range from one nest per 671 ha to one nest per 2,326 ha (Reynolds 1989 in Rosenfield and Bielefeldt 1993). In North Dakota, the mean nest density was one occupied nest per 292 ha and one occupied nest per 395 ha on two intensively searched areas (Nenneman et al. [a] *In review*). In Wisconsin, the average was one nest per 1,907 ha (Bielefeldt et al. 1998). In New Mexico, Kennedy (1989 in Mannan and Boal 2000) estimated the home range size of males to be 1,206 ha based on telemetry.

Studies of raptors have reported that home range size is a function of prey availability. Newton (1986) found that sparrowhawks (*Accipiter nisus*) in Scotland became sedentary when prey animals were abundant and ranged widely when prey animals were scarce. Home ranges of Cooper's hawks in urban landscapes are typically smaller than in habitats where much of the natural vegetation still exists, which is likely due to higher prey density and prey availability in urban habitats. The mean home range size of nine, adult, male Cooper's hawks in Tucson, Arizona was only 65.5 ha (range = 13.3 – 130.6 ha; Mannan and Boal 2000). Doves were abundant in Tucson and were the primary prey of Cooper's hawks. Other trends in observed in the spacing of Cooper's hawks were that home range sizes generally decreased with the number of years a hawk had lived on a breeding territory. Only one pair of home ranges overlapped each other; the overlap included 14.2% and 10.6% of each territory. In suburban Wisconsin, a male Cooper's hawk had a breeding season home range of 784 ha but spent 88% of daylight time in only 12% of the home range (Murphy et al. 1988). Urban areas have also reported some of the highest nest densities. Mean nest density was one nest per 272 ha in Stevens Point, Wisconsin (Rosenfield et al. 1996) and one nest per 437 ha in Tucson, Arizona (Boal and Mannan 1998). No information is available on home range size or nest density of Cooper's hawks in the BHNF.

Local Density Estimates

No estimates of Cooper's hawk density in the BHNF are available.

Limiting Factors

Currently, the single most imminent threat to Accipiters is that of habitat alteration and/or destruction (White *in* Jones 1979). Habitat loss decreases the availability of nest sites, which can limit Accipiter populations (Reynolds 1983). However, the impacts of habitat alteration are somewhat controversial, as Cooper's hawks have been documented to successfully breed in urban environments such as Tucson, Arizona (Boal and Mannan 1999, Bielefeldt and Rosenfield 2000, Boal and Mannan 2000).

Habitat loss can decrease prey abundance and prey availability, which can also limit Accipiter populations. Petty et al. (1995) reported that reproductive success of sparrowhawks decreased as food availability decreased. In 1991, a heavy cone crop year, songbird density was four times higher than in 1992 and sparrowhawks increased their breeding numbers and productivity so that seven times more chicks were reared in 1991 than in 1992.

Millsap (1981) reported that livestock grazing has probably affected populations in Arizona. Cooper's hawks nesting in lightly grazed areas laid an average of 1.6 more eggs, hatched 1.4 more eggs, and fledged 1.1 more young than pairs in similar but heavily grazed regions.

Patterns Of Dispersal

Information on natal and adult dispersal of Cooper's hawks is scarce. Rosenfield and Bielefeldt (1992) documented the natal dispersal of Cooper's hawks in Wisconsin. Males (n = 6) dispersed in all directions and moved an average of 12.0 km. A female moved 14.4 km, which was farther than 5 of 6 males. For Cooper's hawks in New York, Meng (1951) reported that of all the young hawks he banded, none were ever found nesting within 20 miles of the nest they hatched from. No information is available on the dispersal of Cooper's hawks in the BHNF.

Community Ecology

Predators And Relation To Habitat Use

Predation in this document is considered killing for food (Taylor 1984). Information on predators and relation to habitat use is scarce, relative to Cooper's hawks. Raccoons (*Procyon lotor*) and great horned owls (*Bubo virginianus*) are predators of Cooper's hawk (Rosenfield and Bielfeldt 1993, Nenneman et al [b] *In* review). Other potential predators across the Cooper's hawks range might include domestic cats (*Felis catus*), opossums (*Didelphis virginiana*), American crows (*Corvus brachyrhynchos*), northern goshawks, and red-tailed hawks (*Buteo jamaicensis*).

In assessing the vulnerability of Cooper's hawks to predation resulting from habitat change, timber harvest is assumed to be the main form of habitat change to occur in the BHNF. It should be noted though that the impacts of timber harvest are unique from site to site, depending on the successional stage at the time of harvest, the form and intensity of harvest, and whether or not Cooper's hawks use an area prior to harvest. A scenario where timber harvest could be detrimental to Cooper's hawks is when a harvest occurs in a nest stand. Cooper's hawks typically select nest sites with high tree density and canopy cover, which provide cover and protection from predators (Bosakowski et al. 1992, Reynolds et al. 1982). Timber harvest in nest stands decreases tree density and canopy cover, thus, increasing the likelihood of detection by predators (Reynolds 1989). Kennedy (1988) recommended leaving uncut areas of approximately 10 ha around active nests of Accipiters.

Competitors

Competition is considered the "…negative effects which one organism has upon another by consuming, or controlling access to, a resource that is limited in availability" (Keddy 1989). Interspecific and intraspecific competition are the two forms of competition discussed here.

Interspecific competition might exist between Cooper's hawks, northern goshawks, and sharp-shinned hawks since overlap occurs in their nesting habitats and diets (Moore and Henny 1983, Siders and Kennedy 1996). Observations of interspecific competition between these species are rare but Moore and Henny (1983) reported an incidence in which a goshawk pair replaced a Cooper's hawk pair at the same nest site the following year.

Few cases of intraspecific competition have been reported. During the breeding season, no cases of extra-pair copulations have been observed (Rosenfield and Bielefeldt 1993). Boal and Spaulding (2000) documented a nesting attempt involving three Cooper's hawks, an adult and subadult male and an adult female in Arizona. The adult and subadult male made prey deliveries to the adult female and all three hawks engaged in nest defense. No evidence of intraspecific aggression was observed among the three hawks. Cooper's hawks are thought to be solitary outside the breeding season.

Parasites, Disease, And Mutualistic Interactions

Rosenfield and Bielefeldt (1993) summarized the available information on body parasites of Cooper's hawks. Documented body parasites include dipterans in the family Calliphoridae and Hippoboscidae, mallophagial bird lice of two species, a tapeworm in the genus *Cladotaenia*, plus *Haemoproteus* spp., *Leucocytozoon toddi*, and a microfilarian among hematozoa, and *Neiodiplostomum*, *Strigea falconis*, *Cyrnae*, *Porrocaecum*, and *Serratospiculoides amaculata* among helminths.

Trichomoniasis is an avian disease caused by the parasitic protozoan, *Trichomonas gallinae*, which caused 79% of Cooper's hawk nestling mortality in Tucson, Arizona (Boal and Mannan 1999). The link between the disease and the Cooper's hawk is probably related to the high densities of mourning doves (*Zenaida macroura*) and Inca doves (*Columbina inca*) in the city, which are hosts of the parasite. None of the nestlings at exurban nest sites died of trichmoniasis.

Risk Factors

Practices that reduce nesting and foraging habitat quality are presumed to be the major threats to Cooper's hawk viability in the BHNF. Habitat loss decreases the availability of nest sites and prey, which can limit Accipiter populations (Reynolds 1983). Timber harvest is likely to be the most common form of habitat loss on the BHNF. Additional risk factors include grazing (Millsap 1981), decreased survival due to human disturbance and habituation (Snyder and Snyder 1974), shooting (Henny and Wight 1972), collisions with vehicles (Boal and Mannan 1999), and environmental contaminants (Pattee et al. 1985, Rosenfield et al. 1991a, Boal and Mannan 1999).

Cooper's Hawk Responses To Habitat Change

Management Activities

<u>Timber Harvest</u>

Cooper's hawks nest in habitats with specific structure. This specificity makes them susceptible to changes in forest stands brought about by timber harvest (Reynolds et al. 1982). It should be noted though that impacts of timber harvest to Cooper's hawks will be unique from site to site depending on the structure of the forest at the time of harvest, the form and intensity of harvest, and the temporal perspective.

The BHNF has proposed the following levels of timber harvest under Alternative G, the preferred alternative (BHNF 1996). Over the next ten years, 5,400 acres per year of precommercial thinning harvests and 25,500 acres per year of commercial harvesting would occur. Several different forms of commercial harvest would occur but the two main forms proposed are shelterwood seed cuts (15,600 acres/year) and overstory removal harvest (6,100 acres/year), which would combine to 85% of the commercial harvest. Presented below is a discussion of how these forms of harvest might affect Cooper's hawks.

Precommercial thinning occurs in stands too small in diameter to be sold for wood products and the end result is decreased sapling density (BHNF 1996). Reynolds (1983) states that active and prospective nest sites should not be precommercially or commercially thinned, because this will result in reduced stand densities and deeper tree crowns. Reduced stand densities and deeper tree crowns could increase the vulnerability of Cooper's hawks to predation. Additionally, several studies have documented that sapling-sized trees are a common characteristic of nest sites (Moore and Henny 1983, Siders and Kennedy 1996). Even though the level of Cooper's hawk dependence upon these saplings is not understood, it is important to acknowledge that saplings could be an important component of their habitat during the breeding season. Precommercial harvest might also negatively impact Cooper's hawks if the operation occurred in areas adjacent to nest stands during the nesting season.

The objective of shelterwood seed cuts is to cut all the trees except those needed to produce seed to regenerate the stand. It is likely that shelterwood seed cuts would adversely affect Cooper's hawks by the reduction in tree density and canopy closure. Cooper's hawks presumably nest in areas with high tree density because of the decreased potential of nest predation (Reynolds 1989). Dense forest is also presumed to be important for foraging because it provides perch sites from which attacks are launched and because it enables them to ambush prey. Dykstra (1996) reported that Cooper's hawks were only detected in unharvested stands in the Black Hills.

The objective of overstory removal harvest is to remove the remaining trees that were left to seed the area from the previous seed cut. This form of harvest would presumably have little influence on Cooper's hawks because areas where overstory removal harvest occurs are likely to have already been abandoned. If Cooper's hawks were still using sites where overstory removal harvests were planned, it could adversely affect Cooper's hawks by removing the remaining nest sites.

Recreation

The BHNF (1996) measures recreation through both dispersed and developed recreation. Dispersed recreation is outdoor recreation that occurs on all areas of the Forest outside developed recreation sites (BHNF 1996). Developed recreation includes all recreational activities that take place on a developed recreation site (BHNF 1996). Over the next 10 years, the BHNF will construct an estimated 138 miles of new roads and 22 recreation sites for developed recreation. There are no positive benefits of recreation to Cooper's hawks that we are aware of. Through the building of roads and new recreation sites, developed recreation will cause habitat loss and potentially increase the incidence of vehicle collisions with Cooper's hawks. The frequency of vehicle collisions is likely to be lower on dirt roads than paved roads due to slower-moving traffic on dirt roads. Additionally, if developed recreation occurs near Cooper's hawk nest stands, it could result in decreased survival (Snyder and Snyder 1974, Boal and Mannan 1999).

Livestock Grazing

Livestock grazing throughout the BHNF is common as 84% of Forest lands are suitable. Habitat changes resulting from grazing could be either structural, through modification of vertical diversity, or compositional, through changes in the vegetative species (BHNF 1996). A detrimental effect of grazing in the BHNF is likely to be decreased understory in forested areas. As mentioned earlier, the most common prey of Cooper's hawks are mid-sized birds and mammals commonly found on the ground (Rosenfield and Bielefeldt 1993). Grazing could reduce the habitat quality of prey species and result in lower prey availability. Millsap (1981) reported that livestock grazing has probably effected population declines in Arizona. Cooper's hawks nesting in lightly grazed areas laid an average of 1.6 more eggs, hatched 1.4 more eggs, and fledged 1.1 more young than pairs in similar but heavily grazed regions. The difference between lightly and heavily grazed was not quantified.

Mining

Effects of ground disturbance from mining could have variable levels of impacts to Cooper's hawks and their prey depending on the extent and intensity of the disturbance. Over time, the most important minerals to the Black Hills economy have been gold, silver, iron, uranium and pegmatite minerals (BHNF 1996). In Idaho, Henny et al. (1994) reported that mining and smelting resulted in high concentrations of lead in Couer d'Alene River sediments and the floodplain downstream, where several species of raptors nested. Measurements of blood characteristics from American kestrels (*Falco sparverius*) and Northern harriers (*Circus cyaneus*) indicated higher levels of lead-exposure on treatment sites compared to control sites. However, no raptor deaths related to lead were observed, and the production rates of raptors at control and treatment sites were similar. Several traits of raptors apparently reduce their potential for accumulating critical levels of lead which is primarily stored in bones of prey species (Henny et al. 1994).

The development of new mining sites is likely to be accompanied by road construction. This could adversely affect Cooper's hawks by the increased likelihood of collisions with vehicles, and the loss and fragmentation of nesting and foraging habitat.

Prescribed Fire

On the BHNF, 5,600 – 8,000 acres are proposed to be burned annually by prescribed fires (BHNF 1996). Prescribed burns simulate natural forms of disturbance that occur periodically across the landscape. These forms of disturbance are likely to be important in providing future nest sites for Cooper's hawks. Reynolds (1983) recommends that it is important to manage for a turn-over of nest sites as tree growth and the associated changes in the vegetative structure occur.

Fire Suppression

Perhaps the most subtle but far-reaching human effect on the Black Hills has been fire suppression (Knight 1994). Fire suppression has been a guiding principle for land management in the BHNF. Historically, surface fires every 5 – 25 years characterized ponderosa pine forests, the most common cover type in the BHNF. Burning kills most young trees but usually not the older trees, because of their thick bark. Fire also maintains a more open forest with low amounts of fuel. Results of fire suppression include an increase in tree density and an increased likelihood of crown fires. How increased tree density interferes effects Cooper's hawks should depend on the degree that tree density increases. If tree density is too high, it could interfere with the ability of the Cooper's hawk to fly and hunt. However, increased tree density in some areas might improve the quality of the habitat for nesting. Studies that have reported values of tree density at Cooper's hawks nest sites (Moore and Henny 1983, Siders and Kennedy 1996) provide a range of values that can serve as guidelines for what Cooper's hawks can tolerate (Table 4).

Table 4. Tree density at Cooper's hawk nest sites .

Oregon – Moore and Henny (1983)			
Tree DBH	**Density/0.08 ha**	**S.D.**	**Mean Density/ha**
2.5 – 8.9 cm	74.7	69.9	934
8.9 – 16.5 cm	38.2	21.9	478
16.5 – 31.7 cm	24.7	12.1	309
31.7 – 41.9 cm	6.8	4.3	85
> 42 cm	2.8	3.6	35
Basal area (m^2)	146.0	86.7	
Mean DBH (cm)	15.0	5.6	

New Mexico – Siders and Kennedy 1996	
Tree DBH	**Density/ha**
2.5 – 12.6 cm	390 – 1,115
12.7 – 30.4 cm	170 – 520
30.5 – 45.6 cm	40 – 130
> 45.6 cm	10 – 60
Basal area (m^2 ha^{-1})	29 – 42

Oregon – Reynolds et al. (1982)	
Tree Density/ha	656 – 1,159

High-intensity crown fires are presumed to be the most deleterious consequence of fire suppression. Crown fires result in vast stand-replacing disturbances with significant habitat loss. The Elk Mountain Complex Fire and the Jasper Fire are recent examples of this in the BHNF. See the section below on wildfire for a more detailed discussion on the impacts of high-intensity crown fires.

<u>**Non-Native Plant Establishment And Control**</u>

Cheatgrass (*Bromus* spp.) could be a problem for the Cooper's hawk and their prey in the grasslands of the BHNF. Knight (1994) reviewed the impacts of cheatgrass. This exotic species invades areas after a disturbance from nearby sites, leads to the rapid accumulation of a highly flammable fuel, and shortens the fire-free interval. Fires occur more frequently, thereby diminishing the chances of sagebrush reestablishment and causing a decline in some perennial grass species, thus favoring cheatgrass expansion still further. The ultimate result is a loss in the heterogeneity of the landscape, and probably lowered prey diversity, abundance, and availability for Cooper's hawks. The invasion of this species can be hastened by the burning of areas adjacent to cheatgrass and also by livestock grazing.

Fuelwood Harvest

Fuelwood harvest in the BHNF occurs by individuals that search out dead and down material to cut up for their personal use while in the Forest. Fuelwood harvest could adversely affect Cooper's hawks if snags are removed that are used as perch sites.

Falconry

Cooper's hawks can legally be taken for falconry in South Dakota and Wyoming. Due to this Accipiter's reputation among falconers as temperamental and difficult to train, take by falconers in both states is low. Therefore, falconry is presumed to be negligible as a threat to population viability on the BHNF.

Natural Disturbance

Insect Epidemics

The most aggressive and destructive insect in the Black Hills, from the commercial forest management perspective, is the mountain pine beetle (*Dendroctonus ponderosae*; BHNF 1996). When populations of this beetle grow to large numbers, they are capable of killing many trees and most of the mortality occurs to the large trees (Knight 1994). The insect prefers dense pine stands, containing trees between 7 to 13 inches DBH (17.8 – 33.0 cm) (Lessard 1982 in BHNF 1996). Suppression of wildfire this century has resulted in more densely stocked stands of timber that are more susceptible to attack (BHNF 1996). When large-scale mountain pine beetle attacks occur, the likelihood of high-intensity crown fires will increase and possibly result in large expanses of habitat being lost.

Wildfire

Wildfire can have a wide range of potential effects on landscapes of the Black Hills, depending on size and intensity of fire, stand type, fire frequency, and post-fire successional trajectory (Buskirk 2001). Surface fires every 5 – 25 years have historically characterized ponderosa pine forests in the BHNF (Knight 1994). These low-intensity fires are thought to be beneficial to Cooper's hawks by maintaining open understories and visibility. However, high-intensity crown fires in the BHNF are likely to negatively affect Cooper's hawk population viability.

Abnormally high fuel build-ups resulting from years of fire suppression have increased the probability of large, catastrophic fires that could destroy vast expanses of habitat. This became apparent during the Jasper Fire of August 2000 and the Elk Mountain Complex Fire of 2001. The Jasper Fire burned 83,000 acres of which 39% burned at high intensity meaning trees were devoid of needles (http://www.fs.fed.us/r2/blackhills/fp/fire/Jasper/Jasper.htm), and the Elk

Mountain Complex Fire burnt 26,000 acres. Areas of complete mortality that are far removed from a viable seed source could take as long as 200 years to regenerate (http://www.fs.fed.us/r2/blackhills/fp/fire/Jasper/Jasper.htm). These are long-term, large-scale losses of Cooper's hawk habitat that could possibly decrease population size and viability on the BHNF.

Wind Events

Wind, especially tornadoes and microbursts, is capable of altering the physical structure of forests very quickly, killing large numbers of trees (Veblen et al. 1989). However, these effects are typically small in scale and short in duration so the impacts to the Cooper's hawk population over the long-term are thought to be negligible.

Other Weather Events

Other weather events that could potentially effect Cooper's hawks are cold temperatures, freezing rain, heavy snowfall, and drought during the breeding season. Freezing rain and snowfall during the breeding season could cause high nestling mortality and decreased recruitment. Drought could cause low survivorship of prey nestlings and thus, insufficient prey availability to reproduce successfully.

SUMMARY

The Cooper's hawk is one of three Accipiters that inhabits the woodlands of North America. They have a relatively short life span with the oldest known individual at 12 years. The mortality rate of juveniles and adults from 1941 –1957 was 72% – 78% and 34% – 37%, respectively. These mortality rates are possibly higher than current mortality rates due to the high use of DDT from the 1940s to the 1970s. Unfortunately, current estimates of survivorship were not found for comparison. They typically have high reproductive success (69% in North Dakota and Wisconsin) and a mean clutch size ranging from 3.3 – 4.3 eggs. The breeding density of Cooper's hawks in the western U.S. ranges from one nest per 671 ha – 2,326 ha. In partially forested areas of the Great Plains in North Dakota, nest densities as high as one nest per 292 ha have been reported. The mean home range of male Cooper's hawks in New Mexico was 1,206 ha. Their diet consists of a variety of birds and mammals that are commonly found foraging on or near the ground. Common prey items throughout much of their range include chipmunks, ground squirrels, robins, jays, blackbirds, sparrows, and flickers. The diet of Cooper's hawks in the Black Hills presumably includes red squirrels, least chipmunks, thirteen-lined ground squirrels, bushy-tailed woodrats, voles, Nuttall's cottontails, ruffed grouse, northern flickers, black-backed woodpeckers, three-toed woodpeckers, American robins, Townsends's solitaire, and dark-eyed juncos.

Cooper's hawks occur in a variety of habitats but similar characteristics are selected at occupied sites throughout their range. Similarities between study areas include the use of nest trees with greater DBH, tree height, and higher canopy cover than is randomly available. However, differences are also apparent between study areas. The average nest tree height was 9.5 m in North Dakota while it was 25.0 m in New York and New Jersey. In Utah, average nest tree DBH was 17.6 cm while it was 79.0 cm in Arizona. Canopy cover varies by as much as 25% between study areas. It is important to take these differences into account when making inferences about habitat use from other studies to the BHNF.

The Migratory Bird Treaty Act of 1972 protects Cooper's hawks throughout their range but they are not designated any special conservation status by the FWS or the USFS. In Wyoming, they are considered to be common and do not have any special conservation status. In South Dakota during the breeding season, Cooper's hawks are either very rare and local throughout their range, or found locally (even abundantly at some if their locations) in a restricted range, or vulnerable to extinction throughout their range because of other factors. Cooper's hawks are taken for falconry in Wyoming and South Dakota. They are considered uncommon but well distributed in the Black Hills. Trends in North America indicate that populations have been increasing since DDT use was eliminated in the 1970s.

Loss of nesting and foraging habitat are presumably the greatest risks to Cooper's hawk viability in the BHNF. Timber harvest is the most likely method by which habitat loss occurs on the Forest but it can also be used as a tool to improve habitat. The impacts from timber harvest depend on the location, method, intensity of harvest, and temporal perspective.

Livestock grazing could have negative effects on Cooper's hawks and their prey species. In Arizona, Cooper's hawks nesting in highly grazed areas had lower clutch sizes and numbers of fledglings per nest than in lightly grazed areas. It is unlikely that the proposed levels of recreation and mining would have important effects on Cooper's hawk viability in the BHNF. Prescribed fire is likely to be important in providing future nest sites but it could negatively affect Cooper's hawks if it occurs in nest stands that are used at the time of burning. Continued fire suppression could adversely affect Cooper's hawks by increasing tree density and increasing fuel-loads on the Forest, which could result in high-intensity wildfires that destroy vast expanses of nesting habitat. The effects of fire suppression became apparent during the Jasper Fire of August 2000 that burned 83,000 acres and the Elk Mountain Complex Fire of 2001 that burned 26,000 acres. Cheatgrass is assumed to be the non-native plant species that could most negatively affect Cooper's hawks in the BHNF. Cheatgrass decreases the heterogeneity of the landscape, which could result in lower prey diversity, abundance, and availability. The effect of fuelwood harvest to Cooper's hawks in the BHNF likely depends on the form and extent. Over the long term, insect disturbances and weather events are unlikely to adversely effect Cooper's hawk viability on the BHNF as Cooper's hawks have evolved with these disturbances.

REVIEW OF CONSERVATION PRACTICES

Management Practices

The Migratory Bird Treaty Act of 1972 protects Cooper's hawks throughout their range. Management practices in North America that specifically target Cooper's hawks are rare. On the BHNF, an ecosystem management approach has been used in an attempt to follow the guidelines in the National Forest Management Act and its implementing regulations. The goal is to manage for a mix of habitats across the entire Forest to provide for species diversity and viability while also managing for different uses. With respect to individual species such as the Cooper's hawk, the impacts of activities on the Forest are assessed before they occur and an attempt is made to mitigate negative impacts. Successful ecosystem management on the Forest is often a difficult task due to the large number of species with diverse habitat needs and the large number of management activities such as timber harvest, recreation, mineral extraction, etc. Other than these assessments, management activities by the BHNF specifically for this species are limited.

Reynolds (1983) made several recommendations for managers attempting to maintain populations of Cooper's hawks in western coniferous forests: (1) uncut areas of approximately 6 ha should be left around active nests, (2) management of Accipiter habitat must consider the turnover of nest sites due to time. Prospective replacement nest sites within the home range of each pair should be selected and managed accordingly, (3) active and prospective nest sites should not be precommercially or commercially thinned, because this will result in reduced stand densities and deeper tree crowns, and (4) determine the desirable nesting density and maintain the landscape so that an appropriate number of nest sites are available.

Forest management recommendations from Kennedy (1988) were: (1) search all proposed timber sales for Accipiter nests during the nestling stage, (2) leave uncut areas of approximately 10 ha around active nests, (3) do not isolate nest sites by silvicultural treatments such as clearcutting or total canopy removal, (4) minimize logging of riparian canyons as these areas tend to have large-diameter trees and provide nesting habitat, (5) in areas where commercial thinning occurs, create brush piles to provide habitat for medium-sized mammals such as cottontails or chipmunks, (6) if commercial thinning occurs at a nest site, maintain a minimum of 10 snags/ha, and (7) minimize human disturbance near nest sites during the breeding season.

Bosakowski et al. (1992) recommended that the entire territory of an active nest should receive complete protection from habitat alterations. The suggested method to estimate territory size was half the mean nearest-neighbor distance.

Models

There are no models we are aware of that model habitat, effects, or other items of interest to Cooper's hawk managers.

Survey And Inventory Approaches (Presence/Absence)

Several techniques are used to survey and inventory the presence/absence of Cooper's hawks. The use of different techniques depends on the scale of the area to be inventoried. Throughout North America, the BBS (Sauer et al. 2001) and CBC (Sauer et al. 1996) are used to survey Cooper's hawk presence/absence and estimate population trends. A strength of these surveys is that data are collected throughout most of North America in an attempt to detect rangewide trends. Some weaknesses are that many people are needed, it is very time consuming to compile and analyze all the data, and statistical significance is often low.

At a smaller scale, yearly surveys can be conducted for breeding raptors, which are aimed at identifying and protecting habitat, and estimating local population trends. The BHNF does not maintain a collection of historical Cooper's hawk nest sites on the Forest (Rob Hoelscher, BHNF, personal communication). If such information was collected, it would provide habitat use information specific to the Black Hills from which the impacts of future management activites could be more accurately mitigated. Methods used to survey breeding raptors include visiting historical nest sites to assess reoccupancy and the playback of conspecific calls to increase detectability of raptors (Rosenfield et al. 1988). Surveys using conspecific calls across the entire BHNF would require a significant amount of time and money. A more cost-effective option would be to survey historical nest sites and areas of concern such as proposed timber harvest sites. Rosenfield et al. (1995) proposed evaluating nest area reoccupancy of Cooper's hawks in Wisconsin at six-year intervals. This interval approximates the maximum known site fidelity from their study, thereby excluding the potential effect of nest area fidelity on estimates of reoccupancy rates. If a studied population exhibits long-term use of breeding sites by different adults (i.e., recruitment) then the population could be assumed to be at least stable.

Monitoring Approaches (Habitat, Population Trend, Presence/Absence And Persistence)

The BBS, CBC, searching historic nest sites to monitor nest reoccupancy, and the systematized searching of new areas for signs of breeding activity are approaches used to monitor Cooper's hawks that have already been discussed above. Migration counts, banding, and radio telemetry are additional methods that monitor habitat, population trends, presence/absence and persistence. Migration counts can establish population trends over periods of time. A limitation associated with migration counts is that multiple years of data are required before meaningful estimates of population trends can be made. Also, the counts do not assess where the birds originated so the application of the data to specific areas such the BHNF is limited. Banding can also be used to study survivorship and dispersal. A disadvantage of banding is that a sometimes unrealistically large number of bands are needed due to low recovery rates. Keran (1981) reported that the return rate for banded Cooper's hawks was 1.5%. A radio telemetry study of Cooper's hawks nesting within the BHNF would be beneficial by providing home range and habitat use information during the breeding season. Additional information obtained from a radio telemetry study might include the timing and extent of migration, and habitat use during the winter. Habitat requirements specific to the BHNF would be the goal of such a study and would better enable managers to mitigate the impacts of management activities to Cooper's hawks. Problems associated with this technique are that radio telemetry equipment is expensive, acquisition of the data is time consuming, and Cooper's hawks occur at low densities in the BHNF. Low densities of breeding Cooper's hawks could result in questions about the statistical validity of the data due to a small sample of telemetered birds.

ADDITIONAL INFORMATION NEEDS

Currently, management directives aimed specifically at Cooper's hawks on the BHNF are limited. Initially, data of historical nest sites on the Forest should be collected. Additionally, these nest sites could be monitored on a yearly basis. Information from nest monitoring would establish population trend, reoccupancy rates, recruitment rates, and habitat use information of nest sites. Ideally, nestlings should be banded so that information on survival and dispersal might be collected. A radio telemetry study of Cooper's hawks within the BHNF would be beneficial by providing information about home range and habitat use, including foraging habitat, during the breeding season. Information might also be collected on winter habitat use, and the timing and extent of migration. Habitat requirements specific to the BHNF would be the ultimate goal of such a study and would better enable managers to mitigate the impacts of management activities to Cooper's hawks.

Reynolds (1983) summarized the additional information needs for Cooper's hawk management: (1) study the impacts of forest management on the nesting density of this species, (2) confirm the suggested size and shape of uncut areas around nest sites, and (3) determine, with telemetry, the size and shape of home ranges, the types of habitats included within ranges, and the extent to which these habitats are used for foraging by these hawks.

Finally, more research is needed to better understand the long-term effects of human disturbance to Cooper's hawks. For example, Snyder and Snyder (1974) reported that recoveries of banded Cooper's hawks exposed to frequent handling and exposure to research personnel were significantly more likely than recoveries of nestlings not disturbed as frequently. Forest managers would benefit from better information on the types and degrees of disturbance Cooper's hawks can tolerate.

SHARP-SHINNED HAWK

REVIEW OF TECHNICAL KNOWLEDGE

Systematics

Taxonomy of sharp-shinned hawks is complex (Bildstein and Meyer 2000). The American Ornithologist's Union (1998) recognizes 10 subspecies which are divided into three subspecies groups: the sharp-shinned hawk (*striatus* group) of North America to southern Mexico, the white-breasted hawk (*chionogaster* group) of Central America, and rufous-thighed hawk (*erythronemius* group) of southeast South America. The North American resident or migratory subspecies in the *Accipiter striatus* group are *A. striatus velox*, *A. s. perobcurus*, *A. s. suttoni*, and *A. s. madrensis*. The most widespread subspecies in North America and the one present in the BHNF is *A. s. velox*; therefore they are the focus of this report. Sharp-shinned hawks are the smallest member of the North American Accipiter family, which also includes Northern goshawks and Cooper's hawks. Sharp-shinned hawks are sometimes confused with Cooper's hawks (Bildstein and Meyer 2000). They are smaller than Cooper's hawks, their tail is squarish and not rounded at the tip as is the Cooper's hawks, and sharp-shinned hawks lack the prominent dark cap of Cooper's hawks (Bildstein and Meyer 2000).

Distribution And Abundance

Bildstein and Meyer (2000) summarized the breeding and non-breeding distribution of sharp-shinned hawks. During the breeding season, the northern extent of their range occurs from Alaska to Newfoundland, throughout most of the conterminous United States, and south into Mexico, Central America, and South America wherever suitable habitat exists. Sharp-shinned hawks are partial migrants, albeit sometimes a long-distance (>1,500 km) migrants throughout much of their North America range. The northern-most breeders largely abandon their breeding grounds and commonly winter in the southern U.S. while some birds remain in their breeding range throughout the winter.

In the South Dakota Breeding Bird Atlas, sharp-shinned hawks are considered 'uncommon' and only occur in the western part of the state (Peterson 1995). During field work for the South Dakota Breeding Bird Atlas (1988-1993), one breeding pair was confirmed in South Dakota, the presence of another breeding pair was probable, the presence of another 10 breeding pairs was possible, and three other individuals were observed without any evidence of breeding (Peterson 1995). Sharp-shinned hawks were reported at all elevations of the Black Hills (Peterson 1995). Two pairs of breeding sharp-shinned hawks were observed on the BHNF in South Dakota during the summer of 2001 (Sean Mohren, University of Wyoming, personal communication). Sharp-shinned hawks winter in the Black Hills also (Palmer 1995). In Wyoming, sharp-shinned hawks are classified as a 'common summer resident' with some individuals remaining during the winter (Wyoming Game and Fish Department 1999). They have been observed throughout much of southeastern Montana during the breeding season and winter (Bergeron et al. 1992). In Nebraska, sharp-shinned hawks are probably irregular or sporadic breeders with a rare, very restricted distribution, and are regarded as uncommon to occasional winter visitors (Mollhoff 2001, Sharpe et al. 2001). They were found only on the central Niobrara River, the Pine Ridge, and the Nebraska National Forest in Thomas County during the breeding season (Mollhoff 2001).

Population Trend

Historically, environmental contaminants have had a major impact upon raptor populations in North America. Population declines of sharp-shinned hawks and other raptors from 1940s through the 1970s were attributed mostly to pesticides, such as DDT, that caused eggshell thinning and decreased reproductive success (Elliott and Martin 1994, Snyder et al. 1973). After many environmental contaminants were banned in the early 1970s, sharp-shinned hawk numbers increased (Bednarz et al. 1990). The BBS estimated that sharp-shinned hawks increased 7.19% per year ($P < 0.001$) over the entire survey area between 1966 and 2000 (Sauer et al. 2001). From 1980 – 2000, the BBS did not detect a significant trend (+2.85%; $P = 0.649$) for U.S. Fish and Wildlife Service Region 6, which includes the BHNF (Sauer et al. 2001). The CBC estimated an increase of 1.4% ($P < 0.01$) between 1959 and 1988 over the entire CBC survey area (Sauer et al. 1996). However, numbers of sharp-shinned hawks counted at raptor-migration watch sites in eastern North America declined in the 1980s and early 1990s but the decline is thought to be caused at least partially by migratory short-stopping (Duncan 1996, Viverette et al. 1996). Migratory short-stopping is defined as, "changing their migratory habits and remaining further north" (Viverette et al. 1994).

Broad-Scale Movement Patterns

Bildstein and Meyer (2000) reviewed the broad-scale movements of sharp-shinned hawks. They exhibit characteristics of a partial migrant throughout much of their North America range. Even as a partial migrant, sharp-shinned hawks are one of the most frequently seen raptors on migration as they frequently concentrate along leading lines, including coastlines and mountain ranges. At Hawk Mountain Sanctuary, Pennsylvania and the Goshute Mountains, Nevada, this species makes up 25% and 33% of all raptors seen, respectively.

Migration of sharp-shinned hawks has been reviewed by Bildstein and Meyer (2000). The timing of migration varies by region. Observations at Cedar Grove, Wisconsin and Hawk Mountain Sanctuary, Pennsylvania indicate that fall migration occurs from August to early November with peak migration on 7 October. The highest one-day counts of sharp-shinned hawks at raptor-migration watchsites in the western U.S. include: 51 on 25 September 1996 near Boise, Idaho; 780 on 16 September 1989 in the Goshute Mountains, Nevada; 114 on 7 September 1988 in the Wellsville Mountains, Utah. These data suggest that peak fall migration of sharp-shinned hawks in the BHNF would occur in September. The timing of spring migration is not as well documented. At two sites in the eastern U.S., spring migration occurs from late March to early May with the peak between 11 – 30 April. The highest one-day counts in the western U.S. include: 44 on 14 April 1981 at Dinosaur Ridge east of Denver, Colorado; and 97 on 15 April 1987 in the Sandia Mountains east of Albuquerque, New Mexico. These data suggest that peak spring migration of sharp-shinned hawks in the BHNF occurs in mid-April.

The routes of migrating sharp-shinned hawks are poorly documented but the northern-most breeders are known to largely abandon their breeding grounds and commonly winter in the southern U.S. Migration distances greater than 1,500 km have been recorded for birds banded in North America. Banding recoveries from Duluth, Minnesota suggest that spring migrants retrace the general route followed during fall migration.

Differences in the timing of fall migration have been observed between age and sex classes of sharp-shinned hawks (Bildstein and Meyer 2000, Evans and Rosenfield 1985, Delong and Hoffman 1999). Banding stations in Ontario, Minnesota, Wisconsin, New Mexico, and Nevada indicate that juveniles precede adults by about two weeks and that within age-groups, females precede males by about 1 week.

Habitat Characteristics

Habitat use by sharp-shinned hawks has been described in Colorado (Joy 1990), Idaho (Powers 1996), Utah (Fischer 1986, Platt 1976), Puerto Rico (Delannoy and Cruz 1988), New Mexico (Siders and Kennedy 1996), Oregon (Moore and Henny 1983, Reynolds et al. 1982), and Wisconsin (Trexel et al 1999; Table 5).

Table 5. Nest site characteristics from sharp-shinned hawk studies in North America.

Nest tree hgt. (m)	Nest hgt. (m)	Nest tree DBH (cm)	Nest % Canopy Closure	% Slope	Stand age in years	Dist. to water (m)	
12 - 19	N/A	17.3 - 35.7	68 - 90	N/A	N/A	N/A	Siders and Kennedy (1996); New Mexico
19	11	29	99	38	86	130	Joy (1990); Colorado
N/A	7.6	28.7	97.9	24.6	N/A	N/A	Moore and Henny (1983); Oregon
14.2	6.8	18.2	87.5	6.7	43	N/A	Clarke (1984); Alaska
11.0*	12.8*	23.2	N/A	24.5	N/A	180	Reynolds et al. (1982); Oregon

* An error is suspected in the article these numbers came from.

Nesting Habitat

In Colorado, nests were always in the crowns of conifer trees, which is likely for concealment

(Joy 1990). Aspens were presumably avoided because nest building was initiated prior to leaf-out. Mean values of nest sites characteristics were: stand age = 86 years, canopy cover = 94%, elevation = 2,682 m, slope = 38%, distance to water = 130 m, and understory vegetation was sparse. Average nest tree and nest height was 19 and 11 m, respectively, with a mean DBH of 29 cm. All nests were in small (1 – 14 ha), insular conifer or mixed aspen-conifer stands surrounded by either aspen forest (10/14 nests), mixed forests (3/14), or conifer forests (1/14). It is likely that most nests were close in proximity to aspen due to high prey availability.

In eastern Oregon, sharp-shinned hawks nested in white fir (n = 7), Douglas-fir (1), ponderosa pine (1), and dogwood (1; Reynolds et al. 1982). All nests were in young (25-50 years), even-aged conifer stands with single-layered canopies. Mean characteristics of the nest stands include: trees/ha = 1,594, tree height = 9.2 m, DBH = 18.3 cm, and canopy closure = 68.3%. Ponderosa pine was the most widespread forest type on the study area, which is also the case in the BHNF. If ponderosa pine is selected against in the Black Hills too, forests containing other coniferous species such as white spruce (*Picea glauca*) could be important nesting habitat.

Platt (1976) documented the nesting habitat of sharp-shinned hawks in Utah. The most common nesting site consisted of grouped or scattered conifers in a stand of taller deciduous trees, just as in Colorado, but the richness of nest tree species used was more diverse. Nests were in dense stands with a well-developed canopy, but well below the top of the canopy. Nest site selection appeared to be for sites that provided concealment from predators. Of 27 nests, two of the deciduous trees used for nesting were diseased, with abnormally dense growth and three other nests were in a combination of two trees growing with trunks nearly touching.

Clarke (1984) reported that the growth form of trees may be the most reliable parameter by which to characterize nest sites of sharp-shinned hawks in Alaska. The vegetation at nest sites is usually in the early successional stages and extremely dense. Nest stands are dominated by trees 7.5 – 37.5 cm DBH and average 2,286 trees/ha. Additionally, nest sites usually contain one major plucking perch and several auxiliary plucking perches within 50 m of nest trees. Plucking perches are level with or uphill from nests. The author suggested that the most likely factor preventing sharp-shinned hawks from extensively using more advanced seral stages is low prey availability. Therefore, the frequent wildfires that set back the successional process may ultimately be the most important factor influencing sharp-shinned hawk distribution and abundance in Alaska.

Limited information is available on sharp-shinned hawk habitat in the BHNF. Two nests within the Forest occurred in white spruce trees located on northern aspects (Sean Mohren, University of Wyoming, personal communication). One of the nests occurred in a 17 ha stand of white spruce classified as a sapling/pole sized trees (2.5 – 23 cm DBH), with 30 – 70% canopy closure, and 200 m from the closest stream. One side of the stand was bordered by mature (> 23 cm DBH) ponderosa pine and the other side was bordered by a grassland riparian corridor . The nearest stand of deciduous trees was an aspen stand approximately 1 km away. No information was available about the landscape characteristics at the other nest site. White spruce is present on 21,737 acres (1.8%) of the BHNF and could be a limiting factor for nesting sharp-shinned hawks. Additionally, if nesting sharp-shinned hawks in the BHNF select for small, insular patches of conifers adjacent to larger stands of deciduous trees as documented in other studies (Platt 1976, Joy 1990), deciduous trees could be a limiting factor. Aspen and birch cover types are only present on 50,848 acres (4%) of the BHNF.

Foraging Habitat

Few telemetry studies have been performed on sharp-shinned hawks, therefore little information is available on foraging habitat. From observations of prey species deliveries to nests, Reynolds and Meslow (1984) estimated that sharp-shinned hawks foraged primarily in the upper canopy zone. However, Clarke (1984) and Joy (1990) observed that sharp-shinned hawks did forage near the ground. Joy et al. (1994) reported that of 11 sharp-shinned hawk nest sites, mature aspen was the most common (8/11) vegetation within a 2 km circle around the nest, mixed aspen-conifer was the most common "secondary" habitat (9/11), and conifer forest was the most "limited" habitat type.

Platt (1973) monitored a male sharp-shinned hawk with radio-telemetry and observed that the male primarily hunted in a clonal-oak grassland community. The author suggested the males' attraction to this community was related to high food availability there.

Winter Habitat

Information on winter habitat use is scarce. Palmer (1988) described sharp-shinned hawk winter habitat as "at lower elevations wherever small birds are plentiful, especially where there are trees, brush, or other concealment from which the hawk can strike suddenly at close range." Male (n = 3) and female (n = 3) sharp-shinned hawks in North Carolina had mean home ranges of 2.5 km^2 and 2.8 km^2 during winter (Meyer 1987 in Bildstein and Meyer 2000).

Several studies have reported increasing proportions of sharp-shinned hawks hunting at bird feeders during the winter in conjunction with decreasing numbers migrating south (Duncan 1996, Latta 1998, Viverette et al. 1996). Powers (1996) trapped and banded 17 sharp-shinned hawks at a bird feeder trapping station in Idaho. Two individuals were recaptured during the same winter and four were recaptured during a second or third winter, suggesting that sharp-shinned hawks may display fidelity to a winter range.

Comparisons Of Sharp-Shinned Hawk, Cooper's Hawk, And Northern Goshawk Habitat

Many studies have compared nesting habitat use between coexisting Accipiters in North America (Fischer 1986, Kennedy 1988, Moore and Henny 1983, Reynolds et al. 1982, Reynolds 1983, Siders and Kennedy 1996, Trexel et al. 1999, Wiggers and Kritz 1991). Where these species coexist, a relationship occurs in which tree height and DBH of nest trees increases in proportion to Accipiter body size (Kennedy 1988, Reynolds et al. 1982, Siders and Kennedy 1996). In New Mexico (Siders and Kennedy 1996) and Wisconsin (Trexel et al. 1999), Cooper's hawks used significantly taller nest trees with greater diameters and used older, nest stands with lower tree densities than did sharp-shinned hawks. In Oregon, sharp-shinned hawk nest sites were characterized as dense, 40 – 60-year-old even-aged conifer stands while Cooper's hawk nest sites were 50 – 80-year-old conifer stands with somewhat larger, more widely spaced trees, and goshawk nest sites were dense, mature conifer stands with varying densities of mature, overstory trees (Reynolds et al. 1982). However, high interspecific overlap occurs between the species in the use of nest site characteristics such as basal area, canopy cover, and tree density (Kennedy 1988, Moore and Henny 1983, Siders and Kennedy 1996).

Food Habits

Sharp-shinned hawks have short, powerful, rounded wings and a relatively long tail that enables them to maneuver through dense cover when pursuing prey. Bent (1961) described the hunting sharp-shinned hawk as "a bold and dashing little hawk, the terror of all small birds."

In southwest Colorado, small birds ($\bar{x}$ = 20.9 g) and mammals ($\bar{x}$ = 41.1 g) comprised 91% and 9% of prey items identified at nest sites, respectively (Joy et al. 1994). Taxa of birds in the diet were consumed in proportion to their occurrence in the three most abundant habitats surrounding nests, whereas some mammalian taxa were consumed in greater proportion than their relative abundance in those habitats. This suggests that sharp-shinned hawks foraged opportunistically for birds, but may have selectively foraged for mammals. The dominant prey items by percentage of diet were yellow-rumped warblers (12.5%; *Dendroica coronata*), American robins (8.3%), white-crowned sparrows (7.0%; *Zonotrichia leucophrys*), and dark-eyed juncos (6.5%). Additionally, 60% of the birds eaten during the hawks' nestling and fledgling stages were nestlings or fledglings. Voles (*Clethrionomys* spp. *Microtus* spp., and *Phenacomys* spp.) comprised over 60% of the mammals eaten.

Small birds, approximately 12 – 25 g, compromised greater than 95% of sharp-shinned hawk prey items in Oregon (Reynolds and Meslow 1984). The dominant prey items in this study were hummingbirds (*Trochilidae* spp.), flycatchers (*Tyrannidae* spp.), chickadees and titmice (*Paridae* spp.), nuthatches (*Sittidae* spp.), creepers (*Certhiidae* spp.), wrens (*Troglodytidae* spp.), warblers (*Parulinae* spp.), and finches (*Fringillidae* spp.). Sharp-shinned hawks in Alaska also depended heavily (96.9% of diet biomass) upon small birds (Clark 1984).

Platt (1976) suggested that prey partitioning between male and female sharp-shinned hawks may occur based on winter observations at a backyard bird feeder in Idaho. More males (88%) than females (12%) were encountered at bird feeders compared to the nearly equal sightings throughout the study area. A prevalence of smaller-sized bird species frequented the feeder whereas the larger prey that females might hunt such as the American robin and northern flicker are less attracted to bird feeders. Mueller and Berger (1970) reported that migrating, adult sharp-shinned hawks displayed no differences in prey selection between the sexes, but male and female juveniles did.

No information is available about the diet of sharp-shinned hawks in the BHNF. From the information above, it can be inferred that sharp-shinned hawks in the BHNF hunt a wide variety of prey items and that small birds are their primary prey.

Breeding Biology

Phenology Of Courtship And Breeding

The sharp-shinned hawk is the last Accipiter to arrive on the breeding range, which is typically from April to early May (Bildstein and Meyer 2000). The period between the arrival and laying dates is relatively short, suggesting that nest building starts soon after arrival (Bildstein and Meyer 2000). In Utah, the period between arrival and laying was approximately four weeks (Platt 1976).

Joy (1990) documented the phenology of breeding for sharp-shinned hawks in Colorado. Initiation of egg laying and incubation between late May and early June, respectively. Incubation lasted approximately 30 – 32 days, and fledging occurred between late July and early August.

The timing of courtship and breeding in Utah is similar to the dates observed in Colorado (Platt 1976). However, the timing varied along a latitudinal gradient in Utah as sites in central Utah were 7 – 14 days earlier than sites in northern Utah (Platt 1976). Also, laying dates for the same territory in consecutive years varied by as much as seven days. Platt (1976) documented that young males fledged at 24 days old while females required 27 days. The difference in fledge-time between males and females is likely due to extreme sexual size dimorphism as adult males weigh 87 – 114 g and adult females weigh 150 – 218 g (Bildstein and Meyer 2000). Fledgling dispersal occurred from mid- to late-August.

Courtship Characteristics

Clarke (1984) described the aerial displays of the sharp-shinned hawk during courtship. The male flies in broad circles just above the treetops with tail closed and undertail coverts flared, uttering a nasal "peee-peee-peee" call. This behavior occurs over the nest site and is evident from first arrival until egg-laying.

During nest construction, material is brought by both sexes, but the female does most or all of the construction. At a nest in South Carolina, the female gathered material in the vicinity of a male, who called frequently (Mitchell and Pitts 1992 in Bildstein and Meyer 2000). The female flew through the understory in the vicinity of the nest, and she dropped to the ground to snatch small branches (Mitchell and Pitts 1992 in Bildstein and Meyer 2000).

Nest Characteristics

Meng (in Palmer 1988) described the structure and dimensions of sharp-shinned hawk nests. The nest is typically broad, flat, and constructed of dead conifer twigs with flakes of bark as a lining. The size is variable but usually large, ranging from 35 – 60 cm in diameter and 10 – 14 cm deep.

Joy (1990) described the nest characteristics of sharp-shinned hawks in Colorado. Nests were exclusively in conifers (*Abies* spp., *Picea* spp.). Mean nest height, nest tree height, and DBH were 11 m, 19 m, and 29 cm, respectively. The nests were at 58% of total tree height and were placed within the tree crown. Sharp-shinned hawks appeared to select nests with concealment and protection characteristics.

Clutch Initiation And Size

In Colorado, egg laying was initiated in late May and incubation was initiated in early June (Joy 1990). Mean clutch size for six sharp-shinned hawk nests was 4.2 ± 0.2 (SE) eggs (Joy 1990). In Utah (Platt 1976) and Oregon (Reynolds and Wright 1978), the mean clutch size was 4.3 eggs (n = 34 clutches) and 4.6 eggs (n = 5), respectively.

Parental Care

Bildstein and Meyer (2000) reviewed parental care of sharp-shinned hawks. The female does nearly all of the incubation and brooding. Young are brooded for about 16 –23 days. The male apparently provides all the food to the female and nestlings, but the female does nearly all the feeding. After the young are fledged, both sexes deliver food to the young. Once the young have fledged, prey delivery rates decrease and a weaning process occurs.

Site And Mate Fidelity

Sharp-shinned hawks do not display strong nest site fidelity but reuse of nest stands is commonly reported. In Colorado, one of four sharp-shinned hawk nest sites used in 1987 was reused in 1988 (Joy 1990). Twenty nine percent of sharp-shinned hawk nest sites found during 1988 were reused in 1989. At reoccupied sites, all new nests (n = 3) were built less than 40 m from former nests. In Utah, Platt (1976) documented only one case where the same nest was used in consecutive years. However, groves were commonly re-used and may contain as many as five old nests. In Alaska, Clarke (1984) reported that the reoccupancy rate of nest sites was 0.33, which is nearly twice the rate reported by Reynolds and Wight (1978) for sharp-shinned hawks in Oregon.

No information is available on mate fidelity of sharp-shinned hawks.

Demography

Life History Characteristics

On average, sharp-shinned hawks live five years or less with the longest lifespan reported at 13 years (Keran 1981, Palmer 1988). Most sharp-shinned hawks probably do not breed until at least two years of age. At nests in Oregon, all females and males were in adult plumage (Reynolds and Wright 1978) as was the case for 12 nests in New Brunswick (Meyer 1987 in Bildstein and Meyer 2000). However, studies in Puerto Rico and Alaska have observed yearlings of both sexes nesting (Clarke 1984, Delannoy and Cruz 1988). Sharp-shinned hawks average four to five eggs per clutch. Sharp-shinned hawks in Wyoming (Craighead and Craighead 1956 in Bildstein and Meyer 2000), Oregon (Reynolds and Wight 1978) and Alaska (Clarke 1984), averaged 3.5, 2.7, and 3.5 fledglings per nest, respectively.

Survival And Reproduction

Based on band recoveries of Cooper's hawks in North America, survival percentages reported per year from 0 to 8 years are 1 - 19%, 2 - 24%, 3 - 25%, 4 - 15%, 5 - 10%, 6 - 5%, 7 - 2%, and 8 - 2% (D. Evans 1982 in Palmer 1988). Only 19% of the sample lived longer than three years. No information is available on ecological influences to reproduction or survival rates of sharp-shinned hawks in the BHNF.

Social Pattern For Spacing

Nest density and home range size of sharp-shinned hawks are difficult to estimate due to the difficulty of locating their nests (Reynolds and Wight 1978). Additionally, differences in estimates are caused by geographic variation and methods used to make estimates. Therefore, the following estimates should be interpreted with caution. The average distance between active nests of sharp-shinned hawks in Colorado (Joy 1990) and Oregon (Reynolds and Wight 1978) was 2.2 km and 4.1 km, respectively. Estimates of sharp-shinned hawk nest density at two sites in Oregon are one nest per 275 ha (Reynolds and Wight 1978) and one nest per 460 ha (Reynolds 1979 in Reynolds 1983), while nest density in Alaska was one nest per 420 ha (Clarke 1984).

Local Density Estimates

No estimates of sharp-shinned hawk densities in the BHNF are available.

Limiting Factors

White (1969 in Jones 1979) suggests that the single most imminent threat to Accipiters is that of habitat alteration and/or destruction. Habitat loss decreases the availability of nest sites, which can limit Accipiter populations (Reynolds 1983). Habitat loss may also decrease prey abundance and availability, which would limit Accipiter populations as well.

Two obvious forms of habitat loss are from development and timber harvest. A less apparent form of habitat loss to sharp-shinned hawks is caused by the growth of forests beyond the early seral stages. Clarke (1984) suggested that the most likely factor preventing sharp-shinned hawks from extensively using more advanced seral stages in Alaska is low prey availability. Therefore, the frequent wildfires that set back the successional process may ultimately be an important factor influencing sharp-shinned hawk distribution and abundance.

In the BHNF, low abundance of white spruce (1.8% of the Forest) may limit nesting. A study in Oregon documented that ponderosa pine, the most common cover type on the BHNF, was selected against for nesting (Reynolds et al. 1982). Two nests in the BHNF have been observed in white spruce, suggesting it is an important cover type. Additionally, limited availability of deciduous trees on the Forest could limit sharp-shinned hawk nesting. Two studies have described nest sites of sharp-shinned hawks as being located in a small patch of conifers surrounded by larger stands of deciduous trees (Platt 1976, Joy 1990). Aspen and birch cover types are only present on 50,848 acres (4%) of the BHNF.

Insect abundance is thought to limit sharp-shinned hawks in some locations. In northeastern forests of North America, the spruce budworm influences abundances of some songbird prey populations (Bildstein and Meyer 2000). Thus, sharp-shinned hawk populations may be affected by cycling of spruce budworm (*Choristoneura fumiferana*).

Patterns Of Dispersal

Information on adult dispersal of sharp-shinned hawks is scarce. Sharp-shinned hawks are known to reoccupy nest sites from year to year but whether or not the same individuals reoccupy a nest site or disperse to new sites has not yet been determined (Reynolds and Wight 1978). Evidence collected by Clarke (1984) in Alaska suggests that one male returned to the same nest in three consecutive years. No information is available on natal dispersal or on the dispersal of sharp-shinned hawks in the BHNF.

Community Ecology

Predators And Relation To Habitat Use

Predation in this document is considered killing for food (Taylor 1984). Sharp-shinned hawks are particularly vulnerable to predation due to their small size. Known predators include peregrine falcons (*Falco peregrinus*), northern goshawks, and bald eagles (*Haliaeetus leucocephalus*) (Clarke 1984, George 1989). Other predators might include great horned owls, Cooper's hawks, American crows, and red-tailed hawks.

In assessing the vulnerability of sharp-shinned hawks to predation resulting from habitat change, timber harvest is assumed to be the main form of habitat change to occur in the BHNF. It should be noted though that the impacts of timber harvest are unique from site to site, depending on the successional stage at the time of harvest, the form and intensity of harvest, and whether or not sharp-shinned hawks use the area prior to harvest. Sharp-shinned hawks typically select nest sites with high tree density and canopy cover, which provide cover and protection from predators (Reynolds et al. 1982). A scenario where timber harvests could be detrimental is when harvests occur in nest stands. Timber harvest in nest stands will decrease tree density and canopy cover, and increase the likelihood of detection by predators (Reynolds 1989). Kennedy (1988) recommended leaving uncut areas of approximately 10 ha around active nests of Accipiters.

Competitors

Clarke (1984) reports that interspecific encounters with sharp-shinned hawks followed one of the three avenues: (1) smaller or weaker animals were killed and eaten, (2) larger animals were harassed, and (3) larger animals that posed a potential threat were avoided. Sharp-shinned hawks have been observed attacking bald and golden eagles (*Aquila chrysaetos*), domestic cats, pine squirrels, red-tailed hawks, great horned owls, humans, and numerous other bird species.

Interspecific competition might exist between coexisting Accipiters as overlaps in nesting habitat and diet have been documented (Moore and Henny 1983, Siders and Kennedy 1996). The degree of interspecific competition is unknown though. However, Reynolds and Wight (1978) observed sharp-shinned hawks nesting within 300 and 450 m of active Cooper's hawk and goshawk nests, respectively. In Colorado, two sharp-shinned hawk nests were 0.5 and 1.5 km from active Cooper's hawk nests, and another sharp-shinned hawk nest was within 1.2 km of a goshawk nest (Joy 1990).

Few cases of intraspecific competition have been reported. During the breeding season, sharp-shinned hawks are highly territorial. Resident males have been observed to fly straight at and chase approaching intruders (Delannoy and Cruz 1988). Meyer (1987 in Bildstein and Meyer 2000) observed dependent fledglings near their nests chase, strike, and grapple with intruding juveniles.

Parasites, Disease, And Mutualistic Interactions

Bildstein and Meyer (2000) summarized the available information on body parasites of sharp-shinned hawks. In Puerto Rico, warble fly larvae (*Philornis* spp.) have been documented to feed subcutaneously on nestlings, damage tissue, and kill the host. During autumn migration, juveniles are more likely to have hemoparasites (*Hemoproteus* and *Leukocytozoon*) than adults. No information is available on diseases.

Risk Factors

Practices that reduce nesting and foraging habitat quality are likely to be the major threats to sharp-shinned hawk viability in the BHNF. Habitat loss decreases the availability of nest sites and prey, which can limit Accipiter populations (Reynolds 1983). Timber harvest is the most common form of habitat loss on the BHNF.

The major causes of mortality identified by Keran (1981) are "road kill" and kill by predators. Also, shooting of sharp-shinned hawks occurs on their winter range. Of the 73 recoveries of birds banded near Duluth, MN from 1972 – 1980, 13 were shot and 12 of these were recovered south of the Mexican border. Additional risk factors include collisions with windows in homes, human disturbance resulting in nest abandonment, and environmental contaminants.

Sharp-Shinned Hawk Responses To Habitat Change

Management Activities

Timber Harvest

Sharp-shinned hawks nest in habitats with specific structure. This specificity makes them susceptible to changes in forest stands brought about by timber harvest (Reynolds et al. 1982). It should be noted though that impacts of timber harvest to sharp-shinned hawks will be unique from site to site depending on the structure of the forest at the time of harvest, the form and intensity of harvest, and the temporal perspective.

The BHNF has proposed the following levels of timber harvest under Alternative G, the preferred alternative (BHNF 1996). Over the next ten years, 5,400 acres per year of precommercial thinning harvests and 25,500 acres per year of commercial harvesting would occur. Several different forms of commercial harvest would occur but the two main forms proposed are shelterwood seed cuts (15,600 acres/year) and overstory removal harvest (6,100 acres/year), which would combine to 85% of the commercial harvest. Presented below is a discussion of how these forms of harvest might affect sharp-shinned hawks.

Precommercial thinning occurs in stands too small in diameter to be sold for wood products (BHNF 1996). Stands are thinned in an effort to reduce tree density and to enable trees to grow larger and faster. Precommercial thinning is likely to be detrimental to sharp-shinned hawks. Studies of nesting habitat have documented that saplings are an important characteristic of nest sites (Moore and Henny 1983, Siders and Kennedy 1996). Reynolds (1983) states that active and prospective nest sites should not be precommercially or commercially thinned, because this will result in reduced stand densities and deeper tree crowns. Additionally, precommercial harvest could negatively impact sharp-shinned hawks if the operation occurred in areas adjacent to nest stands during the nesting season.

The objective of shelterwood seed cuts is to cut all the trees except those needed to produce seed to regenerate the stand. Decreased tree density caused by shelterwood seed cuts would likely increase the vulnerability of sharp-shinned hawks to predation. Additionally, dense forest is presumed to be important for foraging because it provides perch sites from which attacks are launched and because it enables them to ambush prey. Studies that have reported values of tree density at sharp-shinned hawk nest sites provide a range of values that can serve as guidelines for what sharp-shinned hawks can tolerate (Table 6). However, Dykstra (1996) reported that sharp-shinned hawks were only detected in unharvested stands in the Black Hills.

Table 6. Tree density at sharp-shinned hawk nest sites.

Oregon – Moore and Henny (1983)			
Tree DBH	**Density/0.08 ha**	**S.D.**	**Mean Density/ha**
2.5 – 8.9 cm	92.5	73.6	1156
8.9 – 16.5 cm	56.6	42.4	708
16.5 – 31.7 cm	30.1	11.9	376
31.7 – 41.9 cm	5.8	4.9	73
> 42 cm	2.3	2.4	29
Basal area (m^2)	3.5	1.2	
Mean DBH (cm)	12.9	3.0	

New Mexico – Siders and Kennedy 1996	
Tree DBH	**Density/ha**
2.5 – 12.6 cm	790 – 1,500
12.7 – 30.4 cm	435 – 760
30.5 – 45.6 cm	30 – 110
> 45.6 cm	12 – 58
Basal area (m^2 ha^{-1})	29 – 42

Oregon – Reynolds et al. (1982)	
Tree Density/ha	652 – 1,028

Alaska – Clark (1984)	
Tree Density/ha	2,286

The objective of overstory removal harvest is to remove the remaining trees that were left to seed the area from the previous seed cut. This form of harvest would presumably have little influence on sharp-shinned hawks because areas where overstory removal harvest occurs are likely to have already been abandoned. If sharp-shinned hawks were still using sites where overstory removal harvest were planned, it could adversely affect them by removing the remaining nest sites.

Recreation

The BHNF (1996) measures recreation through dispersed and developed recreation. Dispersed recreation is outdoor recreation that occurs on all areas of the Forest outside developed recreation sites (BHNF 1996). Developed recreation includes all recreational activities that take place on a developed recreation site (BHNF 1996). Over the next 10 years, the BHNF will construct an estimated 138 miles of new roads and 22 recreation sites for developed recreation. There are no positive benefits of recreation to sharp-shinned hawks that we are aware of. Through the building of roads and new recreation sites, developed recreation will cause habitat loss and potentially increase the incidence of vehicle collisions with sharp-shinned hawks. The frequency of vehicle collisions is likely to be lower on dirt roads than paved roads due to slower-moving traffic on dirt roads. Additionally, recreation near nesting pairs could result in nest abandonment.

Livestock Grazing

Livestock grazing throughout the BHNF is common as 84% of Forest lands are suitable. Habitat changes resulting from grazing could be either structural, through modification of vertical diversity, or compositional, through changes in the vegetative species (BHNF 1996). Sharp-shinned hawk habitat relative to livestock grazing has not been studied but it is plausible that if vertical diversity in forested areas is diminished by grazing, it could have a negative impact upon sharp-shinned hawks and their prey.

Mining

Effects of ground disturbance from mining could have variable levels of impacts to sharp-shinned hawks and their prey depending on the extent and intensity of the disturbance. Over time, the most important minerals to the Black Hills economy have been gold, silver, iron, uranium and pegmatite minerals (BHNF 1996). In Idaho, Henny et al. (1994) reported that mining and smelting resulted in high concentrations of lead in Couer d'Alene River sediments and the floodplain downstream, where several species of raptors nested. Measurements of blood characteristics from American kestrels and Northern harriers indicated higher levels of lead-exposure on treatment sites compared to control sites. However, no raptor deaths related to lead were observed, and the production rates of raptors at control and treatment sites were similar. Several traits of raptors apparently reduce their potential for accumulating critical levels of lead which is primarily stored in bones of prey species (Henny et al. 1994).

The development of new mining sites is likely to be accompanied by road construction. This could adversely affect sharp-shinned hawks by the increased likelihood of collisions with vehicles, and the loss and fragmentation of nesting and foraging habitat.

Prescribed Fire

On the BHNF, 5,600 – 8,000 acres are proposed to be burned annually by prescribed fires (BHNF 1996). Depending on conditions of the vegetation at the site of the burn, the effects could be either beneficial or detrimental to sharp-shinned hawks. In areas where prescribed fires reduce the density of understory conifers, the impacts of fire could be detrimental. Sharp-shinned hawks nest in areas with high densities of small-diameter trees. Loss of the dense cover could increase their vulnerability to predators. However, prescribed fire simulates a natural process that sharp-shinned hawks evolved with. Over time, fires presumably benefit sharp-shinned hawks in areas where the vegetation is returned to the early seral stages. The apparent benefits of vegetation in the early seral stages are high prey availability and cover from predators (Clarke 1984). Clarke (1984) suggests that frequent wildfires may ultimately be the most important factor influencing sharp-shinned hawk distribution and abundance in Alaska.

Fire Suppression

Perhaps the most subtle but far-reaching human effect on the Black Hills has been fire suppression (Knight 1994). Fire suppression has been a guiding principle for land management in the BHNF. Historically, surface fires every 5 – 25 years characterized ponderosa pine forests, the most common cover type in the BHNF. Burning kills most young trees but usually not the older trees, because of their thick bark. Fire also maintains a more open forest with low amounts of fuel. Results of fire suppression include an increase in tree density and an increased likelihood of crown fires. How increased tree density interferes effects sharp-shinned hawks should depend on the degree that tree density increases. If tree density is too high, it could interfere with the ability of the sharp-shinned hawk to fly and hunt. However, increased tree density in some areas might improve the quality of the habitat for nesting.

High-intensity crown fires are presumed to be the most deleterious consequence of fire suppression. Crown fires result in vast stand-replacing disturbances with significant habitat loss. The Elk Mountain Complex Fire and the Jasper Fire are recent examples of this in the BHNF. See the section below on wildfire for a more detailed discussion on the impacts of high-intensity crown fires.

Non-Native Plant Establishment And Control

The effect of non-native plant establishment and control on sharp-shinned hawks in the BHNF is unknown but it is possible that cheatgrass could be a problem for sharp-shinned hawks and their prey in the grasslands of the BHNF. Knight (1994) reviewed the impacts of cheatgrass. Cheatgrass leads to the rapid accumulation of a highly flammable fuel, shortening the fire-free interval. Fires occur more frequently, thereby diminishing the chances of sagebrush reestablishment, causing a decline in some perennial grass species, and favoring cheatgrass expansion still further. The ultimate result is a loss in the heterogeneity of the landscape, and probably lowered prey diversity, prey abundance, and prey availability for sharp-shinned hawks. The invasion of this species can be hastened by the burning of areas adjacent to cheatgrass and also by livestock grazing.

Fuelwood Harvest

Fuelwood harvest in the BHNF occurs by individuals that search out dead and down material to cut up for their personal use while in the Forest. Fuelwood harvest could adversely affect sharp-shinned hawks if snags are removed that are used as perch sites.

Falconry

Sharp-shinned hawks can legally be taken for falconry in South Dakota and Wyoming. Take by falconers in both states is low; therefore it is thought to be a negligible threat to population viability on the BHNF.

Natural Disturbance

Insect Epidemics

The most aggressive and destructive insect in the Black Hills, from the commercial forest management perspective, is the mountain pine beetle (BHNF 1996). When populations of this beetle grow to large numbers, they are capable of killing many trees and most of the mortality occurs to the large trees (Knight 1994). This insect prefers dense pine stands, containing trees between 7 to 13 inches DBH (17.8 – 33.0 cm) (Lessard 1982 in BHNF 1996). Suppression of wildfire this century has resulted in more densely stocked stands of timber that are more susceptible to attack (BHNF 1996). Mountain pine beetle disturbances are likely to benefit sharp-shinned hawks by returning the vegetation back to the early seral stages.

In northeastern forests, sharp-shinned hawk populations may be affected by cycling of spruce budworm. The spruce budworm influences abundances of some songbird prey populations (Bildstein and Meyer 2000).

Wildfire

Wildfire can have a wide range of potential effects on landscapes of the Black Hills, depending on size and intensity of fire, stand type, fire frequency, and post-fire successional trajectory (Buskirk 2001). In landscapes where fire-frequency has not been altered, wildfire is generally considered a healthy form of disturbance. These types of wildfires should benefit sharp-shinned hawks, which use younger successional stands in forests (Reynolds et al. 1982, Moore and Henny 1983, Clark 1984).

Fire suppression over the past 100 years has altered the dynamics of wildfire across much of the landscape. Abnormally high fuel build-ups resulting from years of fire suppression have increased the probability of large, catastrophic fires that could destroy vast expanses of habitat. This became apparent during the Jasper Fire of August 2000 and the Elk Mountain Complex Fire of 2001. The Jasper Fire burned 83,000 acres of which 39% burned at high intensity meaning trees were devoid of needles (http://www.fs.fed.us/r2/blackhills/fp/fire/Jasper/Jasper.htm), and the Elk Mountain Complex Fire burnt 26,000 acres. Through 1996, only 2,000 – 3,100 acres were burned annually by wildfire in the BHNF (BHNF 1996). Areas of complete mortality that are far removed from a viable seed source could take as long as 200 years to regenerate (http://www.fs.fed.us/r2/blackhills/fp/fire/Jasper/Jasper.htm). These are long-term, large-scale losses of sharp-shinned hawk habitat that could possibly decrease population size and viability on the BHNF.

Wind Events

Wind, especially tornadoes and microbursts, is capable of altering the physical structure of forests very quickly, killing large numbers of trees (Veblen et al. 1989). Wind events have blown nests out of trees, resulting in nest failure. However, these effects are typically small in scale and short in duration so the impacts to the sharp-shinned hawk population over the long-term should be negligible.

Other Weather Events

Other weather events that could potentially affect sharp-shinned hawks are cold temperatures, freezing rain, heavy snowfall, and drought during the breeding season. Freezing rain and snowfall during the breeding season could cause high nestling mortality and decreased recruitment. Drought could cause low survivorship of prey nestlings and thus, insufficient prey availability to reproduce successfully.

SUMMARY

Sharp-shinned hawks are one of three Accipiters that inhabit the woodlands of North America. The longest lifespan reported for a sharp-shinned hawk is 13 years but few live past five years. Most sharp-shinned hawks probably do not breed until at least two years of age. Typically, they have high reproductive success with an average of 4 – 5 eggs per clutch, and 2 – 4 fledglings per successful nest. Estimates of sharp-shinned hawk nest density range from one nest per 275 ha to one nest per 460 ha in suitable habitat. Their diet primarily consists of small birds. In Colorado, the dominant prey items by percentage of diet were yellow-rumped warblers (12.5%), American robins (8.3%), white-crowned sparrows (7.0%), and dark-eyed juncos (6.5%). Presumably, the diet of sharp-shinned hawks in the Black Hills is primarily small birds also.

Nest site habitat has been characterized as forests in the early seral stages with dense stands and a dense canopy. A common description of nest sites reported in the literature consists of grouped or scattered conifers in which the nest stand was adjacent to a stand of deciduous trees. Nest site selection appears to be for sites that provide concealment from predators. Two known sharp-shinned hawk nests within the BHNF were in white spruce trees on north aspects.

The Migratory Bird Treaty Act of 1972 protects sharp-shinned hawks throughout their range but they are not designated any special conservation status by the FWS or the USFS. In Wyoming, these hawks are considered to be common and do not have any special conservation status. In South Dakota, they are designated as "S3", meaning they are either very rare and local throughout their range, or found locally in a restricted range, or vulnerable to extinction throughout their range because of other factors. Trends in North America indicate that populations have been increasing since DDT use was eliminated in the 1970's. No information is available about population trend in the Black Hills region.

Loss of nesting and foraging habitat are presumably the greatest risks to sharp-shinned hawk viability in the BHNF. Habitat loss on the Forest occurs by timber harvest but timber harvest can also improve habitat. The impacts from timber harvest depend on the location, method, timing, and intensity of harvest.

Sharp-shinned hawk habitat relative to livestock grazing has not been studied but it is plausible that if vertical diversity in forested areas is diminished by grazing, it could have a negative impact upon sharp-shinned hawks and their prey. The proposed levels of recreation and mining are unlikely to have important effects on sharp-shinned hawk viability in the BHNF. The effects of prescribed fire and fire suppression may vary depending on conditions at the site of interest. The effects of non-native plant establishment and control in the BHNF is unknown. The effect of fuelwood harvest to sharp-shinned hawks in the BHNF depends on the form and extent. Insect disturbances would likely benefit sharp-shinned hawks by causing a disturbance resulting in the vegetation moving back to the early successional stages and by boosting populations of some avian prey species. Weather events are unlikely to adversely effect sharp-shinned hawk viability on the BHNF as the species has evolved with these disturbances.

REVIEW OF CONSERVATION PRACTICES

Management Practices

The Migratory Bird Treaty Act of 1972 protects sharp-shinned hawks throughout their range. Management practices in North America that specifically target sharp-shinned hawk populations are rare. On the BHNF, an ecosystem management approach has been used in an attempt to follow the guidelines in the National Forest Management Act (NFMA) and its implementing regulations. The goal of the NFMA is to manage for a mix of habitats across the entire Forest to provide for species diversity and viability when managing for multiple uses. The impacts of activities on sharp-shinned hawks in the Forest are assessed before they occur and an attempt is made to mitigate negative impacts. Successful ecosystem management is often a difficult task due to the large number of species with diverse habitat needs and the large number of management activities such as timber harvest, recreation, mineral extraction, etc. that occur on the Forest. Other than these assessments, specific management activities by the BHNF for this species are limited.

Reynolds (1983) made several recommendations for managers attempting to maintain populations of sharp-shinned hawks in western coniferous forests: (1) uncut areas of approximately 4 ha should be left around active nests for sharp-shinned hawks, (2) management of Accipiter habitat must consider the turnover of nest sites due to time. Prospective replacement nest sites within the home range of each pair should be selected and managed accordingly, (3) active and prospective nest sites should not be precommercially or commercially thinned, because this will result in reduced stand densities and deeper tree crowns, (4) determine the desirable nesting density and maintain the landscape so that an appropriate number of nest sites are available, and (5) confirm the suggested size and shape of uncut areas around nest sites.

Kennedy (1988) made several forest management recommendations for Cooper's hawks, which may also be applicable for sharp-shinned hawks: (1) search all proposed timber sales for Accipiter nests during the nestling stage, (2) uncut areas of approximately 10 ha should be left around active nests, (3) nest sites should not be isolated by silvicultural treatments such as clearcutting or total canopy removal, (4) logging of riparian canyons should be minimized as these areas tend to have large-diameter trees and provide nesting habitat, (5) if commercial thinning occurs at a nest site, a minimum of 10 snags/ha should be maintained, and (6) minimize human disturbance near nest sites during the breeding season.

Models

There are no models we are aware of that model habitat, effects, or other items of interest to sharp-shinned hawk managers.

Survey And Inventory Approaches (Presence/Absence)

Several techniques are used to survey and inventory the presence of sharp-shinned hawks. The use of different techniques depends on the scale of the area to be inventoried. Throughout North America, the BBS (Sauer et al. 2001) and CBC (Sauer et al. 1996) are used to survey sharp-shinned hawk presence/absence and to inventory population trends. A strength of these surveys is that data are collected throughout most of North America in an attempt to detect rangewide trends. A weakness is that many people are required and it is very time consuming to compile and analyze all the data. The CBC is less reliable than the BBS due to inconsistencies in methodology.

At a smaller scale, yearly surveys can be conducted for breeding raptors, which are aimed at identifying and protecting habitat, and estimating local population trends. The BHNF does not maintain a collection of historical sharp-shinned hawk nest sites on the Forest (Rob Hoelscher, BHNF, personal communication). If these data were collected, they would provide habitat use information specific to the Black Hills from which the impacts of future management activities could be more accurately mitigated. Methods used to survey breeding raptors include visiting historical nest sites to assess reoccupancy, and the playback of conspecific calls to increase detectability of raptors (Rosenfield et al. 1988). Surveys using conspecific calls across the entire BHNF would require a significant amount of time and money. A more cost-effective option would be to survey known nest sites and areas of concern such as proposed timber harvest sites. If a studied population exhibits long-term use of breeding sites by different adults (i.e., recruitment) then the population could be assumed to be at least stable.

Monitoring Approaches (Habitat, Population Trend, Presence/Absence And Persistence)

The BBS, CBC, searching historic nest sites to monitor nest reoccupancy, and the systematized searching of new areas for signs of breeding activity are approaches used to monitor sharp-shinned hawks that have already been discussed above. Migration counts, banding, and radio telemetry are additional methods that monitor habitat, population trends, presence/absence and persistence. Migration counts can establish population trends over periods of time. A limitation associated with migration counts is that multiple years of data are required before meaningful estimates of population trends can be made. Also, the counts do not assess where the birds originated so the application of the data to specific areas such the BHNF is limited. Banding can also be used to study survivorship and dispersal. A disadvantage of banding is that a sometimes unrealistically large number of bands are needed due to low recovery rates. Keran (1981) reported that the return rate from banded sharp-shinned hawks was 0.6%. Finally, a radio telemetry study of sharp-shinned hawks nesting within the BHNF would be beneficial by providing home range and habitat use information during the breeding season. Additional information obtained might include the timing and extent of migration, and habitat use during the winter. Habitat requirements specific to the BHNF would be the goal of such a study and would better enable managers to mitigate the impacts of other management activities to sharp-shinned hawks. Problems associated with this technique are that radio telemetry equipment is expensive, acquisition of the data is time-consuming, and sharp-shinned hawks occur at low densities in the BHNF. Small sample sizes could result in questions about the statistical validity of data due to a small sample of telemetered birds.

ADDITIONAL INFORMATION NEEDS

Currently, management directives aimed specifically at sharp-shinned hawks on the BHNF are limited. Initially, data of historical nest sites on the Forest should be collected. If this data were collected, it would provide habitat use information from which the impacts of future disturbances could be more accurately mitigated. Additionally, these nest sites could be monitored on a yearly basis. Information from nest monitoring would establish population trend, reoccupancy rates, recruitment rates, and habitat use information of nest sites. Ideally, nestlings should be banded so that information on survival and dispersal might be collected. A radio-telemetry study of sharp-shinned hawks nesting within the BHNF would be beneficial by providing home range and habitat use information specific to the Black Hills.

Reynolds (1983) summarized the additional information needs for sharp-shinned hawk management: (1) study the impacts of forest management on the nesting density of this species, (2) confirm the suggested size and shape of uncut areas around nest sites, and (3) determine, with telemetry, the size and shape of home ranges, the types of habitats included within ranges, and the extent to which these habitats are used for foraging by these hawks.

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DEFINITIONS

Adult dispersal – distance between the previous and present year's nest site.

Exurban – sites where much of the natural vegetation still exists.

Intraspecific competition – competition between organisms of the same species.

Interspecific competition – competition between organisms that are different species.

Migratory short-stopping – changing migratory habits and remaining further north during winter.

Natal dispersal – movement between birth place and breeding site.

Partial migrant – some individuals staying in the breeding area while others migrate.